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# Improving blended learning effectiveness through the use of learning management system

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**Abstract – This paper presents experimental analysis of LMS log data from two undergraduate courses that differ in terms of learning activity design. Data were resulting from the User Activity functions on open source learning management system, which report the number of student hits across the LMS tools. The research identifies obstacles encountered when using log data. Results suggest that the plan of learning activities has significant impact upon levels of student interaction with the LMS. Additionally the larger amount of asynchronous learning activities, against synchronous ones, may generate increased student interaction not just with the interactive applications but with the LMS overall. This outcome is mainly related given the correlation between LMS interaction and student results reported in other studies. The research confirms the potential of log data to support inform blended learning and online teaching practice, highlights some of experiments involved and outlines possibilities for future abstract.**

*Keyword:* log data, learning management system, grade result

## I. INTRODUCTION

Mongolia is a country with a vast steppe and is one of the most sparsely populated countries with an area of 1.5 million sq.km and population of 2.8 million. 175000 students study at the 99 universities; most of the students attend to the public university. There are 15 public, 79 private universities and 5 international universities in Mongolia. THE educational rate of the population is comparatively higher than other developing countries in the region, more than 40000 youth graduate secondary school and 35000 matriculate. Mongolian University of Science and Technology (MUST) has 17 branch Schools. There are more than 35,000 students and 139 major. MUST has 14 online master programs 178 e-lesson already used in master program.

The aim of this paper is to introduce the results of an experiment improving learning environment, provide opportunity to conduct training suitable for learners' learning style, evaluate teachers' work using information technology achievements.

Most-learning management systems provide tools such as report, grade to capture data in an e-learning courseware.

These tools can be used by teachers, content experts to evaluate learners' activities and identify online behaviors and interaction patterns in a virtual learning environment.

Statistical results provided by these reports are able to be used for motivating students and building more effective interactive content for e-learning course hosted in a LMS.

Learning Management System (LMS)'s infrastructure supports many types of plug-ins such as Activities, Resource types, Question types, Data field types, Enrollment methods, Content Filters and Reports. All Learning Management Systems are useful in outcomes-based learning environments that could be continuously improved by analyzing the captured data included in the Reports of a courseware hosted on the system. The research identifies obstacles encountered when using log data.

For this study a sample of two fundamental courses of bachelor degree program and the data derived from their "Reports" is used to evaluate the level of interactivity.

## II. METHOD

Outcomes propose that the plan of learning activities has important influence upon levels of student interaction with the LMS. Additionally the larger the total of asynchronous learning activities, against synchronous ones, may generate increased student interaction not just with the interactive applications but with the LMS overall. This outcome is particularly relevant given the correlation between LMS interaction and student results reported in other studies. The research confirms the potential of log data to inform online teaching practice highlights some of challenges involved and outlines avenues for future research.

Data for this study were collected from 40 students, Power engineering school – 28, School of civil engineering and architecture – 4, School of Geology and Petroleum – 11, School of Mining Engineering – 7, other 3 school - 7. Overall 1376 students used open source learning management system, application program I – 762, Application program II – 414 and 12 teachers who teach same subject. All participants didn't have previous experience with online courses; on average, learners had taken 2.1 (SD = 1.6) online courses prior to participation in the study. Application program II concludes 8 lectures, 16 laboratory works and teaches MS Access, MS Outlook and Communication skills. The lecture was prepared through SCORM standard and self-test, additional materials are available. The teacher contribute for chat

twice a month, forums are discussed every day. They had 5 assignments and sent it to the teacher by e-mail.

We conducted the survey after finishing the courses.

Our research aim is to control students' learning processes using LMS during the semester and review the students' evaluation system. Now teachers assess the students' by 70 point scale during the semester. This scale consists of independent work - 30, midterm exam -30, lesson activity -10. Teachers can control students' access using open source LMS. Students using collaborative tools have been more successful than traditional training. We are trying to calculate which one is most effective tool and involve the result of these activities into course evaluation for the whole semester. Students are classified as being either synchronous or asynchronous activities. The log data downloaded from Moodle enable the mean number of hits per student to be calculated for each of the selected tools. Although our study was interested only in the cumulative number of data logs, Moodle sorts logs by type as well, including the number of pages within the LMS visited, messages read in discussions, posts in discussion and the utilization of LMS communication (email, chat). A teacher or administrator can access the reporting feature and view or download (in Excel or text format) multiple reports based on their preferences. For example, reports can be generated for individual students, multiple students, and specific assignments or for a specified time period. Through this method a cumulative number of logs for each student were obtained; also, a summary of the students' activities in the LMS was obtained allowing for future analysis of specific types of events (e.g. content views, new postings, and replies to existing postings). Collective logs were combined with scores for each participant; linear regression procedures were then performed upon the data set to separate the relationships between the independent variables (sense of community, connectedness and learning) and the dependent variable (data log events). Finally, analysis of modification procedures was utilized to explore differences between the studied courses.

### III. RESULT

The availability of internet connection was highlighted as a contributing factor by 67% of the student participants and 98% able to use computer at home. 61% of overall students used learning management system. Logs can record many different actions, each of which can and does have a variety of different causes

Results of the experiment:

1. We assessed students' independent work by result number of lecture view, participation of the chat, forum, new posting, and replies of existing postings. Students' scores were increased comparatively with other students who didn't use online learning tools. The research identifies obstacles encountered when using log data. Moodle grading result algorithm was unable to calculate the time of lecture view.

элемент	Утга
Баганаг оноо	100
байдал	давх
цэг	1 минут 5 seconds

элемент	Element Definition	passed
cmi.core.exit		
cmi.core.lesson_status		passed
cmi.core.score.max	Maximum value in the range for the raw score	100
cmi.core.score.min	Minimum value in the range for the raw score	0
cmi.core.score.raw	Number that reflects the performance of the learner relative to the range bounded by the values of min and max	100
cmi.core.total_time		1 минут 5 sec
cmi.suspend_data	Provides space to store and retrieve data between learner sessions	true,true,true

Fig. 1. Grade result of lecture view

Fig.1 shows that student grade result viewing lecture time is 1 min 5 sec. The lecture has 56 slides. These outcomes were not able to use students' assessment.

2. All lectures available on the system were prepared by SCORM standard. Also they were prepared power point format and published by Ispring presenter, so it was not able to copy. Students can read when they are online. Teachers were released to prepare lesson content using operable software. Also the content was able to protect of illegal usage.
3. Studies examining how teachers spent their time in online tools combining multiple sources of data to understand system log data. For example, we examined the amount of time teachers spent on all learning tools and these data result can be used to evaluate teachers' work in virtual environment.

We collected the surveys at the end of the lesson. Students' scores whose use online learning tool like forum, chat, were increasing during the lesson. Collaboration tool was also helpful to evaluate students' activity. Teachers evaluated some of students' perception by result of self-test during the lesson. Because several students had some problems using online learning tool. They had to check their understanding of the lesson after every topics. We consider that if the students use other learning materials like book, printable materials, their self-test, midterm test results will show the learners' knowledge rate. To measure various opportunities and their impact on student learning, researchers must address, at a minimum, four factors: (1) the tools complete availability to users, (2) the degree to which tools are essentially used, (3) how those tools are appropriated or redeveloped by users, and (4) how the use of any tool fits within the overall environment.

### IV. CONCLUSION

Whereas the overall number of students studying the units examined in this-research is large, the sample of different courses involved is narrow. Nevertheless, the log data analysis supports the hypothesis that course activity design in the virtual learning environment has a strong influence on how students interact with the learning management system. Furthermore, it appears that units with more asynchronous learning activities may correspond with greater levels of interaction. This increased access appears to occur not only with the interactive areas of the LMS but across all application areas. Given that others studies

confirm links between level of LMS interaction and results, this finding could have important implications for teaching practitioners wishing to design courses that encourage maximum student interaction with the LMS, and thereby contributes to the ongoing debate on online education surrounding synchronous versus asynchronous delivery.

This study is specific to one LMS, but underlines the potential for, as well as some of the challenges of, using Moodle log data to inform teaching practice. The study may therefore assist e-learning teachers, as well as LMS service providers in terms of ranking the development of more effective log data reporting capabilities.

Further research involving a larger sample of units, as well as using other LMS platforms such as Moodle, might seek to confirm the otherwise tentative findings and patterns discussed in this exploratory study.

Data from LMS, on the other hand, with its inherent capability to collect and report student actions, interactions and testing data, have potential to qualitatively change teaching and learning. Instead of relying on often-fallible intuitions based on an impoverished data stream, future e-learning instructors may well take advantage of what computers are good at—gathering and sorting data—to build representations of online students that are in many ways richer and more accurate than they'd have had in the classroom. At higher levels, administrators and course designers will be able to embed features and dynamic content that encourage a deeper exploration of content. Current research attempting to identify indicators of student attitudes like sense of community brings us closer to such a reality.

#### REFERENCES

Author (in press). An overview of evaluative instrumentation for virtual high schools. Paper to appear in *The American Journal of Distance Education*.  
Ayers, I. (2007). *Super Crunchers: Why thinking by the numbers is the new way to be smart*. New York: Bantam Dell.

Berge, Z.L. & Collins, M.P. (1995). *Computer Mediated Communication and the Online Classroom*. Cresskill, NJ: Hampton Press.  
Cereijo, M. V. P., Young, J., & Wilhelm, R. W. (2001). Factors Facilitating Student Participation in Asynchronous Web-Based Courses. *Journal of Computing in Teacher Education*, 18.  
Curry, D. B. (2000). Collaborative, Connected and Experiential Learning: Reflections of an Online Learner, Retrieved 7/15/2007, from <http://www.mtsu.edu/~itconf/proceed01/2.html>.  
Davenport, T. & Harris, J. (2007). *Competing on analytics: The new science of winning*. Boston: Harvard Business School Press.  
Dillman, D. (2002). Navigating the rapids of change: Some observations on survey methodology in the early twenty-first century. *Public Opinion Quarterly*, 66(3), 473-494.  
Donath, J., Karahalios, K., & Viegas, F. (1999). Visualizing conversation, *System Sciences, 1999. HICSS-32. Proceedings of the 32nd Annual Hawaii International Conference on System Sciences-Volume 2*.  
Dringus, L. P., & Ellis, T. (2005). Using data mining as a strategy for assessing asynchronous discussion forums. *Computers & Education*, 45, 141-160.  
Eastmond, D.V. (1995). *Alone but together: Adult distance study through computer conferencing*. Cresskill, NJ: Hampton Press.  
Foshay, R., & Bergeron, C. (2000). Web-based education: A reality check. *TechTrends*, 44, 16-19.  
Hanna, M. (2004). Data mining in the e-learning domain. *Campus-Wide Information Systems*, 21, 29-34.  
Haythornthwaite, C., Kazmer, M., Robins, J., and Shoemaker, S. (2000). Making connections: Community among computer-supported distance learners. Paper presented at the *Association for Library and Information Science Education 2000 Conference*. San Antonio, Texas. Retrieved July 15, 2007 from: [http://www.alise.org/conferences/conf00\\_Haythornthwait\\_e\\_Making.htm](http://www.alise.org/conferences/conf00_Haythornthwait_e_Making.htm)

# Measuring traffic congestion using computer simulation

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**Abstract**— In order to decrease the traffic congestion we had to measure the number of vehicles, the traffic congestion time, the destination, the capacity and their combination. In order to decrease traffic congestion we needed first to identify the reasons of it, such as holiday, weather, accident, working time, traffic light, road condition, special event, special vehicles, law-and-order and population. Then we had to re-measure and compare it when we will change some of these reasons. Some specific simulation software is used to do the measurement. It is also possible to develop your own simulation software. In this paper we are calculating some important statistics such as traffic density, traffic intensity, capacity, traffic average speeds, queue length and waiting time for each vehicle without any specific computer simulation software. In order to do it we have developed a computer model based on the data of UBTCC and simulated it.

This research result will be used to develop Smart Traffic Control system in Ulaanbaatar city, Mongolia.

**Keywords**—traffic congestion; statistic; traffic light; computer simulation and modeling; smart traffic control

## I. INTRODUCTION

Many country defined traffic congestion differently. There are about 10 different definitions depending on cost, service, demand and requirement. For example,

- Traffic congestion occurs when a volume of traffic or modal split generates demand for space greater than the available road capacity.
- a condition in which is very slow, with many queues and traffic congestion
- slower speeds, longer trip times /in USA/

In our country we don't have a traffic congestion definition.

Traffic congestion has a number of negative effects: [10]

- wasting time of motorists and passengers
- delays, which may result in late arrival for employment, meeting and education
- less time on productive activities
- wasted fuel and increasing air pollution
- stress and frustration

Department of Road Transportation reported “We register approximately 300 to 400 vehicles daily in Ulaanbaatar.” The

Traffic Police gave also the following notice: “There are about 300000 vehicles in our city and traffic congestion is the most important problem. 70 percent of the vehicles always stop down on traffic congestion”[8].

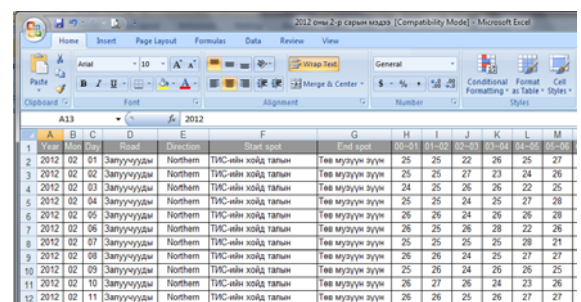
UBTCC has Korean software that controls and monitors traffic condition. They also use loop detection in order to count the vehicles, VDS, which is sensor moving and Germany's mathematic modeling software VISSIM and VISUM.

In the recent years UBTCC and other authorities' organizations attempted several ways in order to decrease the traffic congestion, using regulations and domestic laws.

### A. First data of simulation

We used following data in order to simulate.

- UBTCC's software considers that there is traffic congestion, if the average speed of vehicle is less than 10km/hour.
- The monthly report of UBTCC is including vehicle's number and speed. (See Figure №1) UBTCC's software delivers reports and statistics in form of graphics and sheets using traffic's database. These reports are available daily, hourly and early and for each chosen intersection, which has loop detection, it reports the number of vehicles and the speed.



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	2012	02	01	Залуучууды	Northern	ТНЭС-ийн хойд талын	Төв музун зүүн	25	25	22	26	25	27
2	2012	02	02	Залуучууды	Northern	ТНЭС-ийн хойд талын	Төв музун зүүн	25	25	27	23	24	26
3	2012	02	03	Залуучууды	Northern	ТНЭС-ийн хойд талын	Төв музун зүүн	24	25	26	26	22	25
4	2012	02	04	Залуучууды	Northern	ТНЭС-ийн хойд талын	Төв музун зүүн	25	25	24	25	27	28
5	2012	02	05	Залуучууды	Northern	ТНЭС-ийн хойд талын	Төв музун зүүн	26	26	24	26	26	28
6	2012	02	06	Залуучууды	Northern	ТНЭС-ийн хойд талын	Төв музун зүүн	26	25	26	28	22	26
7	2012	02	07	Залуучууды	Northern	ТНЭС-ийн хойд талын	Төв музун зүүн	25	25	25	25	28	24
8	2012	02	08	Залуучууды	Northern	ТНЭС-ийн хойд талын	Төв музун зүүн	26	26	24	25	27	27
9	2012	02	09	Залуучууды	Northern	ТНЭС-ийн хойд талын	Төв музун зүүн	25	26	24	26	26	25
10	2012	02	10	Залуучууды	Northern	ТНЭС-ийн хойд талын	Төв музун зүүн	26	27	26	24	23	26
11	2012	02	11	Залуучууды	Northern	ТНЭС-ийн хойд талын	Төв музун зүүн	26	26	25	26	27	27

Fig. 1. UBTCC's report

- We are also using this assumption for our computer simulation. The following figure (See Fig. 2.) shows the main roads and intersections where the traffic congestion is mostly occurring in the morning and in the evening, during working days in our city.

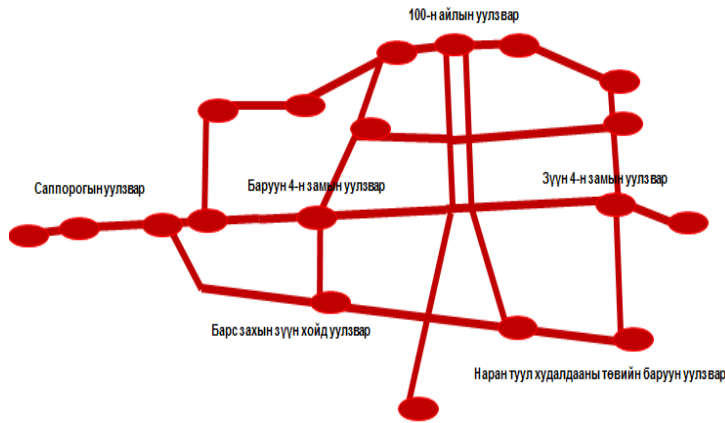


Fig. 2. The main road and intersection in Ulaanbaatar

We found some information such as road and intersection's width, length and lane number using Google Map and [www.its.mn](http://www.its.mn) site.

## II. RESEARCH

### A. Research motivation

The 27th of August 2012, Ulaanbaatar city mayor announced that there will be a restriction of vehicles depending on their number, in order to decrease traffic congestion. Official peoples expected that traffic congestion will decrease approximately by 20 percent (See Table I). We separately calculated a concrete percent of this decrease using computer simulation before the rule and after the rule.

TABLE I. CITY REGULATION RESTRICTED BY VEHICLE NUMBER

Working days	Vehicle number's last number	Total vehicles	Sum vehicle	decrease traffic percent
Monday	1	29931	60446	19.6
	6	30515		
Tuesday	2	30088	60432	19.5
	7	30344		
Wednesday	3	30182	62381	20.3
	8	32199		
Thursday	4	29979	62092	20.1
	9	32113		
Friday	5	30832	62375	20.2
	0	31543		
<b>Total:</b>		<b>307726</b>	<b>307726</b>	<b>19.94</b>

### B. Research scope

The study, based on the data from UBTC, was conducted with the following conditions:

- City road is from Sansar Tunnel Intersection to Left Central Intersection (See Figure 3).
- Road length is 0,86km

- One way road, three lanes
- Data before the regulation and after the regulation

We developed a C# computer model and simulation to calculate traffic density, traffic congestion speed, capacity and percent of traffic.

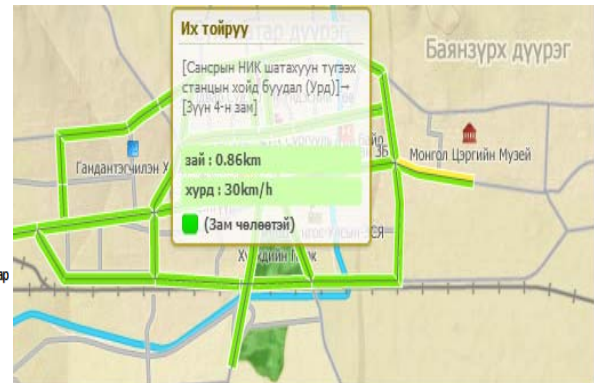


Fig. 3. Experimental road

The capacity of road is depends on vehicle's length and width. (See Table II) We used for our computer simulation.

TABLE II. VEHICLE CLASSIFICATION

Classification	Long(meter)	Width (meter)
A	3.6	1.6
B	3.9	1.7
C	<b>4.3</b>	<b>1.7</b>
D	up to 4.6	1.7
E	up to 5	1.7
F	more than 5	1.7

The mode of traffic light depends on roads, intersections and daily hours.

Our experimental road's traffic light works on following mode. (See Table №3)

TABLE III. TRAFFIC LIGHT MODE OF LEFT CENTRAL INTERSECTION

Цар	1-р үе	2-р үе	3-р үе
06-09	25	35	40
09-16	16	50	54
16-22	16	50	54

Ногоон	40'	16'
Шар	25'	50'
Улаан	35'	54'

## III. MATHEMATICAL MODEL

Our selected road consists of several lanes and separate queues of vehicles.

In our system, we have considered that the service time is based on the loop detection which is located at the start of road until the next loop detection.

Our system is continuous and the model is deterministic.

A. Exogenous variables

- **Q** - flow rate (veh/hr) – how many vehicle passed through the server
- **SPEED** - average travel speed (km/hr)
- **T** – (Time) ; experiment time (1hour = 3600second)

A. Parameters

- **Y** – (Yellow) how many second do yellow light flush
- **R** – (Red) how many second do red light flush
- **G** – (Green) how many green do yellow light flush
- **R\_WIDTH** – width of road
- **R\_LENGTH** – length of road
- **K** - density (veh/km)
- **R\_LANE** – number of lane

B. Status variables

- **TLC** – (Traffic Light Cycle) /second
- **CAT** - (Cumulate Arrival Time) – when did the vehicle arrive at the first loop detection?
- **PT** – (Pass Time) – how many second did the vehicle spend?
- **WT** – (Waiting time) – the amount of time spent waiting to enter second loop
- **ST** – (Service Time) – the process time
- **SST** – (Service Stop Time) – the time needed to arrive at the end of the intersection
- **DT** – (Depart Time) – the depart time

C. Operating characteristics

$$K = Q/V$$

$$R\_LANE = R\_WIDTH/1.7$$

$$TLC = Y+R+G$$

$$\text{Count}(CAT) \leq R\_LANE$$

$$\text{Rand}(0,3600) \% TLC > R$$

$$PT = R\_LENGTH/SPEED$$

$$WT = \begin{cases} 0 & \text{if } (PT \% TLC < R) \\ TLC - PT \% TLC & \text{else} \end{cases}$$

$$ST = PT + WT$$

$$SST = CAT + PT$$

$$DT = CAT + PT + WT$$

D. Endogenous variables

- **AWT** – (Average Waiting Time)
- **AST** – (Average Service Time)
- **DP** – (Destiny Percent)
- **QL** – (Queue Length)

IV. COMPUTER MODEL

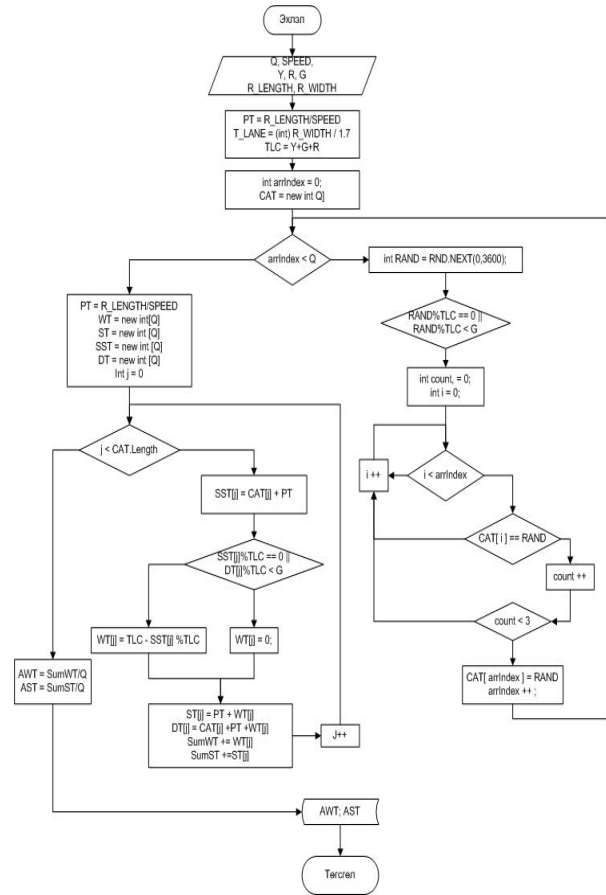


Fig. 4. Experimental road

V. RESULT OF WORK

We achieved following results with our computer simulation based on UBCC's traffic data (From 2012/09/10 to 2012/09/14 and from 2011/09/12 to 2011/09/16, between 08:00 to 09:00) (See Table №4, 5). Then we have experimented our computer model on other intersections.

TABLE IV. RESULT OF BEFORE REGULATION

Working days	Date	Passed car count	Average speed	Average waiting time (AWT)	Average service time
Monday	9/12/2011	1616	28	26	148
Tuesday	9/13/2011	1902	35	10	95
Wednesday	9/14/2011	1694	32	12	95
Thursday	9/15/2011	1766	31	8	115
Friday	9/16/2011	1714	35	8	95



TABLE V. RESULT OF AFTER REGULATION

Working days	Date	Passed car count	Average speed	AWT	AST
Monday	9/10/2012	1458	16	18	233
Tuesday	9/11/2012	1764	26	25	147
Wednesday	9/12/2012	1467	24	36	179
Thursday	9/13/2012	1610	24	37	180
Friday	9/14/2012	1638	26	26	148

TABLE VI. DECREMENT AND INCREMENT

	Count vehicle		Average speed		Average waiting time		Traffic congestion
	n	%	n	%	n	%	
Monday	158	9.8	12	-75	8	-44.4	increased
Tuesday	138	7.3	9	-34.6	-15	60	increased
Wednesday	227	13.4	8	-33.3	-24	66.6	increased
Thursday	156	8.8	7	-29.2	-29	78.3	increased
Friday	76	4.4	9	-34.6	-18	69.2	increased
Traffic congestion	decreased		increased		increased		



Fig. 5. Decrement and increment

## VI. SMART TRAFFIC CONTROLLING

Traffic lights have become an integral part of human’s day-to-day life.

We can develop smart traffic controlling system using some statistics also it is possible to work in real time using loop detector.

With this motivation in the mind, this project aims at designing and implementing, a running model of traffic light controller which is controlled according to the density of vehicle on road. We will use the following model.

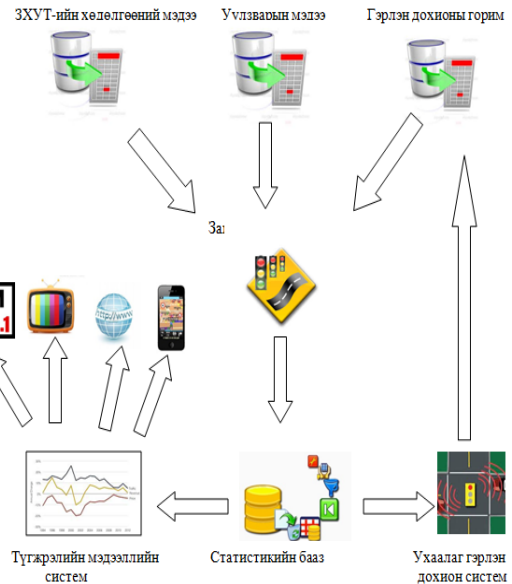


Fig. 6. Smart controlling system’s architecture.

## VII. CONCLUSION

We have developed a mathematical and computer modeling in order to determine some statistics of traffic congestion and we have developed computer simulation.

This is our result:

1. After our analyze we expected that the new regulation (forbidden number's on certain days) will not influence the decrease of the traffic congestion in most of roads and intersections in Ulaanbaatar. So we propose to cancel this regulation.
2. We can study and measure traffic condition in each interaction and road.
3. We can develop a smart traffic controlling system.
4. We want to study the impacts of traffic congestion and develop model and simulation for it.
5. We want to present to Ulaanbaatar city’s mayor, UBTCC and Department of Road Transportation these results and then discuss with them.

## REFERENCES

- [1] Transportation Research Board Highway Capacity Manual, USA 2000
- [2] Kerner, The Physics of Traffic B.S. 2004
- [3] Ganbat Tsend “System simulation with computer” Ulaanbaatar. 2004
- [4] Edward Chung, “Transport simulation beyond traditional approaches”, 2008
- [5] Juame Barcelo, “Fundamentals of Traffic Simulation”. 2010
- [6] The institute of Traffic “Handbook of Mongolia traffic Psychology”. 2006
- [7] UBTCC, “Traffic statistic report”. 2011, 2012
- [8] The Traffic Police, The statistic report. 2011
- [9] <http://mctrans.ce.ufl.edu/hcs/hcs2000/>
- [10] <http://www.wikipedia.org/>

# Design and Development of Computer Sign Language Interpreter of the Russian Language for the Deaf

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**Abstract— The Russian sign language grammar peculiarities are examined in this work, which should be necessarily taken into account in the development of a computer signer, making a literal adaptive translation from Russian audible (sounding) speech to the Russian sign language. Detailed characteristics of Russian text analysis stage, morphological, syntactic and semantic analysis including, are given in this research too.**

Keywords: computer sign language translation, Russian sign language, grammar, text analysis.

## I. INTRODUCTION

Developments of computer sign language translation systems are very active in Russia nowadays. Their goal is to overcome communicative barriers between deaf and hearing citizens of Russia. The known systems of Russian text (oral speech) to the Russian loan sign language translation do not solve the existing problems in full, for people with limited possibilities of hearing, using mostly the informal Russian sign language (RSL) have many difficulties understanding such translation. Having analyzed applied linguists researches, dedicated to the translation theory, we have come to the conclusion that the sign language translator should make a literal adaptive translation, using an intermediary language strategy. We examined RSL grammar peculiarities (wordforming, morphology and syntax), which should be taken into consideration during computer signer developing, we give a detailed characteristic of Russian text analysis stage here, morphological, syntactic and semantic analysis including.

## II. RUSSIAN SIGN LANGUAGE GRAMMAR

“Sign languages are full-value human languages and are in no way inferior to sounding ones in their communicative functions, but they differ by their physical expression’ [1]; that is why, as any other natural language, they have got their own grammar system, combining word-forming, morphology and syntax. And the Russian sign language is not an exception. Zaytseva

G.L. thinks that RSL – is a peculiar linguistic system, having got its own vocabulary and grammar [2].

“In spite of the fact that sign languages use visualkinesthetic information channel instead of an audio one, they are similar to sounding languages in their fundamental features. And this fact lets us rank them among natural human languages and analyze them with methods and notions, developed for sounding languages” [3]. Having analyzed lexicographical, theoretical and empiric resources, we have come to the conclusion that RSL grammar system consists of word-forming, morphology and syntax, and all of them have got their own peculiarities.

The RSL word-forming system has the following features [4, 5]:

1. RSL word-forming system is mostly oriented to the word morphological character expression, and not to new signs forming, compare: “Possibility of a sign articulation change and its ability to paradigms forming, presenting a complex with motional-spatial sign characteristics and their con-situational meanings interaction and interdependence – is the main feature of RSL morphology” [2].
2. The base RSL word-forming units are the wordforming chains, paradigms and word-families, with underlined motivated and motivating signs, and audible Russian motivated words are not always the names of the motivated gestures.
3. There are no means, completely corresponding to word-forming formants of Russian, in RSL wordforming system. But this system has got its own specific new signs-forming means. As far as the sign language uses visual-kinesthetic information channel instead of an audio one, signs, similar to conjugate words, can be formed by RSL two independent gestures combination, by additional signs complementing the nominative sign (sign HUMAN, for example), by the additional sign repetition, by the sign amplitude/intensity change, its localization, mimic and/or body turn usage. The systematic usage of the mentioned above means gives us reasons to mark out distinctive word-forming models in RSL, which sometimes have analogues in audible Russian, prefixal, suffixal and stems composition methods, for example.

4. There are special cases in RSL sign-forming:

- sign articulation similarity of conjugate words from audible Russian word-forming viewpoint, but they are not included in word-forming chains;
- sign articulation identity of sounding Russian conjugate words analogues;
- sign articulation difference of sounding Russian conjugate words.

RSL morphology, as well as its word-forming, can be described in categories and notions of the Russian language. Having studied literature, dedicated to RSL, we have found that there are word classes in it, identical to parts of speech in the sounding language: the noun, the adjective, the numeral, the pronoun, the verb, the participle, the predicative, the adverb, modal words, the interjection, the preposition, the conjunction, the particle, which have got some grammar categories, in analogue with their prototypes in the audible language [6].

We have marked the following RSL morphology features, during our research:

1. There are no grammar categories of gender and case.
2. There are groups of sign-numerals TWO, THREE, FOUR, FIVE, combining paradigmssubgroups, where gestures of different measures (time, weight, cost and others) differ in the character of movement.
3. Personal pronouns have a demonstrative function.
4. There is a tendency to place interrogative pronouns and negative particles in the postposition of a statement.
5. There is the possibility to express different meanings of a verb in the past time (preterit and perfect);
6. The preposition is not a mean of subordination of one full-sensed word to another in a word phrase or a sentence, but a mean of spatial relations expression in RSL.
7. Configuration and gesture movement are the main methods to express grammar meanings. RSL syntax, similar to Russian sounding, plays the leading role. This grammar component has got its own peculiarities too:

1. Proposition is the main syntactic unit, and not the sentence, as in the Russian audible language. A statement consists of syntagmas, whole semantic units, presenting combinations of gestures.

All RSL propositions can be divided into two large classes; simple and compound [2].

Simple propositions can be in their turn divided into two classes:

- Statements, expressing spatial, attributive and casual relationships, syntagmas with two gestures simultaneous performance including;
- Con-situational propositions, having got unsubstituted positions, which meaning is determined by the con-situation, that is a situational context; situation, which helps to clarify and understand the meaning of certain words in the concrete sentence.

There are 4 big classes of compound propositions in RSL.

The class of asyndetic propositions is the largest of them. It consists of the following statement type:

TANYA CRY BALL SINK. This class has the following features:

- Semantic relationships between predicative parts lay in these parts content;
- There are no conjunctions and other morphological indicators of these relationships;
- The meaning of relationships are determined not only by the proposition components but by the consituation itself.

The class name and its features lead us to the conclusion about their identity with conjunctionless sentences.

The second class of compound propositions –consists of statements with free connections – the name was given because of a “free construction” in the structure, building a single unit with the main part, but able to take any position in the proposition.

The third class – consists of propositions with interference, that is with two predicative constructions combined into one unit; and as a result, a general term appears in the superimposed constructions.

The fourth class has no analogues in Russian – it consists of compound propositions, syntagmas with simultaneously performed gestures including.

2. According to Zaytseva G.L. [2], RSL sign order is freer than in the Russian literary language sentences. But this was refuted by Kimmelman V.I., who proved with his research the existence of base sign order, and showed this order dependence on its components’ belonging to different parts of speech [7, 8]:

- The subject precedes the attribute-predicate in nominal sentences, and the linking verb TO BE precedes the attribute (BALL BE BLUE);
- A locative demonstrative pronoun can take any position;
- A gesture-attribute follows the gesture-noun in most sentences (GIRL FEED DOG SMALL);
- A gesture-adverb precedes the gesture-verb in most cases; adverbs of place and time are often separated from the verb, adverbs of manner and aspect are usually near it;
- A negation takes a postposition from the negated (GRANDFATHER HEAR NOT). Viktorova S.V. in her interrogative words research came to the conclusion that gestures indicating them are often used in the end of a proposition [9].

3. The sign language – is a soundless one, and an intonation framing of an expression is impossible in it. The none-manual component is an intonation analogue: lips, eyes, cheeks, eyebrows, nose, body and head movements, for example, let them mark different lexical, morphological and syntactical properties. Interrogative expressions in RSL are regularly marked by nonmanual signals.

4. Zaytseva G.L. thinks that RSL syntax analysis in terms subject-object-predicate is not effective, because of the difficulty to ascertain where the object is, and where the subject is [2]. Kimmelman V.I. proved that RSL syntax can be described in terms S,V,O, where S- is the subject,

V- is the predicate/verb, O – is the (direct) object. The order SVO is the most spread one for RSL, but there are some factors influencing the word order in RSL sentences:

- The pronoun (a pronominal subject and pronominal adverbs usually precede the verb);
- The aspect marking (an aspect – is the repeating of activity in the verb, which indicates repeated actions; the subject is in the end of the sentence);
- The type of the verb (different verb types demand different word order, but the most widely-spread one is still the order SVO);
- The inverse order (this factor is connected with animate arguments, both of them should be animate; animate subject precedes the predicate, inanimate subject follows the predicate);
- The animate object (it is probable, that such object will appear right from the verb, an inanimate object usually precedes the verb);
- The extended object.

We cannot but mention two peculiarities of RSL, which let us separate the subject and its object. The first one is that the main and the secondary members' separation is possible with the gesture direction change. So, in the subject performance, the gesture-nominal is directed from oneself, and, in the object performance, the gesture-nominal is directed to oneself. The second feature is that referents in sign languages are associated with positions in the gesture zone (sign space), that is the zone for gesture performance in front of the speaker. Some verbs can change their form in such a way that their initial and final movement positions coincide with referent locuses, which is necessary for the subject and object indication.

5. The last remark by Zaytseva G.L. about RSL syntax – that it should be analyzed on the base of the functional approach – is partially refuted by one of the functional grammar founders, the creator of the functional-semantic fields theory – Bondarenko A.V.: "Functional grammar, from our point of view, cannot be limited by the principle "from the content to the formal expression means", underlying the active grammar. The direction from the form to the content is necessary and obligatory for any grammar, the functional one including, for it builds grammar system unity [10]. As far as there has been no RSL grammar system description by the moment, the approach "from the form to the content" is the only possible approach to describe the given material about RSL syntax.

Summing all the said above up, we can conclude that the Russian sign language has got a grammar system with peculiarities in the levels of word-forming, morphology and syntax. These peculiarities should be taken into account by the computer signer system developing.

### III. TRANSLATION SYSTEM CHARACTERISTICS INTO RSL

The general structure of the computer translation system from Russian text into RSL was determined in the research [11], it supposes the following sub-systems presence:

- 1) The original text analysis;
- 2) The transfer (interlingua transformations);
- 3) The sign language synthesis;
- 4) The translation results' visualization by a dummy; - and the original text analysis stages examination: grapheme, morphological, syntactic and semantic ones.

The grapheme analysis stage (the original text structure elements separation) is a preliminary one and can differ depending on the text processing goals but it does not depend on the language, the translation is made into.

The morphological analysis presents morphological characteristics (parts of speech, gender, number and others) and the base wordform of each word determination. The morphological analysis of a Russian text is made nowadays with the methods: using "Russian language grammar dictionary" by Zaliznyak A.A. ("clear" morphology and "fuzzy" morphology). The dictionary by Zaliznyak A.A. contains main Russian language wordforms with a special code for each of them. A system of rules has been made, according to which one can build all forms of the given word with the initial wordform and the proper code, and automatically can get their morphological characteristics. So, to make a morphological text analysis - one should create a dictionary with all wordforms of Russian words on the base of Zaliznyak's dictionary, putting a set of morphological characteristics to each of the wordforms accordingly. Then a word morphological analysis task will be just to find this word in the dictionary and get the kept characteristics, one can find several variants of their meaning as well.

The "fuzzy" morphology methods present a set of rules making, determining morphological characteristics by the word, its certain parts (morphemes) presence and absence. Affixes ability to reflect the word grammar characteristics lays in the ground of one of these methods: a morphological dictionary, containing stems, prefixes, suffixes, affixes, exceptions, is used to define a word morphological features. One more "fuzzy" morphology method – is the method of similar words finding in a dictionary, got from Zaliznyak's dictionary. If inflections maximally coincide – the word is considered to be equal.

A certain problem arises when such obligatory morphological character of nouns as animate or inanimate is determined by the second group of methods. This information is necessary for translation into RSL, because of its influence on the word order in a sentence. Usage of an out-word animate character expression can become a solution in some cases: the inflection of an attribute or participle, agreed with the noun in the accusative, differs, depending on an animate or inanimate noun is given, compare: (SEE) NOV-**YCH** (NEW) PEOPLE, but NOV-**YE** (NEW) FEATURES. Zaliznyak's dictionary, at the same time, contains information about this criterion.

The syntactic analysis, which goal is to determine interconnections between separate elements: words and parts, - sentence, - is made on the ground of the results of each word morphological analysis. A fragmentational analysis is made preliminarily to simplify the syntactic one; its objective is to mark out fragments in a sentence (simple sentences in a compound one, participle and gerundial phrases, and others) and to determine the relations between the fragments. Different models of the Russian language are used now, taking into account syntactic (subject, object) and semantic (manner, place, time and others) relations between words.

The main methods of a syntactic analysis results presenting are immediate constituents and dependency trees [12]. The immediate constituents tree reflects the consecutive complication of a syntactic structure, which means syntactic units' binary consolidation in syntactic groups. Connections between separate words in the sentence under analysis are reflected in the dependency tree forming: words of the sentence in their base wordforms are the junctions, relations between words are marked by arcs.

A semantic text analysis, based on the syntactic analysis results, is made not with the words list of sentences, but with a number of trees, reflecting the original text sentences syntactic structure. The analysis results in the text meaning presenting in the form of a tight formal system, the look of which depends on the chosen method of analysis. A "strong" approach [13] is used for an automatic text analysis, it applies semantic metalanguages and is characterized by maximally possible full coverage of recognized expressions range of the natural language and by a detailed semantic description of these expressions. Each meaning of a word is described by a semantic formula, and a semantic language dictionary presents a set of such descriptions.

A sentence meaning is described by a mathematical expression. The objective of a semantic meta-language creation is to choose a base functions and notions system, which is able to describe meanings of other notions and sentences, which further interpretation is either impossible or unreasonable. The last term is the reason for these problem different variants of solvation, depending on text analysis systems developing goals. Questions and problems of a text semantic analysis realization in the frames of Russian text translation into Russian sign language are covered in the works [14, 15]. Reduction can be taken into consideration at the stage of a semantic analysis; it is a widely-spread phenomenon in the sign language and presents insignificant phrase elements exclusion [14]. The polysemanticism (homonymy) resolving aims can be also worked out at this stage, but they demand the context to be taken into account when the words meaning is being determined. The context limits cannot coincide with the sentence limits in case of translation into the sign language. The context size is an important question in translation system developing: it may be too small to determine connections

between the proposition parts, or too large to let the system work quick enough and make real-time translation.

There are two main approaches to an automatic signer developing: a rule-based translation and a databased translation. In the systems of the first type, the rules are specified manually, on the ground of the two languages knowledge. In the systems of the second type, the rules are given automatically, on the ground of language data computer analysis, without any preliminary knowledge about the examined languages structure. A statistical automatic translation is an example of the second type system. This approach is considered to be unrealizable nowadays, because of the representative enough parallel texts absence, where the system can learn correlation regularities of the Russian sounding language with the Russian sign language.

The systems of the first type differ in the translated text analysis range.

A syntactic (and semantic particularly) analysis cannot be made in the *direct translation*, the interpretation is made on the base of lexical correlations finding. The "transfer" type of interpretation is based on the deeper analysis, going up to the syntactic or semantic level. The translated text syntactic/semantic presentation is transferred (on the base of the given to the system rules) into syntactic/semantic presentation of the other language, which then is used as the ground for interpretation generation. Such strategy goes up to ideas by Victor Yngve, suggested in the end of 50-ties of the last century.

A deeper text analysis is based on artificial mediator-language creation (Interlingua). The interpretation strategy goes up to ideas by Warren Weaver, suggested in 1955 [16]. And it presents the translation circuit usage, where a text of one language is transferred into a text of another language being brought into a general for them (independent on the languages L1 and L2, ideally) semantic presentation in the mediatorlanguage.

There are two Interlingua modeling strategies [16]:

1. A universal language description creation, generalizing syntactic and semantic means of different natural languages. This approach is close to the method, used in the system [17].
2. A mediator-language creation, directly modeling the world itself these languages speak about, and not just natural languages. The knowledge about the world formalization let us include logical inference procedures in the interpretation process, based on the reasons of common sense. For example, the system ZARDOZ [16] is applied to this class by its authors.

#### IV. CONCLUSION

It has been shown in this work that the original text necessary analysis level is determined on the ground of the language characteristics into which RSL interpretation is made. The variant with artificial mediator-language (Interlingua) modeling seems to be the

most promising approach in a computer signer system developing.

#### REFERENCES

- [1] Prozorova E.V. *Discourse local structure markers in the Russian sign language: The author's abstract*, candidat of philological science, M., 2009. 23 p.
- [2] Zaytseva G.L. *Sign language. Dactilology: a study book for students of higher education*. M., 2000. 192 p.
- [3] Prozorova E.V. The Russian sign language as the object of a linguistic research // *Pphilology questions*. M., 2007. № 1. P. 44-61.
- [4] Korolkova O.O. *The Russian sign language wordforming characteristics // Modern linguistics and intercultural communication: monography /O.A.Berezina, E.N.Grushetskaya, T.V.Itskovich [and others]*. Krasnoyarsk: Research-Innovative centre, 2012. P. 98-152.
- [5] Korolkova O.O. Comparative analysis of the Russian sounding language word-forming formants with the Russian sign language means of gesture-forming // *In the world of scientific discoveries*. 2012. № 7.2(31). Krasnoyarsk: Research-Innovative centre, 2012. P.213-230.
- [6] Korolkova O.O. *The Russian sign language morphology / Linguistics and intercultural communication: monography*. Book 3. / O.A. Berezina, N.V.Bizukov, O.O. Korolkova [and others]. Krasnoyarsk: Research-Innovative centre, 2011. P. 60-87.
- [7] Kimmelman V.I. *The Russian sign language base word order*: Diploma thesis. M., 2010. <http://signlang.ru/science/bibliography/>
- [8] Kimmelman V.I. *Irregular negations in the Russian sign language*. <http://signlang.ru/science/bibliography/>
- [9] Viktorova S.V. *Interrogative pronouns in the Russian sign language*. Term paper. MSU(MGU), 2007. <http://signlang.ru/science/bibliography/>
- [10] Bondarenko A.V. *Functional grammar principles and aspectology questions*. M., 2001. 208 p.
- [11] M.G. Grif, Ye.A. Demyanenko, O.O. Korolkova, and Ye.B. Tsoy, "Development of Computer Sign Language Translation Technology for Deaf People", in *Proc. Int. Conf. "IFOST-2011"*, Vol.2. Harbin University of Science and Technology, Harbin, China, pp.674-677.
- [12] Gladkiy A.V. *Natural language syntactic structures in automatic communication systems*. M.: Science, 1985. 142 p.
- [13] Ermakov A.E., Pleshko V.V. Semantic interpretation in the systems of computer text analysis – *Informational technology*. - 2009. – N 6. – P. 2-7.
- [14] Voskresenskiy A.L., Chachalin G.K. Multimedia explanatory dictionary of the Russian sign language// *Materials of the International conference of computer linguistics «Dialogue 2007»*: <http://www.dialog-21.ru/dialog2007/materials/html/18.htm>
- [15] Voskresenskiy A.L., Chachalin G.K. Semantic search means// *Computer linguistics and intellectual technology: Proceedings of the International conference «Dialogue 2006»*. M.:Publishing house RGGU, 2006. pp. 100-104.
- [16] Veale T. Space, metaphor and schematization in sign: Sign Language translation in the ZARDOZ system/ T.Veale, B.Collins // *Proceedings of the Second Conference of the Association for Machine Translation in the Americas (AMTA'96)*, Montreal, Canada, 1996.
- [17] Patten T. Automatic Translation of English to American Sign Language / T.Patten, J.Hartigan //P. Paul and C. Moreland (Eds.), *National Conference on Deafness*. Columbus, Ohio, 1993.

# Signal detection in frequency domain

Maria V. Gundareva

**Abstract**—a new approach of random signal detection in the frequency domain based on principle of invariance and well-known goodness of fit test is proposed. Statistical characteristics of the algorithms are obtained by statistical simulation and analysis of real signal recordings. Experimental results show that the proposed algorithms can be used for signal detection in frequency domain in conditions of signal and noise a priori uncertainty.

**Index Terms**—Irregularity coefficient, Fourier transform, prior uncertainty, principle of invariance, signal detection, F-distribution, goodness of fit test.

## I. INTRODUCTION

Signal detection in a given frequency domain appears in many application tasks. Nowadays it is quite difficult to detect the desired signal with noise occurrence due to spectral density fluctuations. At the same time type of signal modulation, carrier frequency and other parameters are unknown. Contemporary systems use algorithms which demand prior knowledge of energy spectrum or its estimation. Unfortunately, in such systems there is no any information about noise spectrum. So, the problem of signal detection in uncertain noise is actual.

An algorithm to resolve the mentioned problem was previously presented in the work [2]. Its main idea is to use both principle of invariance to overcome prior uncertainty levels of noise and well-known goodness-of-fit tests at the same time. The tests can be used are the well-known chi-squared, Cramer-Mises-Smirnov, Anderson-Darling, Kolmogorov and Smirnov tests.

Investigation of this algorithm has been resulted in introduction of a new parameter called irregularity coefficient. This parameter can be used as a criterion for signal detection. New algorithm based on this coefficient is proposed.

## II. FORMULATION OF THE PROBLEM

Signal detection is produced in a narrow frequency band so noise energy spectrum is approximately constant. In order to detect the signal one can use the differences between the energy spectrum of the noise and their mixture spectrum.

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Let  $\mathbf{X}$  be a body of data observations which consist of  $\mathbf{X}_n = \{X_{in}, i = \overline{1, B}\}$ ,  $n = \overline{1, N}$ ,  $X_{in}$  are the coefficients of the discrete Fourier transform (DFT) of the complex envelope samples, obtained at sequential time intervals,  $N$  is a dimension of DFT,  $B$  is a number of time intervals where DFT is applied. The normalized spectrum of the observed data can be represented by

$$z_{in} = \frac{|X_{in}|^2 (B-1)}{\|\mathbf{X}_n\|^2 - |X_{in}|^2}. \quad (1)$$

All the elements  $z_{ni}$  have F-distribution with  $(2, 2B-2)$  degrees of freedom when there is no signal component in observed data.

Thus, signal detection problem is equivalent to testing hypothesis of the observed data samples have F-distribution against alternative hypothesis of difference from F-distribution.

## III. FORMATION OF DETECTION ALGORITHM

The presented method [2] is based on the set  $\mathbf{V} = \{v_1, v_2, \dots, v_M\}$  of variate values, where  $M = BN$ ,  $v_1 = \min_{n,i}(z_{ni})$ ,  $v_M = \max_{n,i}(z_{ni})$  and  $v_1 \leq v_2 \leq v_3 \leq \dots \leq v_M$ .

The signal detection algorithm has the form

$$\varphi(S^*) = \begin{cases} 1, & S^* > S_\alpha; \\ 0, & S^* \leq S_\alpha. \end{cases} \quad (2)$$

Decision statistics  $S^*$  is calculated depending on test type.

For Kolmogorov test

$$S^* = S_K^* = \frac{6MD_M + 1}{6\sqrt{M}}, \quad D_M = \max(D_M^+, D_M^-), \quad (3)$$

$$D_M^+ = \max_{1 \leq i \leq M} \left\{ \frac{i}{M} - F_{2, 2B-2}(v_i) \right\}, \quad (4)$$

$$D_M^- = \max_{1 \leq i \leq M} \left\{ F_{2, 2B-2}(v_i) - \frac{i-1}{M} \right\}. \quad (5)$$

For Smirnov test

$$S^* = S_C^* = \frac{(6MD_M^+ + 1)^2}{9M}. \quad (6)$$

For Cramer-Mises-Smirnov test

$$S^* = S_\omega^* = \frac{1}{12M} + \sum_{i=1}^M \left\{ F_{2, 2B-2}(v_i) - \frac{2i-1}{2M} \right\}, \quad (7)$$

For Anderson-Darling test

$$S^* = S_{\Omega}^* = M - 2 \sum_{i=1}^M \left\{ \frac{2i-1}{2M} \ln[F(v_i)] + \left(1 - \frac{2i-1}{2M}\right) \ln[1 - F(v_i)] \right\}. \quad (8)$$

The threshold  $S_{\alpha}$  can be calculated as  $\alpha = \int_{S_{\alpha}}^{+\infty} g(s | H_0) ds = 1 - G(S_{\alpha} | H_0)$ , where  $g(s | H_0)$  is probability density and  $G(S | H_0)$  is the cumulative distribution function [3-5].

These tests were compared with chi-squared test [1]

$$T_i(N) = \frac{b}{\sum_{j=1}^b} \frac{(y_{ji})^2}{N \cdot \bar{p}_j} - N, \quad i = \overline{1, B}, \quad (9)$$

where  $\bar{p}_j = \frac{n_j}{N}$  is empirical probability,  $N$  is the number of segments,  $n_{j,k}$  is a number of hits.

In order to study performance of the algorithms one special parameter called irregularity coefficient was introduced [1]. This parameter characterizes the spectral nonuniformity and for the  $n$ th time interval has the form

$$r_n = \frac{B}{(B-1) \|\mathbf{X}_n\|^2} \sum_{i=1}^B \left[ |X_{in}| - \frac{1}{B} \sum_{i=1}^B |X_{in}| \right]^2. \quad (10)$$

The minimum value of irregularity coefficient is 0 (uniform spectrum) and maximum is 1 (one-point spectrum). If signal present the coefficient is greater than zero.

Dependence of probability of detection on irregularity coefficient is presented on Fig.1. A we can see chi-squared test is more effective than others.

Fig.2 shows the dependence of irregularity coefficient on signal to noise ratio.

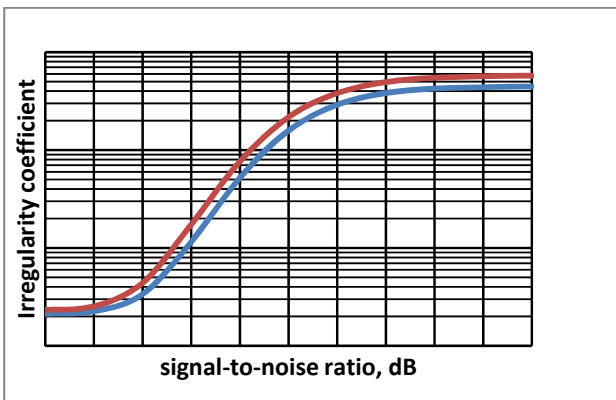


Fig.2 Dependence of irregularity coefficient on signal to noise ratio

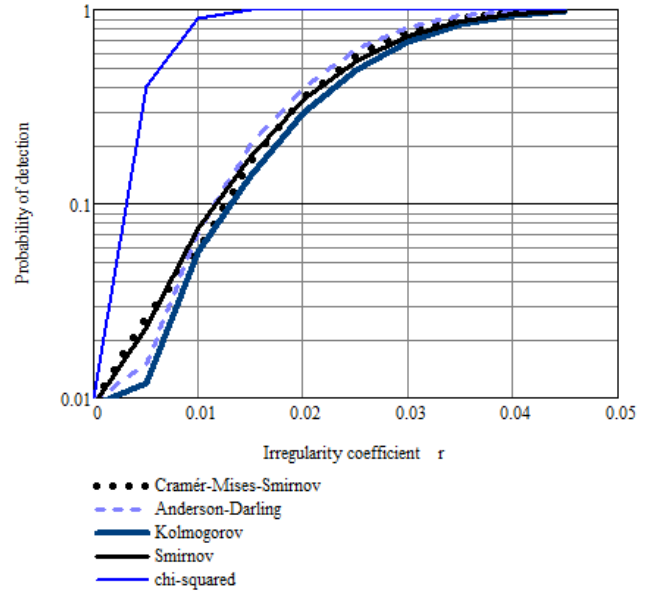


Fig. 1 Dependence of probability of detection on irregularity coefficient

#### IV. CONCLUSION

Two algorithms are proposed in this paper: the first used both invariance principle and well-known goodness of fit tests and the second one based on irregularity coefficient. Both algorithms are analyzed by statistical simulation and real signal recordings. It has been shown that irregularity coefficient is very informative criterion, so in further research this coefficient should be taken into account.

#### REFERENCES

- [1] Bogdanovich V.A., Borodich Y.J. Development of invariance signal detection algorithms in frequency aria on the basis of consent criterion\ Novosibirsk, 2010, №1, P. 74-83.
- [2] V.A. Bogdanovich, A.G. Vostretsov, M.V. Gundareva Application of goodness of fit criteria for detection of signals with unknown shape in frequency domain/ Tomsk, 2012. – № 1 (25), part. 1. – P. 19-23
- [3] B. Y. Lemesko, S.B. Lemesko Construction of Statistic Distribution Models for Nonparametric Goodness-of-Fit Tests in Testing Composite Hypotheses: The Computer Approach/ Quality Technology & Quantitative Management, 2011. Vol. 8, No. 4. – P. 359-373.
- [4] B. Y. Lemesko, S.B. Lemesko Construction of statistic distribution models for nonparametric goodness-of-fit tests in testing composite hypotheses: the computer approach / Second International Conference on Accelerated Life Testing in Reliability and Quality Control, Abstract Book, Bordeaux, France, 9-11 June 2008. – P. 91-97.
- [5] B. Y. Lemesko, S.B. Lemesko, S.N. Postovalov Improvement of statistic distribution models of the nonparametric goodness-of-fit tests in testing composite hypotheses /XIIth Applied Stochastic Models and Data Analysis (ASMDA 2007) International Conference. Book of Abstracts. May 29 – June 1, 2007. Chania, Crete, Greece. Editor Christos H.Skiadas. – P. 111.

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# DLRAC: Habituating Digital Content Reading among Students

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**Abstract**— Moolji Jaitha college is a leading college of higher education in north Maharashtra region of India offering 43 undergraduate and postgraduate programs and 35 certificate/Diploma programs in Arts, Science and Commerce faculties. The college library has over 1,38,340 books and subscribes to 252 printed periodicals. Demographically the students of the college belong to lower and middle economic and social strata with a strong inclination toward learning resources published in Marathi, their mother tongue and exhibit mediocre technical skills. With the intention of habituating the students to use digital content that keeps the learners abreast with the latest developments of their subject and also offer effective learning experiences in multiple formats such as audios and videos, the college has established a Digital Learning Resources Access Centre (DLRAC) in the college library, an electronic reading room facility providing access to e-content. The paper explains the architecture and functionality of DLRAC, as an innovative enterprise.

**Keywords**— E-content; Digital resources; NList service; E-books; Audios and videos.

## Introduction

Traditional Libraries, whether they be public libraries or academic libraries suffer due to the inherent limitations of learning resources in printed form. Starting from the book procurement from a distantly located book seller to storage, to provision of adequate copies to the users to shelving, - books in physical format pose many challenges. However, the revolution in Information and Communication Technology (ICT) post 1990 has forced the conventional libraries to rethink about the nature of acquisition and circulation of learning resources to the library users. The mission document of National Mission on Education Through Information and Communication Technology of Government of India laments that 'for most of the students and learners, the library culture has gone missing either because of inadequate library facilities or because of a paucity of time with the students or due to the procedural hassles and availability of fewer copies of books to be issued or non-issuance of reference books<sup>1</sup>. Resources in digital format offer a one stop solution for most of the, if not, all these maladies of a conventional library. A digital learning resource is both an artifact and a semiotic tool with a bigger potential than traditional textbooks<sup>2</sup>. With the information explosion witnessed virtually in every field, academic libraries reckoned as the heart of higher education institutions, have the

additional responsibility of providing the latest developments to its users in the least possible latency period. Further, digitally stored content allows the user to view and navigate through the information non-sequentially in much the way that humans think – by association rather than linear sequence apart from offering multimedia experience. As the Digital Learning Resources As Systemic Innovation Project - Outline And Definitions, published in June 2007 puts it, 'Digital learning resources can be multi-modal, which means that the communication can be made both visually and auditory<sup>3</sup>. All these points underscore the need for the conventional academic libraries to transform themselves into hybrid libraries with a right blend of printed books and digital resources.

The college library of Moolji Jaitha college was a traditional library till 2007 when the first attempt to automate the library began with the setting up of a library automation software known by the name Software for University Library (SOUL), developed by the Information and Library Network Centre (INFLIBNET), an Autonomous Inter-University Centre (IUC) of University Grants Commission (UGC) of India. SOUL is an Integrated Library Management software that is widely used in academic institutions and research centers across India. Though this initiative has led to database creation of books purchased by the library, acquisition, cataloguing, circulation, serial control and administration sections of the library still functioned manually. A three day training program on the use of SOUL software in the campus organized in collaboration with INFLIBNET in May 2011 provided the required impetus and the automation of library services began in the academic year 2011-12. Though the services were automated, the library still was not providing e content to the students and relied heavily on the printed books. The college library's effort to transform itself into a hybrid library began in the second half of 2011 with the subscription to NList service of INFLIBNET through which the college could acquire access to over 70,000 e-books and over 3,200 e-journals of international eminence. Posters were designed to draw the attention of students and faculty members to the new availability of e-content and were pasted across the college campus. An eight page pamphlet titled 'Know Your College Library' was also published and distributed freely to the student community. The college library also began to acquire e-books, audios and videos during this period. The Government of India

also launched many e-content portals such as [www.sakshat.ac.in](http://www.sakshat.ac.in) and [www.nptel.iitm.ac.in](http://www.nptel.iitm.ac.in) which offer many resources that ensure effective learning experiences. The college library also had a good collection of encyclopedias, dictionaries, demonstrations of experiments etc., in Compact Disc format, but since they were not issued to the students for the fear of breakage or corruption, they were not much utilized by the students. There was no facilitating centre in the library for the students to access these e-resources. This led to the designing and developing of a Digital Learning Resources Access Center in the college library the architecture and functionality of which are described below.

## I. CAMPUS AREA NETWORK AND INTERNET CONNECTIVITY IN THE COLLEGE

### A. Overview of Campus Network

The college campus is spread in 21.46 acres of land with various academic and administrative buildings spread across the campus. The college has a well laid Campus Area Network (CAN) using CAT-6 Ethernet Cable and more than 80% of the campus is Wi-Fi connected. The college is provided with a dedicated 20MBPS broadband connectivity through Virtual Private Network (VPN) of Bharat Sanchar Nigam Limited (BSNL), the national Internet Service Provider under National Mission on Education through Information and Communication Technology scheme. The college has a dedicated server with a firewall which receives the broadband connectivity and distributes it across the campus.

### B. DLRAC Architecture and Topology

The DLRAC is set up in client server environment with 18 computer nodes serving as clients and a dedicated Internet Information Service (IIS) server. The computer nodes are connected to each other using mesh topology with a fast Ethernet Switch. The Switch receives the internet connection from the college's main server which distributes the internet connectivity among the nodes. A database consisting of 1700 e-books, 250 videos and about 70 audios pertaining to the topics of interests to the students has been developed. The collection has been classified subject-wise and, with the help of HTML code, web pages with links to the collection have been created. Each computer terminal is installed with dictionaries, encyclopedias and other ready reference material so that the student has direct access to these resources. The browsers in all the terminals are configured to open the DLRAC homepage with index of documents as the default page. Further, the index page also is provided with other useful links that are of great significance to the students of higher education. For example <http://www.nptel.iitm.ac.in> links to a large collection of video recordings of lectures by eminent Indian Institute of Technology professors. <http://shodhganga.inflibnet.ac.in> provides the research dissertations and theses submitted by the research scholars to various Indian universities. Question papers of previous year examinations of all the subjects offered by the college have

been scanned and uploaded on the DLRAC server. The server also hosts personality development and etiquette related videos including spoken English programs. Thus the DLRAC is designed to host all that a student can get benefit out of.

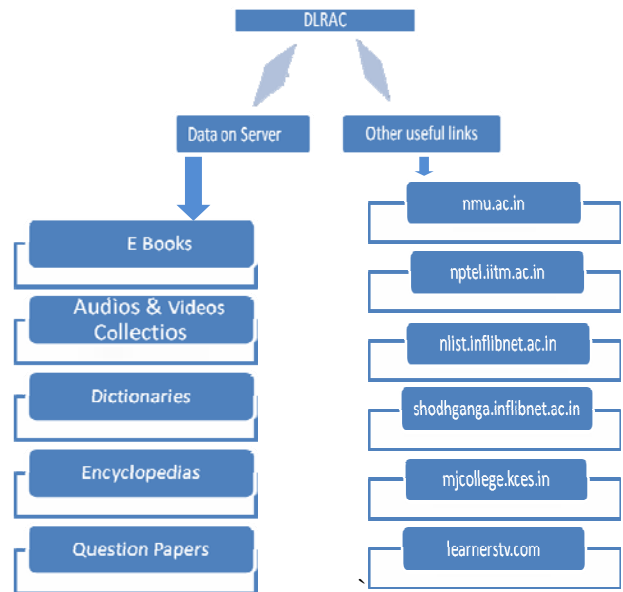


Fig. 1. DLRAC: A schematic representation

### C. Nlist Service: Opening Doors to World Class Learning Resources

The Information and Library Network Centre (INFLIBNET) has established tie up with internationally renowned publishers such as Oxford University Press, Mathscience.net, Cambridge University Press, etc., and provides access to their journals and e-books for college and university libraries at throwaway price of Rs.5000 (91USD) per annum under the service titled Nlist. The college subscribed to the service in 2011 and quickly scaled up the user chart and was among the top 10 colleges in India utilizing this service in 2012. The college generated usernames and passwords for all the faculty members of the college as well as for over 7,000 students for accessing the e-resources of Nlist. This service is also made available free of cost to the students through DLRAC. The resources available through Nlist are especially useful for the postgraduate students and research scholars as the service provides access to primary sources of information published in international journals of reputed research organizations.

## II. MEASURING THE EFFECTIVENESS OF DLRAC

Establishing a facilitation centre in the college for accessing digital content is only successful when the content is actually put to use by the students in their learning process. Use studies are conducted by the college to study whether the centre is successful in meeting the objective of facilitating easy access to digital learning resources, for the students and encouraging greater use of digital content in their learning

process. The college adopted the benchmarks proposed by the Organization of Economic Cooperation and Development (OECD) to evaluate the effectiveness of Digital Learning Resources.

*A. Analytical framework for the benchmarking of DLR*

The analytical framework for benchmarking the Digital Learning Resources was proposed by Organization for Economic Co-operation and Development (OECD) in its draft which identified a few system indicators<sup>4</sup>. It identifies environment, readiness, use and effect as the benchmarks for measuring the effectiveness of Digital Learning Resources.

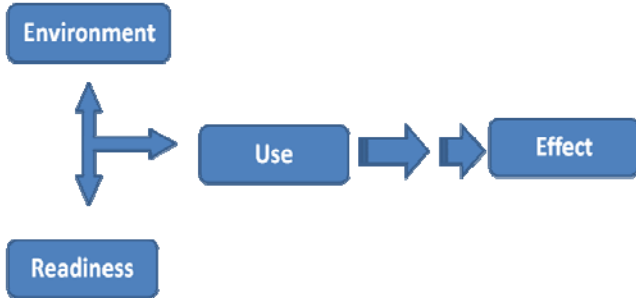


Fig. 2. Analytical Framework for Benchmarking of DLR as per OECD draft

Under Environment it identifies two criteria: how easy it is to access DLR and how many DLR are available to the users. User readiness is the propensity of users to use DLR which is linked to the level of ICT related skills and competence shown by the students. According to the draft the technological environment and the level of readiness combine to facilitate the actual use of DLR. Accordingly, use is defined as the actual application of DLR in teaching and learning activities as well as the type of DLR used and for what purpose. And finally, any kind of measurable effect of the use of DLR either in the quality or in the output of the teaching and learning process is said to be the impact of using DLR. It is also argued by the draft report that intensive use of DLR and ICT at large can result also in the learning of competences and skills not accounted for in traditional educational settings. With these benchmarks as the basis the effectiveness of DLRAC is evaluated.

*B. Infometrics and Use Statistics*

The DLRAC is kept open for the students on all working days from 7:30am to 6:00pm. A student on an average sits for about an hour browsing the resources that includes web surfing. To check whether the students spends time merely surfing the web or seriously makes use of the resources, the internet access has been highly restricted. Yet, since inception, there has been steady growth in the student visits to DLRAC. The first month registered 1002 student visits and by the mid March 2013, at the time this paper is prepared, there were already 1900 student visits to the Centre. As regards to the number of DLRs made available to the students the DLRAC server itself hosts over 1700 e-books, 250 videos and about 70 audios, apart from providing access to 3200 e-journals, 78000 ebooks through Nlist service and a wide gamut of rich audio visuals through sakshat and NPTEL portals. For enhancing the

resource handling skills a facilitator is made available in the DLRAC throughout the day. The college library is in the process of preparing a questionnaire to assess the usefulness of the DLRs, but informal dialogues with the users indicates that the students are greatly benefitting from a wide variety of learning resources showcased. It is also observed that the DLRAC facility is chiefly used by the students to complete their project reports, prepare power-point presentations and search for reference material for their research reports. The effect of the DLRAC is surmised by the steady increase in the number of visitors to the centre over a period of seven and half months which is graphically depicted hereunder:

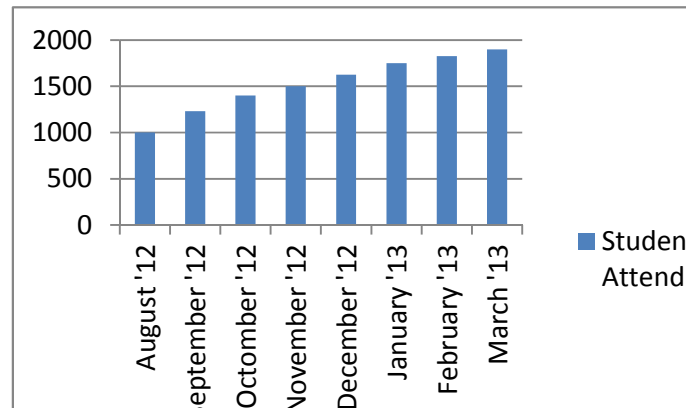


Fig. 3. Use statistics of DLRAC

A survey of the users on their purpose of visit to DLRAC and the content they access is conducted through a questionnaire. The survey revealed that undergraduate students visited the DLRAC to search for information on World Wide Web using Google followed by accessing scanned question papers of previous year examinations while postgraduate students showed interest on the video library and research dissertations and Ph.D. theses available on <http://shodganga.inflibnet.ac.in>. Postgraduate students also showed interest in the online video lectures of eminent professors available on NPTEL portal. Attempts are also being made to analyze the use statistics more elaborately to elicit the expectation of the students, problems faced by them in the access and use of digital content, which is underway.

III. CONCLUSION

Changing the reading habits of the students from conventional methods and habituating the reading of digital content is the immediate challenge in front of academic libraries, especially in case of rural located ones in the developing countries. The present ongoing research vouches for the success of the centre and attests for the need for such electronic resources access centre in the college library. While the fact that most e-books are available in English language only is the chief discouraging factor for the students hailing from rural backgrounds to prefer digital content over printed books, video lectures, simulations, power point presentation and previous year question papers etc., generally prove points of attraction to the students.

#### REFERENCES

- [1]. P 29, Mission document, National Mission On Education Through Information And Communication Technology, Government of India.
- [2]. Alexandersson, M et al (2006)
- [3]. P 4, Digital Learning Resources As Systemic Innovation Project Outline And Definitions June 2007 <http://www.oecd.org/edu/cei/38777910.pdf>.
- [4]. Draft, Benchmarking Digital Learning Resources <http://www.oecd.org/edu/39275179.pdf>

# Noise reduction in digital holographic interferometry by means of the Kalman filter

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**Abstract**—A method of noise reduction in process of digital holographic reconstruction of phase difference in digital holographic interferometry is proposed. The method is based on the Kalman Filter with a priori information about wrapped phase function.

## I. INTRODUCTION

Any manufacturing encounters with necessity of products quality control. In high-precision manufacturing quality of a product determines fitness of the product as well as life and usage safety of this product. Methods of non-destructive testing help to control quality of products without damaging them. There are a lot of methods of non-destructive testing: ultrasonic testing, holographic interferometry, electronic speckle pattern interferometry, eddy current measurements, shearography and others.

Holographic interferometry is a method to measure optical path length variations, which are caused by deformations of opaque bodies or refractive index variations in transparent media, e.g. fluids or gases [1]. HI is a non-contact, non-destructive method with very high sensitivity. Optical path changes up to one hundredth of a wavelength are resolvable. A conventional holographic interferogram is generated by superposition of two waves, which are scattered from an object in different states. The interferogram carries the information about the phase change between the waves in form of dark and bright fringes. Digital holography allows a completely different way of processing. In each state of the object one digital hologram is recorded. Instead of superimposing these holograms as in conventional holographic interferometry using photographic plates, the digital holograms are reconstructed separately [2].

Digital holographic interferometry (DHI) provides a robust way of non-destructive testing. However, it has some cons. The phase difference which is formed in process of DHI is wrapped in range  $[0; 2\pi)$  or  $[-\pi; \pi)$ . To unwrap this phase difference an algorithm of phase unwrapping should be applied. Most of these algorithms are sensitive to noise. Big noise causes to false detection of phase jumps and phase difference cannot be unwrapped correctly. So looking for a method which allows to unwrap phase difference in conditions of intensive noise is an important task.

## II. PROPOSED SOLUTION

To reduce the noise appearing in process of holographic reconstruction we need to use a smoothing filter. However, saw-tooth like phase difference function constricts range of allowable variants. Note that in process of filtration areas where phase wraps modulo  $2\pi$

must not be smoothed, otherwise an unwrapping algorithm can skip a phase jump. Consequently, the filter has to contain a priori information about saw-tooth like phase difference. The Kalman filter is a set of mathematical equations that provides an efficient computational (recursive) means to estimate the state of a process, in a way that minimizes the mean of the squared error. The filter is very powerful in several aspects: it supports estimations of past, present, and even future states, and it can do so even when the precise nature of the modeled system is unknown [3]. The Kalman filter also allows to set a priori information about the modeled system.

The Kalman algorithm consists of two steps: the prediction and the updating. In the first step, the Kalman filter makes a prediction of the current system state considering uncertainties of the state variables and the previous system state. In the second step, the measured value corrects the values of predicted variables considering their uncertainties and random noise.

Let us consider the mathematical view of the Kalman filter. In the prediction step we calculate two values: the predicted state estimate  $x_k'$  and the predicted estimate covariance  $P_k'$  (the covariance is a measure of how much two random variables change together). Index  $k$  denotes the current state,  $k-1$  – the previous one. Thus, the predicted state estimate can be calculated as

$$x_k' = F_k x_{k-1} + B_k u_{k-1}, \quad (1)$$

where  $F_k$  – the state transition model which defines the dynamic model of the system;  $x_{k-1}$  – the system state in the previous step;  $B_k$  – the control-input model which is applied to the control vector  $u_{k-1}$ .

The predicted estimate covariance can be calculated as

$$P_k' = F_k P_{k-1} F_k^T + Q_{k-1}, \quad (2)$$

where  $P_{k-1}$  – the estimate covariance state in the previous step;  $Q_{k-1}$  – the covariance of the process noise;  $\text{sign}^T$  – the matrix transposing operator.

In the updating step we calculate three values: the Kalman gain  $K_k$ , the updated state estimate  $x_k$  and the updated estimate covariance  $P_k$ . The Kalman gain is determined by the following equation

$$K_k = \frac{P_k' H_k^T}{H_k P_k' H_k^T + R_k}, \quad (3)$$

where  $H_k$  – the observation model which maps the true state space into the observed space;  $R_k$  – the covariance of the observation noise.

The updated state estimate can be calculated as

$$x_k = x'_k + K_k(y_k - H_k x'_k), \quad (4)$$

where  $y_k$  – the observed (measured) value.

The updated estimate covariance is determined by the following equation

$$P_k = (I - K_k H_k) P'_k, \quad (5)$$

where  $I$  – the identity matrix.

Let us consider the one-dimensional Kalman filter in the context of our process. The states of the system  $x_k$  represent the filtered values of the phase difference. The matrix  $H_k$  is identity. This means that all observed values (points of phase difference function) affect to the system state the same way. The control-input model and the control vector can be neglected in our case, because we have not got additional information about input of the system. The state transition model  $F_k$  defines the dynamics of the phase difference function. This model can consist information about saw-tooth like phase difference. Thus,  $F_k$  can be represented as

$$F_k = c_1 \cdot \frac{x_{k-1} \bmod 2\pi}{2\pi} + c_2, \quad (6)$$

where  $\bmod$  – the operator of getting the remainder after division of real numbers,  $c_1$  and  $c_2$  – the matrices of tuning coefficients. The covariance of the process noise  $Q_k$  and the covariance of the observation noise  $R_k$  can be chosen experimentally and can be the same in each point of the phase difference function.

Thus, to filter one-dimensional phase difference function wrapped modulo  $2\pi$  we can define the following Kalman filter

$$\begin{cases} x'_k = \left( c_1 \cdot \frac{x_{k-1} \bmod 2\pi}{2\pi} + c_2 \right) x_{k-1} \\ P'_k = \left( c_1 \cdot \frac{x_{k-1} \bmod 2\pi}{2\pi} + c_2 \right)^2 P_{k-1} + Q \\ x_k = x'_k + \frac{P'_k}{P'_k + R} (y_k - x'_k) \\ P_k = \frac{P'_k R}{P'_k + R} \end{cases} \quad (7)$$

Also there is possibility to filter the two-dimensional phase difference array. To implement the two-dimensional Kalman filter we can apply the one-dimensional filter to each row, then to each column.

### III. EXPERIMENTS

In our experiments we use a classic scheme of the holographic setup. This setup is based on an interferometer in which the laser beam is divided to two

beams which bring together afterward. Thanks to the fact that divided beams pass close optical paths, in place of the beams superposition the stable interference pattern forms. In the way of a beam we put a specimen. In the result the light reflected from the object interferes with the second beam. The light reflected from the object is called the object wave, the unchanged beam – the reference wave. We can adapt this scheme for the digital holography and obtain the scheme in the figure 1.

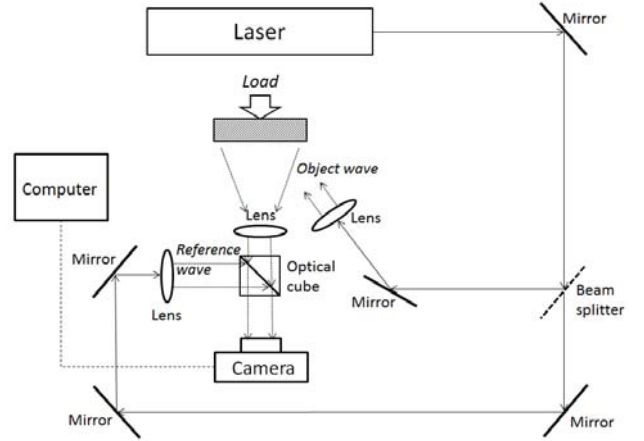


Fig.1. Scheme of DHI setup.

In the case of DHI we capture two holograms: in initial state of the object and after loading which causes to deformation.

We use the camera Canon Eos 650D with maximum resolution 5184 x 3456 and physical size of matrix 22.3 x 14.9mm. As a source of coherent light we use red He-Ne laser with wavelength 628nm. As a specimen we use special deformable plate equipped with the micrometer deformation tuner. The inclination of the reference wave is  $3^\circ$ , the distance of holograms capturing is 0.4m. To provide enough precision we form digital hologram in resolution 2048 x 2048.

Let us capture and reconstruct two digital holograms: in initial state of the plate and after deformation  $5\mu\text{m}$ . Then we obtain phase difference by means of DHI. The result is in the figure 2.

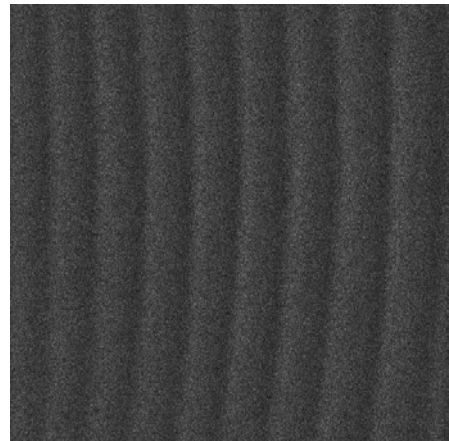


Fig.2. Phase difference obtained by DHI.

Then we execute the contrast adjustment [4] and apply the Kalman filter with a priori information about phase difference function (7). You can see the result in the figure 3.

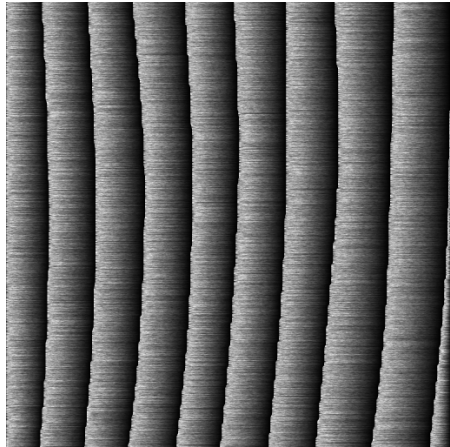


Fig.3. Phase difference after filtering by proposed Kalman filter and contrast adjustment.

The obtained image is suitable to the unwrapping process and the deformation reconstruction. The experimental results of the reconstruction are shown in the figure 4.

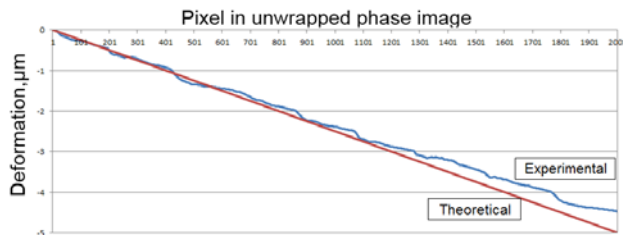


Fig.4. Deformation reconstruction.

Also in the figure 4 you can see the theoretical deformation. The obtained deformation is close to a straight line approximately at the range from 0 to 1000 points (about 250mm), and then the deformation curve begins to deviate from linear trajectory. The deviation of the deformation curve means that we reconstruct a part of the deformed surface which is out of the linear deformation zone. It happens because real deformation of the plate cannot be pure linear because of some technical reasons. Let us draw the graph of the absolute deviation of the deformation curve from the theoretical line. This graph can be seen in the figure 5.

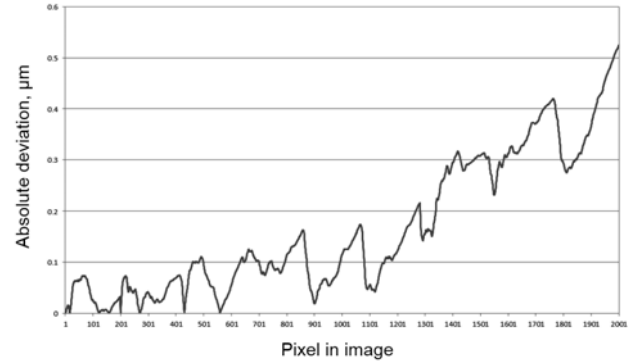


Fig.5. Absolute deviation of experimental deformation curve from theoretical one.

Thus, in the linear zone (from 0 to 1000 points) the maximum absolute error becomes about  $0.157\mu\text{m}$  (a quarter of wavelength).

#### IV. CONCLUSIONS

The proposed solution based on the Kalman filter allows to reduce the noise which is appearing in process of the digital holographic reconstruction. A priori information about saw-tooth like phase difference function helps to avoid smoothing phase jumps. We managed to achieve a quarter wavelength absolute errors. This fact allows us to use DHI in the submicrometer non-destructive testing.

#### REFERENCES

- [1] Y. I. Ostrovsky, M. M. Butosov, G. V. Ostrovskaja, *Interferometry by Holography*. Springer, New York, 1980.
- [2] U. Schnars, W. Jueptner, *Digital Holography: Digital Hologram Recording, Numerical Reconstruction, and Related Techniques*. Springer-Verlag, Berlin: Heidelberg, 2005.
- [3] G. Welch, G. Bishop, "An Introduction to the Kalman Filter", Chapel Hill, NC: University of North Carolina, 2006.
- [4] A. Rosenfield, A. C. Kak, *Digital Picture Processing*. Academic Press, New York, 1982.

# A Frequency Meter

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**Abstract** – there has been researched into work of a device which takes frequency measurements with a defined maximum discontinuity error level of discrete by three ways.

The classic method of frequency measurement by an integer number of measurable periods lies in the fact that we count the number of the periods of an exemplary frequency during a defined integer number of periods of a measurable frequency [1].

On the Fig. 1, there are timelines that describe the classic frequency measurement method by a period. On the axis 1, there are to be shown impulses which are formed with a fixed-rate signal. On the axis 2, there are impulses with an exemplary frequency. The following designations are accepted on the fig. 1:  $T_0$  - period of an exemplary frequency,  $T_x$  - period of a measurable frequency,  $N_{xk}^T$  - number of counted periods of the measurable frequency per time of frequency measurement,  $N_{0k}^T$  - number of counted periods of the exemplary frequency per time of frequency measurement,  $t_{1k}^T$  and  $t_{2k}^T$  absolute discrete's error, occurring because the beginning and the end of a measuring period of time do not clash with the beginning and the end of the exemplary period.

The peak absolute value of the discrete's error doesn't exceed the duration of the period of the exemplary frequency.

The conversion equation of the classic method with integer number of measurable periods is the following,

$$F_{xk}^T = \frac{N_{xk}^T \cdot F_0}{N_{0k}^T \cdot (1 \pm \frac{1}{N_{0k}^T})} \approx \frac{N_{xk}^T \cdot F_0}{N_{0k}^T} \cdot (1 \mp \frac{1}{N_{0k}^T}) \quad (1)$$

From (1), the modulus of the relative peak discrete's error is as follows below,

$$\gamma_k^T = 1 / N_{0k}^T \quad (2)$$

The classic method includes counting a number of periods of a measurable frequency during a having been beforehand defined integer of periods of an exemplary frequency [1].  $N_{xk}^F$  - number of counted periods of a measurable frequency per measurement time,  $N_{0k}^F$  - number of counted periods of an exemplary frequency per measurement time,  $t_{1k}^F$  и  $t_{2k}^F$  absolute discrete's errors, occurring because the beginning and the end of a measuring period of time do not clash with the beginning and the end of the exemplary period.

The peak absolute value of the discrete's error doesn't exceed the duration of the period of the exemplary frequency.

The conversion equation of the classic method of frequency measurement by a frequency is the following,

$$F_x^F = \frac{N_{xk}^F \cdot F_0}{N_{0k}^F} \cdot (1 \pm \frac{1}{N_{0k}^F}) \quad (3)$$

From (3), the modulus of the relative peak discrete's error by the classic method of frequency measurement by a frequency is as follows below,

$$\max \gamma_k^F = 1 / N_{0k}^F \quad (4)$$

If a measurable frequency is higher than an exemplary one, frequency measurements by a period, based on the classic method, will be executed quicker.

The essence of the coincidence circuit is to form impulses of the measurable and exemplary frequencies with a given duty cycle; then, we count all the periods of the measurable and exemplary frequencies per time slice of the moments of their concurrency. A measuring result is accounted for a moment of coincidence, only.

On the Fig. 1, we can see absolute discrete's errors of  $t_{1c}$  and  $t_{2c}$  which occur as a result of a measurement of a frequency using the coincidence circuit, because the beginning and the end of the time slice (that is formed from an integer number of periods of  $T_x$ ) concur with the initial and finite impulses of the period of  $t_c$ . At that, the impulses of the measurable frequency are formed with a minimum available duration, but the overall impulse duration and the measurable frequency are equal to  $\tau_0$ .

The peak absolute value of the discrete's error doesn't exceed the duration of exemplary impulses.

The conversion equation of the coincidence circuit while taking frequency's measurements is the following,

$$F_{xc} = \frac{N_{xc} \cdot F_0}{N_{0c} \cdot (1 \pm \frac{\eta}{N_{0c}})} \approx \frac{N_{xc} \cdot F_0}{N_{0c}} \cdot (1 \mp \frac{\eta}{N_{0c}}) \quad (5)$$

From (5), the modulus of the relative peak discrete's error by the coincidence circuit while taking frequency's measurements is as follows below,

$$\gamma_c = \eta / N_{0c} \quad (6)$$

Statistical modeling and probabilistic estimate of the frequency measurement process achieved that there was a frequency range where the coincidence circuit was worse (if taking an operating speed) than the classic method of frequency measurement. For elimination of that range, a functional flow block diagram (FFBD) was worked up for a device which (the device) would do measuring a frequency using the coincidence circuit and the classic method at once. The FFBD is shown on the Fig. 2 [2].

The device contains: a frequency reference (FR), a shaper (S), a logical scheme AND (AND), a



microcontroller (MC) that has the first and the second counters, an I/O device. The device works in three different modes:

- 1) in Classic Method of Frequency Measurement mode by an integer number of a measurable frequency;
- 2) in mode of frequency measurement by an integer number of an exemplary frequency;
- 3) in Coincidence Circuit of Frequency Measurement mode.

A measuring result is accepted by a method which has taken a minimum time of measurement with the given peak discrete's error (hereinafter: "PDE").

When the device is turned on, the level is set to the PDE and to the exemplary pulse ratio.

In mode 2, frequency measurement goes as follows: using (4), we find a necessary amount of impulses for providing with a needed level of the PDE. Then, after the first impulse has come (which has been formed by the beginning of the period) we start to make a calculation of exemplary and measurable periods on the first and second counters. As soon as the needed amount of impulses for the PDE has been reached, the second counter stops the measurement; there's to be computed a value of the frequency using (3), and the result is printed.

The coincidence circuit measurement process is conducted as follows: after the first hit in between impulses of exemplary and measurable frequencies, collected data are saved to special registers from the first and second counters. In the next coincidence, an error is accounted using (6). If the value fits the given level then a value of the frequency will be found by (5); the result is printed. Otherwise, automatic data processing will go on.

With all this going on, if any of methods gives a result then a new cycle will begin.

Let's take an example on the Fig. 1:  $F_0 = 1.4705$  MHz. Let us set the level of the defined relative peak discrete's error into 3%, and the pulse ratio will be 0.3. To get the PDE by the classic method, we need 34 periods. In this case, the calculated frequency is less than the exemplary one. Therefore, here are two methods: the classic method of frequency measurement by an integer number of measurable periods and the coincidence circuit; either of them is used.

The measurement process by the coincidence circuit takes place in the following way: after the first hit in between impulses of exemplary and measurable frequencies, collected data are saved to special registers from the first and second counters. Over here,  $N_0 = 2$  and  $N_x = 2$ . As it's the second hit, we find a discrete's error using (6) as follows,

$${}_2\gamma_c = 0.3/6 = 5\%$$

The measurement process continues, because the value of  ${}_2\gamma_c$  does not meet the PDE. When it's the third hit, we find a discrete's error using (6) as follows,

$${}_3\gamma_c = 0.3/11 \approx 2.7\%$$

Then, we determine a value of the measurable frequency by doing (5),

$$F_{xc} = \frac{9 \cdot 1.4705}{11} \cdot (1 \mp 0.027) = 1.2031 \mp 0.0325 \text{ MHz}$$

Thereby, we've got 11 cycles for the exemplary frequency using the coincidence circuit. If we used the classic method, we'd need 34 ones.

#### References

- [1] K.B. Klaassen. Electronic measurement and instrumentation. Cambridge University Press. 1996
- [2] Patent 110499 Russian Federation. Laptev D.V., Pasinkov Y.A. bulletin №32, 20.11.2011

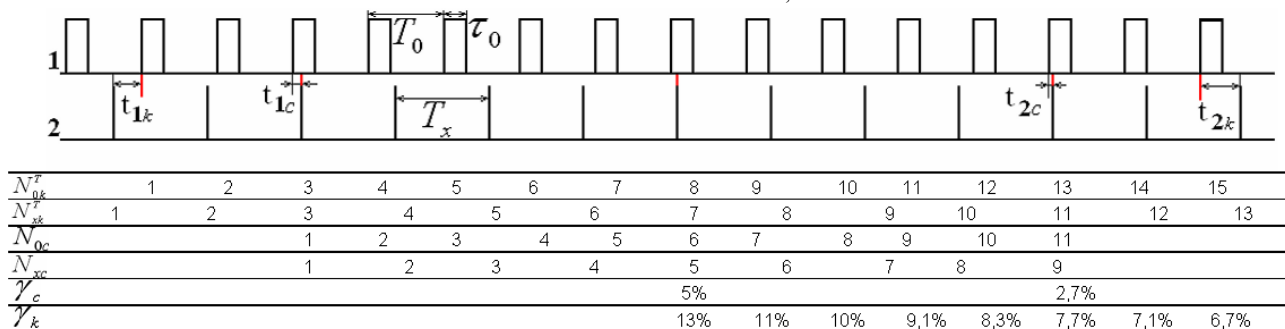


Fig.1

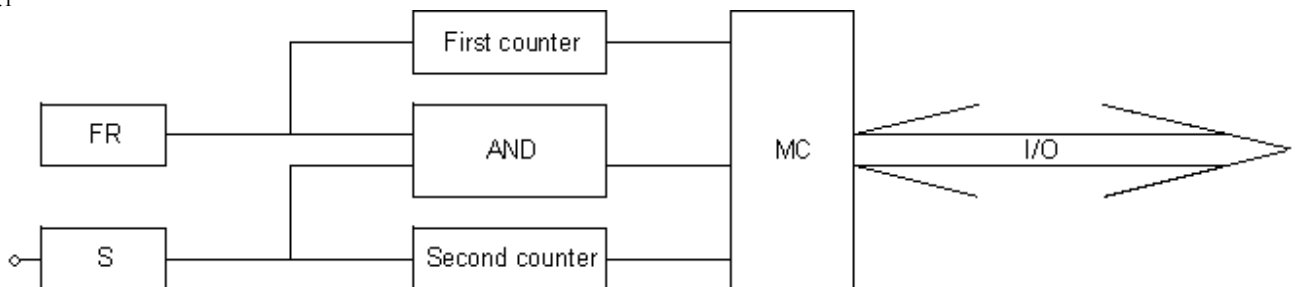


Fig.2

# CAN-Based Distributed Automated Lithium Electrochemical Cell Cycling System

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**Abstract** — The CAN-based distributed electrochemical cell cycling system is presented. System allows to perform galvanostatic cycling and galvanostatic intermittent titration technique (GITT) up to 100 electrochemical cells simultaneously with the processing and displaying the results in real time. Users can access the system over Internet using the VPN.

**Index Terms** – CAN-interface, CAN-Open, electrochemical cell cycling, GITT, Electrochemical properties, Li-Ion cathode materials.

## I. INTRODUCTION

Currently, electrochemical energy sources are one of the state-of-the-art power sources. The best characteristics of commercially available have lithium-ion batteries (LIBs), including high power batteries based on LiFePO<sub>4</sub>.

Materials for the LIBs are constantly being improved. So Institute of Solid State Chemistry and Mechanochemistry of Russian Academy of Sciences synthesizes the new nanoscale cathode materials for LIB by mechanochemistry methods. At the same time Russian government scheduled to run in Novosibirsk a full cycle of LIBs production. This is synthesis of cathode materials based on Novosibirsk Chemical Concentrates Plant and LIB finish assembly on “Liotech” factory. All stages of production from the materials synthesis to final product require a system of measurement (test) of the basic electrochemical parameters.

There are different systems for electrochemical measurements well represented in the market. But, as a rule, every system is focused on highly specialized function (laboratory cycling, testing the final product, etc.). Thus, in this case, we are needed to the purchase several systems, each of which has its own software and to combine it in the single system for a wide range of measurements requires additional development.

This paper describes a cycling system which measures the basic electrochemical parameters of as the electrochemical power sources and as their constituent materials. This parameters are [1]: the specific capacity (mAh / g), power density (Wh / g.), operating voltage (V), endurance (i.e. cycleability — number of cycles with a decrease of the specific capacity for a certain %); nominal / maximum operating current and the dependence of the specific capacitance value of the operating current; cycleability dependence on the

magnitude of the operating current; cycleability dependence on operating voltage range.

## II. DISTRIBUTED AUTOMATED LITHIUM ELECTROCHEMICAL CELL CYCLING SYSTEM

### A. System topology

The system was initially designed as a distributed scalable control system with the ability to integrate into the system cycling modules with different parameters. Thus, the system allows one hand to conduct laboratory research of new LIB materials, on the other hand the system allows for the high power LIB testing up to 100 A\*h capacity and above when high-current cycling modules are used.

Fig. 1 is a block diagram of the cycling system [2].

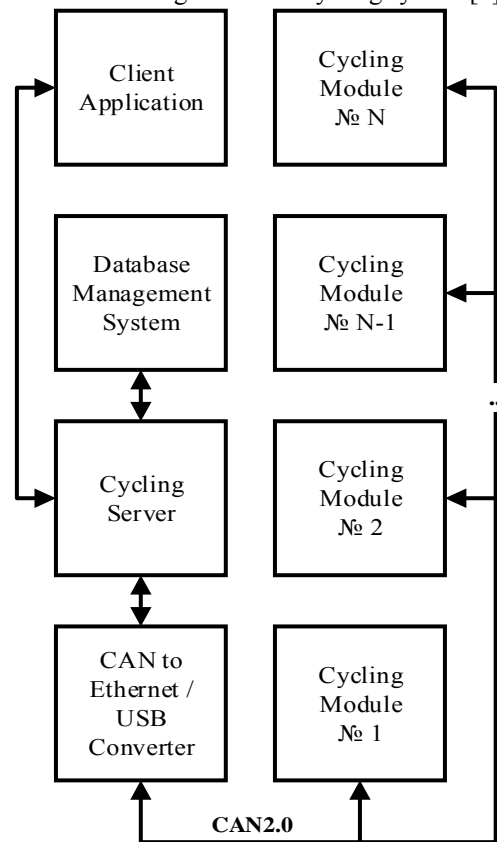


Fig. 1. System topology.

The system consists of modules that directly measure the cycling parameters of electrochemical cells. Cycling modules are integrated into a single network via CAN interface. The basis of the high-level of CAN interface is CAN-Open. Data from the module are read by the cycling server which is connected to CAN network modules via USB / Ethernet to CAN converter. The data from the cycling server are recorded in the database. The user controls the system through a client application that has access to the cycling server through a network connection.

#### A. Cycling modules

At the present moment, we designed and produced several models of cycling modules depending on the task. Fig. 2 shows a view of the module for cathode materials laboratory cycling for one cell. The basic parameters of the module: the cycling voltage range from 0 to 8 V, the cycling current range from 1 mA to 100 mA, the basic error of set/measuring voltage/current cell is not more than 0.05%.



Fig. 2. Module for laboratory cell cycling.

Fig. 3 shows a view of the laboratory cycling system with 4 modules of 4 cells each. The basic error of set/measuring voltage/current is not more than 0.01%. The other characteristics are similar to the module in Fig. 2.



Fig. 3. Cell cycling system with four-cell modules.

Fig. 4 presents a view of the module for high-power LIB cycling.

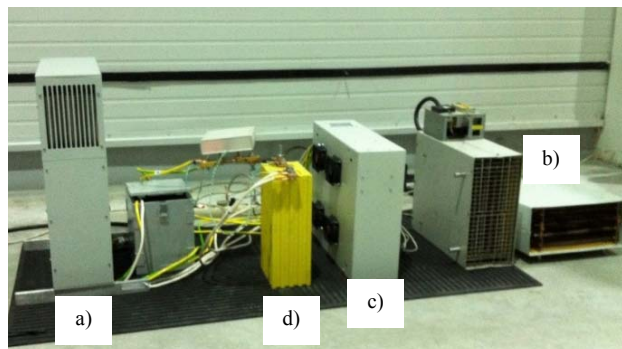


Fig. 4. High power Cell cycling module. a) Charging unit; b) Discharging unit; c) Control unit; d) Li-ion battery LiFePO4 240 A\*h

The power module consist of: Charging unit; Discharging unit and Control unit.

The basic parameters of the module are: the cycling voltage range from 0 to 70 V, the cycling current range from 500 mA to 250 A, the basic error of set/measurement of voltage/current is not more than 0.1%. Total module power is 15 kW.

#### C. High level software

Cycling software installation is a client - server application implemented using a high level language C # and platforms .NET Framework 3.5.

The roles of the cycling server are to control cycling process, to collect cycling data, and processing, primary analysis, saving data in to the database and to provide access to client applications.

The database is a relational database management system Microsoft SQL Server, which allows you to effectively manage large amounts of data, resulting from the cycling modules, and accelerate the processing.

The client application is used to specify, control and visualization of the experiments carried out earlier. The connection between client and server is based on the technology of Windows Communication Foundation (WCF), which allows you to connect many clients, including remote clients to control the flow of the process of electrochemical cells cycling. Users can access the system over Internet using the VPN.

Application allows to preset such parameters as the cycling type (i.e. galvanostatic mode, intermittent titration), the cycling name, the cathode area, the active substance mass, the active substance molar mass, the period of cell parameters measurement, the minimum and maximum number of lithium ions per formula unit , titration period, etc. For cycles groups user can specify the minimum and maximum voltage value, current charge/discharge value and after-charge value in mA or capacity percent.

In the "Current cycle" window user can to see parameters of the real-time experiment and to control it. In the "History of cycling" window user can to see

information about all previously performed experiments. There are two windows to visualize the dependencies: capacity of the voltage, the normalized capacity of the voltage, capacity of the cycle number etc. It is possible to

export specified dependencies in the form of tabular data in text files for further analysis also. Fig. 5 shows the cycling results visualization.

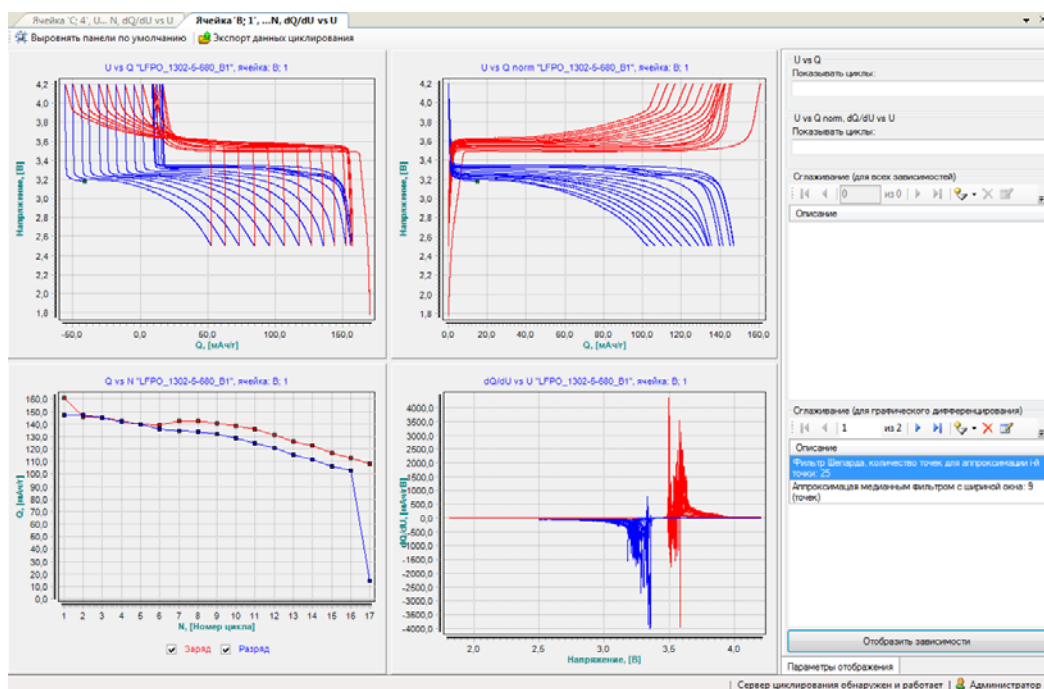


Fig. 5. The cycling results visualization.

To simplify data processing user can apply filters for approximating dependencies. Currently are implemented two filters: a modified Sheppard method for filtering noisy signals and median filter for processing of exposed to impulse noise signal. Implemented filters are using plug-in architecture. It makes it easy to add new filter implementations of third-party developers into an existing program, such as MatLab packet filters.

The application supports the data backup to external storage, which reduces the load on the hardware. There is the ability to dynamically connect and disconnect external storage.

### C. System implementation examples

For LIB materials laboratory of Institute of Solid State Chemistry and Mechanochemistry SB RAS cycling system was implemented. The total number of cells of the laboratory cycling system is 48 pcs. Cycling system successfully operated for several years.

Thanks to the CAN fieldbus communication, rugged hardware implementation is possible to operate the system in the presence of electromagnetic interference. In particular, the system was used to study the cycling of structural transformations in nanoscale materials for lithium deintercalation by in situ synchrotron radiation diffraction. The system worked steadily in the bunker SI VEPP3 BINP at station number 4 (diffraction in the hard

X-ray emission) [3] as well as at the experimental station BESSY KMC-2, Berlin, Germany [4].

Power modules are used for high power LIB cycling tests on "Liotech" plant, Novosibirsk.

Fig. 6 represents comparing of two batteries cycling curves: LIB LiFePO<sub>4</sub> and standard truck Lead-Acid battery (LAB). The capacity of LIB was 240 A\*h. The LIB was produced by "Liotech" plant. The capacity of LAB was 500 A\*h.

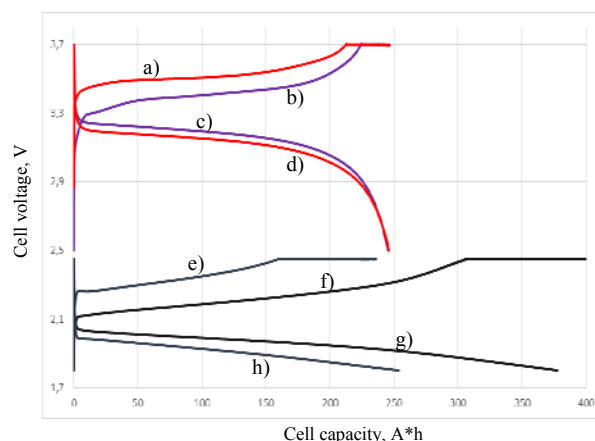


Fig. 6. High power battery testing. Cell cycling module. a) LIB 1 C Charging curve, b) LIB C/2 Charging curve, c) LIB C/2 Discharging curve, d) LIB 1 C Discharging curve, e) LAB C/2 Charging curve, f) LAB C/5 Charging curve, g) LAB C/5 Discharging curve, h) LAB C/2 Discharging curve.

We can conclude the significant superiority of LIB over LAB from the fig. 5. At a current value of  $C/2$  nominal capacity of the Lead-Acid battery is decrease by 2 times. The LIB a nominal capacity is not changed even at a current rate of 1 C.

### III. CONCLUSION

Universal CAN-Based Distributed Automated Lithium Electrochemical Cell Cycling System was developed and implemented for low-current material measurement and high-current LIB testing. Currently, high-power cycling module with a current rate up to 1000 A and above is developing.

### ACKNOWLEDGMENT

The authors are thankful to LIB materials laboratory of Institute of Solid State Chemistry and Mechanochemistry SB RAS for partial financial support of low-current cycling module development.

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### REFERENCES

- [1] Allen J. Bard, Larry R. Faulkner, "Electrochemical Methods: Fundamentals and Applications, 2nd Edition" *JOHN WILEY & SONS New York*, pp. 856, January 2001.
- [2] A.V. Markov, V. K. Makukha, N.V. Kosova, V.V. Eichler, Automated distributed system cycling lithium electrochemical cells with CAN-interface, Moscow, Radio Industry, 2012, vol. 1, pp. 207-214 (In Russian).
- [3] N.V. Kosova, D.D. Karnaushenko, E.T. Devyatkina, A.I. Ancharov, A.V. Markov, V.K. Makukha. The study of structural transformations in nanoscale  $\text{LiFe}_0.5\text{Mn}_0.5\text{PO}_4$  with lithium deintercalation by in situ diffraction SI. VIII National Conference on "The X-ray, synchrotron radiation, neutrons, and electrons for the study of nanosystems and materials. Nano-Bio-Info-Cognitive Technologies" (RSNE-NBIC 2011). Moscow, 14-18 November 2011 (CD ROM) (In Russian).
- [4] N.V. Kosova, E.T. Devyatkina, A.I. Ancharov, A.V. Markov, D.D. Karnaushenko, V.K. Makukha, Structural studies of nanosized  $\text{LiFe}_0.5\text{Mn}_0.5\text{PO}_4$  under cycling by in situ synchrotron diffraction. *Solid State Ionics*, Volume 225, October 2012, pp. 564-569.

# Adaptive agent supported mobile learning

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**Abstract**— the usage of multimodal virtual agents supports the learning motivation and the learning process. To establish their use in the growing field of mobile learning an adaption to the specific characteristics of mobile devices and mobile learning situations and the events that occur during mobile learning is important. This contribution discusses options for the modeling, implementation and evaluation of an adaptive agent, the relevant mobile context and the preparation of content for an adaptive logic.

**Keywords**— mobile, learning, adaptive, agent, decision making, content, parameters

## I. INTRODUCTION

### *MOBILE LEARNING*

During the last years smartphones, tablets and other mobile devices have reached a significant market share. These devices share common features like small screens and specific mobile interaction mechanisms like touchscreens and accelerometers. Due to the improvement of computing power and screen resolution and the emerge of application stores they are more and more used as e-learning instruments [7].

To support this usage an adaption of the desktop learning systems to suit the features of the mobile devices and the mobile learning situations is needed to support the learning success.

Characteristics of mobile devices are the efficiency, which allows ubiquitous learning without time and location constraints and the personal sphere which leads to a personalization of the learning content and promotes a more informal self directed learning. A permanent internet connection and the availability of context information to individual situations from the internet are also vital parts of a mobile learning process.

### *ADAPTIVE AGENTS*

Agents are autonomous computer programs which fulfill tasks on behalf of users or systems while using a minimum amount of intelligence [3]. As pedagogic agents they are used in learning systems to guide and support users in the learning process.

Characteristics of adaptive agents are their supportiveness, ability to communicate and cooperate, reactivity and proactivity, autonomy, intelligence and the capability to have own intentions.

Adaptive agents and visual representations of virtual agents have been found to have a positive influence on the learning process and the learning motivation [1]. An agent can give support on solving tasks and problems, remind on learning content and react according to contextual information.

To make this positive impact usable in a mobile environment an adaption of the agent to the special characteristics of mobile devices and context is needed.

To achieve this ambition, actions for an agent which support the mobile learning process are defined and triggered in appropriate situations.

The four main aspects of agent actions are the collection and structuring of information, the communication with the human or another agent or system, the use of transaction and resources and the interaction to induce the change of the state of a system [4].

## II. MODELLING ADAPTIVE AGENT BEHAVIOR

### *ATTENTION AND INTERCEPTIONS*

Important problems during mobile use are how to focus the attention of the user during varying environmental influences and how to deal with interceptions in the learning process to maintain the learning motivation within different time and usage conditions.

An adaptive agent is able to identify the learning situation, to focus the attention to the crucial parts of the learning content and to motivate the user. With the usage of an adaptive logic mobile learning processes can be initiated and supported.

### *TOWARDS AN ADAPTIVE AGENT FRAMEWORK*

To solve the problem of having different time conditions for learning the agent offers and selects tasks depending on time consumption. The different environmental conditions can be addressed by choosing an adequate complexity of the learning task and adapting the device parameters like contrast and volume to the situation. To approach the problem of a fragmentary self directed learning process without any teacher control the agent can use actions to motivate the learner, control the duration and frequency of the learning and use context and meta information about the content to provide a structured learning experience.

**EXAMPLE OF AGENT LOGIC DURING A MOBILE SITUATION**

A learner is in a mobile learning situation that is influenced by external parameters like varying brightness, noise and device movement which is recognized using sensors and an agent logic.

The learning history of the user shows progress in the basics of the learning topic. Because of frequent learning the agent is satisfied and chooses a praise as action towards the user and summarizes the recent learning achievements. The learning history suggests the strategy to deepen the understanding of the basics with transfer tasks. After evaluating environmental parameters a task of low complexity with a low amount of time required is suggested, that focusses the attention with action and game based content which allows knowledge transfer even in a mobile situation. Additionally the adaptive agent logic adjusts the volume level and the brightness of the device.

**AGENT ACTIONS DURING THE LEARNING PROCESS**

In addition to the adaptive behavior of an agent during the selection of proper tasks for proper timeslots and environmental conditions there is the possibility to perform agent actions during the learning process. The following actions are considered for the first prototype of the adaptive agent.

These actions for the agent will be selectable through a frontend for each learning situation and for each individual learning task.

TABLE I.  
AGENT ACTIONS DURING THE LEARNING PROCESS

Praise, dispraise (audio and visualized; concerning the task and learning advancement)
Agent reading the task
Explanation of the task (reading of meta information)
Hints for a deeper understanding
Context sensitive operation manual
Hints for solving a task
Asking for continuation of a previously started learning process
Self controlled requests after inactivity
Request to concentrate and focus
Showing the learning history and achievements

**SENSORS AND PARAMETERS**

The technical parameters which the agent accesses during a mobile situation are:

*Volume:* high, low, varying

*Accelerometer:* much movement, shaking, still, direction to the learner

*GPS, Movement:* fast, slow, no movement, varying, no signal, location

*Brightness:* bright, dark, constant or changing lighting condition

*Time:* day, nigh, schedule for learning

*Learning history:* time since last learning, frequency of learning, last learning time, assessment results

All of this information can be obtained by polling sensor data of mobile devices with exception of the learning history which consists of user centered data collected in previous learning sessions.

These parameters are used in the process of selecting the appropriate learning content and agent actions as shown in Fig. 1.

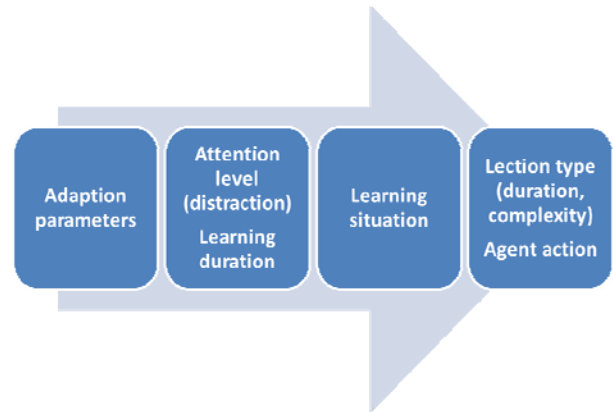


Fig. 1: Adaption process

An overview on the technical realization of an agent framework which supports mobile learning by adapting to environmental conditions including the data storage process and the manual input process of certain situations is shown in Fig. 2.

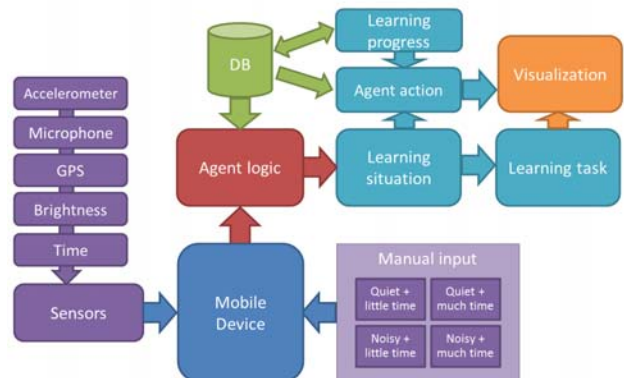


Fig. 2: Technical realization

### III. ACTION AND INTERACTION MODEL

Beside the internal state of an agent which is often determined by past actions and an emotion model (like WASABI [2] or FATIMA [6]) there are several other parameters in a mobile learning context to be processed by an agent logic. On one side there are external events which are relevant to the learning process and the application running on the mobile device. Such events can be incoming notifications or a signal to have reached a destination by GPS notification or the excess of certain volume levels which are considered negative for the learning activity and which request an agent reaction. On the other side there are user specific events which can occur during the personalization of the agent [5], and agent actions that derive from the leaning content like explanations by the agent. These events can have a user response which induces another agent reaction.

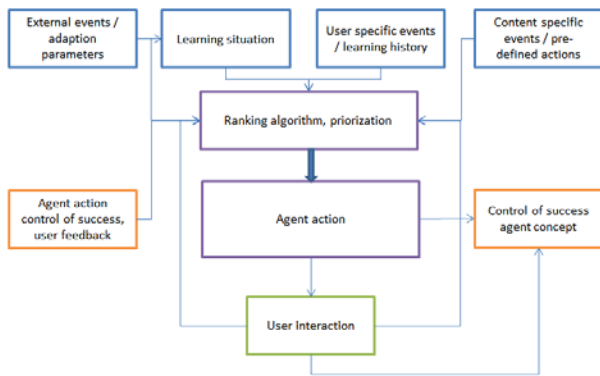


Fig. 3. Agent interaction model

By analyzing existing mobile learning platforms and applications, the evaluation of surveys and the rating of apps, initial ranking weights are determined considering social science aspects, similar to a cost–utility analysis [8]. Then several action alternatives for a decision making process in different learning situations for different task types are implemented.

### IV. MODELLING LEARNING CONTENT

During the research process common used mobile learning applications and learning platforms were explored, often used lection types and mobile specific content characteristics identified and starting points for a mobile agent support worked out.

Relevant events and stimuli for a decision making in mobile context were defined. Commonly used lection metaphors are currently implemented in prototypes for simulation and evaluation purposes.

### A SPECIFIC COMPUTER SCIENCE PROBLEM

As area for a prototype the basics of computer science were chosen. There is a high level of experience and competency among the involved researchers in this field and several real existing problems at the computer science department of Chemnitz University of Technology (TUC) can be addressed.

In this learning area the usage of different graph algorithms is explored with the purpose to understand the importance of graphs in computer science, to be able to program own implementations of graph algorithms and to gain knowledge about their usage in applications.

These learning tasks are complex and require a high level of understanding which is not obvious at the first contact with the matter. Nonetheless they are important basics for applications like navigation systems and networks where an optimal path needs to be discovered.

Because of this hidden difficulty the failure rate of students in exams is quite high. Especially in bigger graphs with many nodes the logic of the algorithms is not easily comprehensible.

To achieve a deeper understanding of these matters a mobile learning approach and the support of an adaptive agent logic to maintain the attention and motivation and to manage the learning process are considered useful.

### THE GOOP APPLICATION

GOOP, as shown in Fig. 4 is a software to provide practical experiences with object-oriented programming developed at the department of technical computer science at TUC. It gives an overview on how to implement graph algorithms using a graph visualization framework. Based on this framework, programmers can simply focus on the algorithm itself and do not have to consider further tasks such as displaying graphs on the screen. By working with the framework, several concepts of object-oriented programming and selected software design patterns are illustrated.

The agent logic is currently being implemented in GOOP. The lection types to be implemented in GOOP are shown in Table 2 together with their complexity and time consumption during a mobile learning process.

TABLE II.  
GOOP TASKS WITH COMPLEXITY AND TIME CONSUMPTION

Task	Complexity level	Time consumption level
Basics of graph theory, fundamental terms, problem types	2	3
Practical use of graph theory	1	1
Technical representation of graphs	2	2
Solving graph problems with different algorithms	3	3
Complexity of common algorithms	1	3
Game based learning, retrace graphs with touch events, timed and precise manual selection of the next processed	1	1



node		
Pseudo code completion tasks	2	2
Building own graphs and experiment with it	1-3	2
Multiple choice assessment of terms and theory	1	2
Transferring the knowledge to other problems	2	3

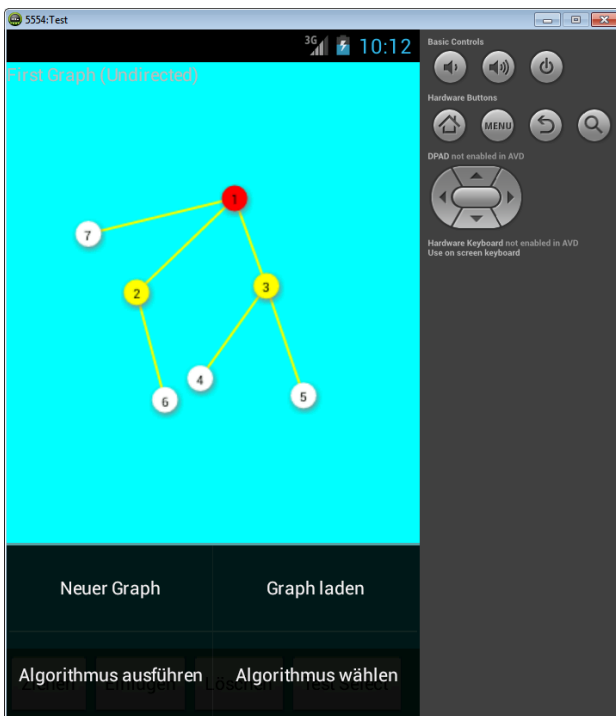


Fig. 4: GOOP application

## V. EVALUATION

An evaluation will take place after the prototype has been finished. Several criteria to match for a successful evaluation have been identified.

First it is crucial that the learning situations are recognized and the matching agent actions are conducted. Second the usability criteria for mobile applications must be matched. By comparing sample groups of users, a higher learning duration, endurance and motivation of the group using the adaptive agent is desired.

The user experience during the mobile learning process will be measured and an assessment will take place after the learning process has finished to determine the influence of the agent on knowledge representation. Furthermore the attention and focus of the participants using the adaptive agent will be monitored.

With the help of an interaction simulation and several tests in the laboratory the adequateness of the agent actions is reviewed. In multiple iterations of this process the weights of the decision criteria of the agent logic are adjusted to better match the expectations of the users. To consider

social scientific standards during the design and evaluation of the agent, the research is conducted together with a social scientist of the RTG CrossWorlds.

## ACKNOWLEDGMENT

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## REFERENCES

- [1] Baylor, A. L. "Promoting motivation with virtual agents and avatars: role of visual presence and appearance." *Philosophical Transactions of the Royal Society B: Biological Sciences* 364.1535, 2009, 3559-3565.
- [2] Becker-Asano, C.: WASABI: Affect simulation for agents with believable interactivity. IOS Press, 2008.
- [3] Bendel, O., Back, A., Brenner, W.: "Pädagogische Agenten im Corporate E-Learning." *Bamberg: Difo-Druck*, 2003.
- [4] Bendel, O., Schnöring, K., Back, A.: *Potenziale pädagogischer Agenten. Arbeitsberichte des Learning Center der Universität St. Gallen* 2, 2002
- [5] Chen, Chih-Ming, Hahn-Ming Lee, and Ya-Hui Chen. "Personalized e-learning system using Item Response Theory." *Computers & Education* 44.3, 237-255, 2005.
- [6] Dias, J.; Mascarenhas, S.; Paiva, A.: "Fatima modular: Towards an agent architecture with a generic appraisal framework." *Proceedings of the International Workshop on Standards for Emotion Modeling*, 2011.
- [7] Franklin, T. "Mobile Learning: At The Tipping Point." *The Turkish Online Journal of Educational Technology* 10.4, 2011.
- [8] Zangemeister, C.: *Nutzwertanalyse in der Systemtechnik*. Wittmannsche Buchhandlung, 1971.

# Some possibility of E-integrated network solution

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**Abstract**—In the world, Information and Communication Technology-(ICT) development trend is leading to integrated business structure of mobile and fixed, and therefore unification of wired and wireless technology as well as ICT which determines features in all social sectors of current society.

Network structures of the highly developed countries are upgrading rapidly into a singly universal network, which are IP, or the internet network, based, globalized that one can use its number anywhere in the world, and high-speed, broadband network that can exchange large data, such as video at same time.

This research work was developed from a detailed analysis of scientific literature of ICT and by national information analysis that compared their term of mid and long strategy management, policies and demand usage of ICT for these sectors. Beside we have made analyze which currently basic network of ICT in these sectors and have defined E-Integrated network solution

## I. INTRODUCTION

Competitiveness of the country, as well as the development of intellectual, creative and competent society depends largely on human development index. Human development index describes capacity and rate of individual human development and expresses three main measures of life such as be healthy, learn and get educated and live in proper condition. (Year book-2010). Therefore made comparison research on implementing ICT to health, education and mining sectors, which have big impacts on human development index, considered how to organize integrated network system, to develop next advanced technology, implement and make applications efficient.

**Role of ICT in the world;** The role of ICTs in development form a part of the discourse of the Millennium Development Goals (MDGs), and for most of the MDG targets there is a potential ICT tool and role to play. (Jackie Davies, 2006).

ICT is considered one of the three major technological breakthroughs the modern era (see Edquist and Henrekson 2007), the others being steam power and electricity. ICT includes some of the wider information technology innovations and applications, and their commercialization and transfer have been quite rapid.

ICT networks had spread throughout much of the Organisation for Economic Co-operation and

Development (OECD) business sector and would spread further to enhance business performance. (OECD-2004)

As well, the European Commission launched the Europe 2020 strategy in March 2010. There was included the Digital Agenda for Europe (DAE) is one of the seven flagship initiatives of Europe 2020 strategy. It defines the key role of ICT for Europe to succeed in its ambitions for 2020.

As noted “UN Chronicle” magazine, ICTs have enabled various information or content to be placed over internet in order to share it all over the world, thus opening the doors for content globalization.

(Ballantyne, 2002), ICTs provide the opportunity to digitize analogue materials, videos, audio, or oral information for simultaneous, unlimited, and remote access.

**Role of ICT in health sector;** ICTs present a range of opportunities for the delivery of health information to public and literature reflects this, however the digital divide and challenges of connectivity clearly remain a central focus; and the bibliography includes a number of digital divide background documents that help to locate the issue of access to health information and use of ICT for health, within the context of broader connectivity debates. (Jackie Davies, 2006).

When we look in more detail at the content of the Google Alerts, information management for health care emerges as the biggest single area for systems and product development. (Tom Wilson, 2011).

**Role of ICT in education sector;** According to Gwang-Jo Kim (2009), ICT in Education can serve the following purposes: (a) Restructuring education system, (b) diversifying teaching-learning and practices, (c) engaging all stakeholders of education and adapt rapidly to changes in society and the environment, and (d) enhancing education efficiency, effectiveness and productivity. Esque (2009) sees three key investment components in long term economic growth. She believes that (1) Investment in knowledge leads to sustained economic growth, (2) knowledge economy framework, and (3) educational reforms build relevant skills. Song et al (2009) think that ICT in education has three main goals: (1) Individual development, (2) education reform, and (3) social and economic growth.

**Role of ICT in mining sector;** As noted “Brainstorm Magazine” the outlook for the mining sector has radically changed due to the global economic crisis. This boom



## II. RESEARCH APPROACH AND METHODS

The establishment of this research will be built on based ICT strategies, policy and current basic network as well as information management and analyze.

- Define to IP based integrated switching system for each ICT companies
- Solutions of approaches and methods to build integrated network of ICT.
- Draw to define integrated scheme and design of E-Integrated network solution

### A. IP based integrated switching system.

In Mongolia, mobile and fixed line network operator's application of IP based 3G, NGN network shows that our communication sectors have improved to world standard, too. Future, all mobile and fixed companies should be developed IP based advanced next generation technology 4G, LTE, IMS in their own business.

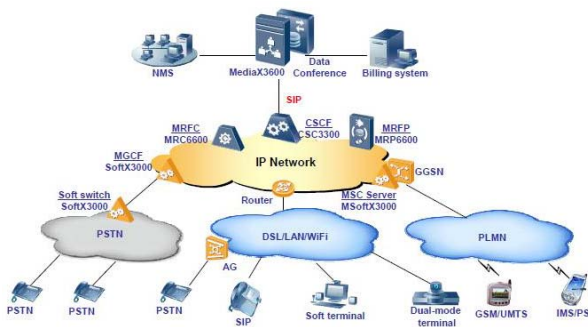


Figure 3 Network structures of IMS

### B. Solution of method to Build Integrated Network

**Solution-1:** In order to develop ICT efficiently in other sectors by using of integrated system shall establish high speed, broadband BACKBONE network connecting Ulaanbaatar city with other branches and connect to National Data Center-(NDC).

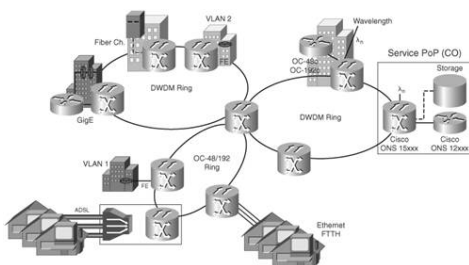


Figure 4 Cycle connection network of DWDM

**Solution-2:** Shall connect other branches with national Data Center through high speed network and also provide

opportunity to connect information systems of fixed and mobile telephone providers. (As shown figure-5)

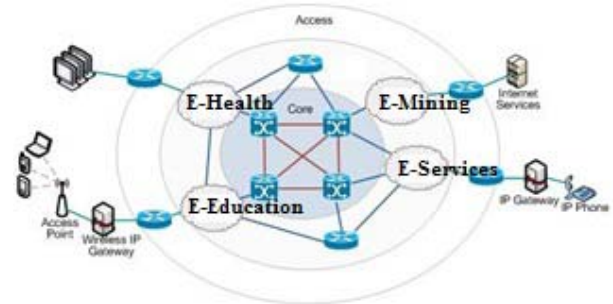


Figure 5 Connection diagram to connect NDC

**Solution-3:** Government of Mongolia has reflected national satellite launch project program in Mongolian Social and Economical plan and strategic goal for 2015. Therefore, use of national satellite shall establish unified system network for mining sector and shall connect it to National Data Center.(As shown figure-6)

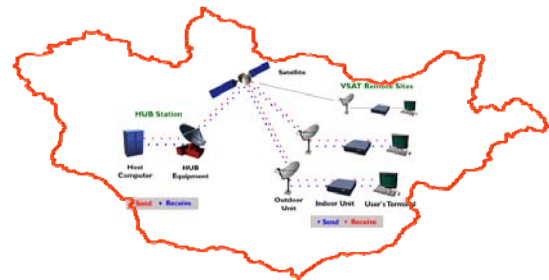


Figure 6 Connection diagram with national satellite

In order to develop ICT, it is efficient solution to establish mesh network or using of Wimax, next LTE technology, and mesh network in mining sector. Finally, we draw to define integrated scheme and design. (As shown figure-7)

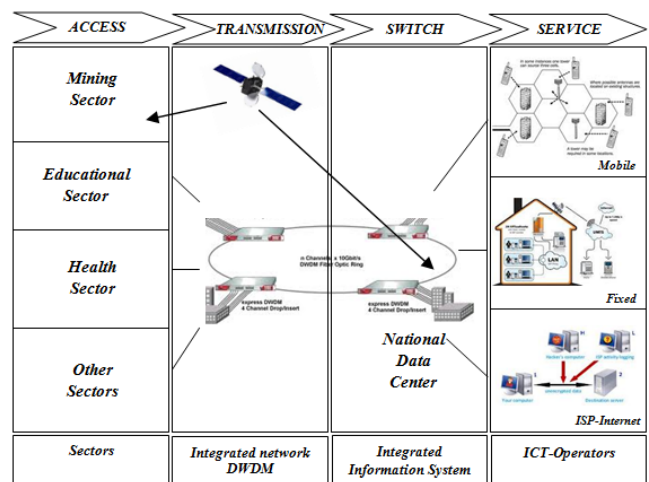


Figure 7 General scheme of integrated network

### III. CONCLUSION

Since modern improved systems are applicable in integrated system software, and deliverable in broadband IP network, multimedia technology has developed sharply and making it available to send loads of information, audio, video, graphic, games, and TV broadcastings simultaneously.

E-government, e-commerce, e-education, and e-health e-services, which are based on improved modern ICT, makes it possible that the communication sector to unite with other sectors, to make that sector more available.

According to the research work can make different conclusion depending on the specific sectors:

#### **E-Education and Training**

- In Education, Culture Science sector: Should have servers and equipments which able to provide and handle large amounts database.
- Students and learners can study by using IP based fixed and mobile network as well as internet network. We have shown comparative characteristic E-learning and M-learning.

**Table1: comparative characteristic**

<b>E-LEARNING</b>	<b>M-LEARNING</b>
<b>Switching system</b>	
E-Training is based by fixed and wired network	M-Training is based wireless and mobile network.
<b>Transmission Technology</b>	
It can be delivered information by high speed broadband because it based fixed network	M-Learning, that information is limited because it based mobile network related bandwidth and end of terminal.
<b>End of device</b>	
Computer, Laptop, Video phone, Soft phone,	Mobility & Mobile terminals, Smartphone, Iphone, Ipad, Navigator
<b>Advantages of E-Learning and M-Learning</b>	
<ul style="list-style-type: none"> <li>• Flexibility - Students can access the system anytime they want 24/7 around the world (global). These devices can be accessed privately and when it is convenient to the student at their own leisure.</li> <li>• Style test can be used within e-learning, to assess the students' needs to locate individual's requirements which can be used for future improvements which will enhance their learning.</li> <li>• M-learning allows multimedia boards to be set up, so that learners can participate in class projects via mobile devices, which the learners can then add comments by text, picture, movies, etc.</li> <li>• Thrift of time and space.....,etc</li> </ul>	
<b>Disadvantages of E-learning and M-learning</b>	
<ul style="list-style-type: none"> <li>• Relation of students and participants is limited.</li> <li>• A participant in the class may have questions that arise during learning. This means that they won't be able to ask for help at that time, and although they will be able to ask at a later stage, they may have forgotten....., etc</li> </ul>	

#### **E-Health**

- In Health sector: Data for consumers and patients must be high secured and related equipments; software should have authentication and protection.
- Doctors and nurses are taking complete information from the electronic database on the computer, based at the hospital and connected to the network, and making

relative decisions. But this database has limited access to that hospital and not available for others. Therefore, by developing united database and network in health sector, electronic database will be established so patient's information will be available anytime and anywhere as paperless health service.

- Health services can be delivered, from anywhere in anytime in 24/7, saving the trouble of queuing and others.

#### **E-Mining**

- In Mining sector: To develop ICT based on wireless network.
- In future, should use widely national satellite in Mongolian mining sector.

Finally, our goal is to develop integrated network of ICT and implement next generation advanced technology in other sectors of Mongolia same as with developed countries.

#### ACKNOWLEDGMENT

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#### REFERENCES

- [1] Mongolian Statistical Yearbook-2010. Human development index (P 436-437).
- [2] Jackie Davies (2006). ICT and Health Sector-Literature review. *ICT and the Millennium Development Goals (MDGs)* (P-2) & *Access to health information* (P-4).
- [3] Encyclopedia World Economy (2012). *ICT: Review of the ICT literature & ICT: The Role of ICT in the world economy.* <http://world-economics.org/488-information-and-communications-technology-review-of-the-ict-literature.html>
- [4] Draft CIP ICT PSP work program me 2013. *The Digital Agenda for Europe* (P-8).
- [5] Presidential National Commission on Information Society and Development. *Role of ICT in Local Content Development.* <http://www.pnc.gov.za/index.php/local-content/role-of-ict-in-local-content>
- [6] Tom Wilson (2011). Information Management, today and tomorrow. *The problem of Information Management* (P-2).
- [7] David Melita Katitia (2012). The Role of ICT integration into classroom in Kenya. A literature review. *Roles of ICT in Education* (P-3).
- [8] Lauri E. Elliott & Hilton Tarrant (2009). *Brainstorm Magazine. ICT in Mining.* [http://www.brainstormmag.co.za/index.php?option=com\\_content&id=3672:ict-in-mining](http://www.brainstormmag.co.za/index.php?option=com_content&id=3672:ict-in-mining)
- [9] Millennium Development Goals-Based Comprehensive National Development Strategy of Mongolia (2007, Ulaanbaatar). *Introduction* (P 6-7) & *ICT Development Policy* (P 43-45).
- [10] Forum of ICT in Mongolia. *Demand of ICT in Education sector.*
- [11] International Conference (2011, Hoi An, Vietnam) *ICT and Health Information System in Mongolia* (PPT). Yukio Suzuki (2013). The Mongolian Ecosystem Network. *Conflict between Mining Development and Nomadism in Mongolia* [http://link.springer.com/chapter/10.1007/978-4-431-54052-6\\_20](http://link.springer.com/chapter/10.1007/978-4-431-54052-6_20)

# Convergence of e-Learning and Knowledge Management: Challenges & Opportunities in Mongolia

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## Abstract:

Today's changing life style and increasing expectation has become a driving force to change learning system. E-Learning technology today has primarily become to handcraft teaching courses about carefully selected topics for delivery to students registered for those courses. Knowledge management is involved in rapidly capturing, organizing and delivering large amounts of knowledge. In Mongolian context, both the Knowledge Management and E-Learning are at the nascent stage and hence there are tremendous opportunities and enormous challenges in implementation.

This paper not only investigates the integration of e-Learning and Knowledge Management technology to improve the capture, organization and delivery of both traditional teaching courses and large amounts of tacit knowledge but also explores the challenges & opportunities. First, problems with models are discussed for the phases of knowledge management. Although these models are developed in context of corporate but it can be related to academia as well. Analysis of these models will help to better understand the practical relationship between knowledge management and e-Learning. Relevance of Laan Model is also discussed in light of KM. Lastly, the current scenario in Mongolia is discussed for a better planning to implement e-Learning in Mongolia.

KEY WORDS: Laan Model, Challenges, Higher Education, e-Learning, Knowledge

five phases of knowledge management as shown below. A sixth phase, Feedback, has also been added.

- Socialization: Competency and skills measurements help identify the people with specific interests, skills and knowledge in the organization.
- Externalization: Knowledge is captured by the system with the intent of teaching that knowledge to other people. This improves the knowledge capture process.
- Combination: Knowledge about products and processes of the business is organized to make learning the knowledge more effective and efficient. Pedagogical techniques are embedded in the knowledge.
- Internalization: Competency and skills measurements help identify which people lack the knowledge to do their job effectively and provide them with online training. e-Learning will insure that a person has learned the knowledge using assessments and alternative learning methods, if necessary.
- Cognition: People can be provided with on demand performance support by getting just the training that they need at the time that they need it to complete a business task.
- Feedback: Assessments provide feedback concerning how well a person has learned and how well they have applied what they learned to a business problem.

## 1. Phases of Knowledge Management:

Ref [1] has investigated the relationship between tacit knowledge and explicit knowledge and has described four phases of knowledge conversion: Socialization, Externalization, Combination and Internalization. The goal of the implementation of knowledge management in an organization is to increase the amount of tacit knowledge that an individual has available to apply to solving business problems. Frappaolo and Tom further added a fifth phase, Cognition, which is the application of knowledge that has been exchanged through the other phases.

- Socialization: Transfer tacit knowledge from one person to another person
- Externalization: Translate tacit knowledge into explicit knowledge in a repository
- Combination: Combine different bodies of explicit knowledge to create new explicit knowledge
- Internalization: Extract the explicit knowledge from a repository that is relevant to a particular person's need and deliver it to that person where it is translated into tacit knowledge
- Cognition: Apply tacit knowledge to a business problem. In cognitive approach the same solution may be obtained by using different approaches.

## 2. Enhancing e-Learning to Knowledge Management

E-Learning technology has been evolving separately from knowledge management technology. There have been recent investigations into the integration of these technologies [2]. E-Learning technology will enhance the effectiveness of each of the

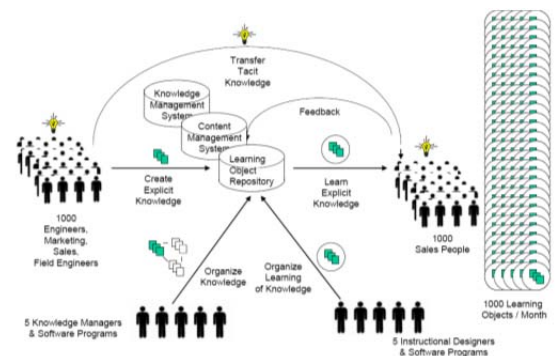


Figure 1 Enhancing e-Learning to KM

(Adopted from-Integration of E-Learning and Knowledge Management, Woelk D, n.d.)

The above figure represents the knowledge management phases with e-Learning enhancements. A Knowledge Holder can either transfer tacit knowledge to a Knowledge Seeker through socialization or create explicit knowledge and store it in a knowledge repository. The Knowledge Organizer is a person (or software program) who relates the created knowledge to other knowledge in the repository or further refines the created knowledge. The Instructional Designer is a person (or software program) who organizes the learning of the knowledge by adding pre-assessments, additional learning aids, and post-assessments. The Knowledge Seeker then learns the explicit knowledge through an online guided learning experience. The Knowledge Seeker then uses the knowledge gained through socialization or internalization to make decisions and perform tasks in the enterprise. The performance of the Knowledge Seeker on these decisions and tasks is measured and returned to the knowledge

repository as feedback that can be used to help determine if the skills have been learned and to suggest additional e-Learning experiences.

### 3. *Rational for E-Learning:*

In 21<sup>st</sup> century *Modern Learning Theory* sees learning as an individual quest for meaning and relevance. It has moved beyond the recall of facts, principles or correct procedures, into the area of creativity, problem-solving, analysis, or evaluation (the essential skills needed in the work-place in a market economy and in personal life as well), learners need the opportunity to communicate with each other as well as their teachers. This of course includes the opportunity to question, challenge and discuss issues. Learning then is as much a social as an individual activity. The gap between the way educational services are currently provided and the needs of employers and working people has become blatant by these changes in workforce. Working people are unable or cannot afford to give up jobs or move house to become full-time or even part-time campus-based students again. They are increasingly looking for more flexible and more responsive forms of education and training where they are. This situation creates the opportunities for E-Learning.

Target Market:

- herdsmen and their families
- farmers and other agricultural workers and their families in remote rural areas
- out-of-school children in remote rural areas
- students and teachers in remote rural schools requiring specialist provision
- specialist support staff (e.g., agricultural extension workers, health workers, non-formal education coordinators) in remote rural areas

#### 3.1 *Objectives of e-Learning:*

Learners receive the “right knowledge” at the “right time” and “just enough” knowledge that they need to execute effectively. The “right knowledge” that a learner needs is determined by his/her role in the company and the products and processes in which he is or wants to participate. The “right time” to receive that is knowledge is when he needs it for a specific task. “Just enough” knowledge is whatever he needs and nothing more.

#### 3.2 *Problems with traditional E-Learning:*

- There could be contents that the instructional designers don't know about that could be used in courses.
- There could be contents that the instructional designers know about but they can't find. Even if they find content, it might be incorrect.
- Instructional designers don't have time to talk to all of the engineers and marketing people so they may produce fewer courses.

#### 4. *Problems with e-Learning Based on Enterprise Content:*

- Courses are created using smaller, reusable learning objects, but entire courses, not individual learning objects, are delivered to sales people.
- People in the company are creating knowledge about the products that is not being embedded in the courses. Email messages, memos, sales call notes, audio messages, meeting notes, product recalls, customer support problem reports, personnel and strategy changes

at customer companies, etc. all contain knowledge that would make the sales person more effective.

- People either never know that this knowledge exists or they spend valuable time interacting directly with engineering, marketing and other people to find the knowledge. Even then, they might interact with the wrong person and get the wrong information.

#### 4.2 *e-Learning Based on Enterprise KNOWLEDGE*

In the company e-Learning leverages not only the content in the Content Management System, but also the knowledge that has been captured in a Knowledge Management System. This knowledge includes email messages, memos, sales call notes, audio messages, meeting notes, product recalls, customer support problem reports, personnel and strategy changes at customer companies that were mentioned in the previous section. But the knowledge also includes information on the roles, skills, expertise and performance of individual employees that will simplify the transfer of tacit knowledge and explicit knowledge to the sales person. This knowledge will enable the sales person to find the right learning objects and to contact the right people for tacit knowledge that is needed to be effective. The key to finding the right content and the right people from the multiple information sources is depicted in figure below as an ontology containing a metadata representation of the concepts, relationships and processes of the enterprise. Progress is being made in the standardization of ontology representations [3]. Enterprise ontology can provide a gateway to multiple information sources that can be navigated by people and software agents [4] [5].

In the case of e-Learning based on enterprise knowledge, knowledge will be delivered through a variety of presentation devices including web browsers, PDA's and cell phones. This enables the learners to receive the knowledge when it is needed regardless of where they are and what they are doing. e-Learning will be delivered as small, focused learning objects to fit the format of the presentation devices.

This figure shows that the role of the Instructional Designer is to organize the learning of the knowledge and the Instructional Designers will be more efficient because the authoring systems will be more intelligent and the knowledge will be better organized. This organization of the knowledge will be the responsibility of Knowledge Managers and automated software programs.

### 5. *KNOWLEDGE ECOLOGY*

In the area of knowledge management several researchers have used the term knowledge ecology. For instance Por [6] defines knowledge ecology as “a field of theory and practice that focuses on discovering better social, organizational, behavioral, and technical conditions for knowledge creation and utilization”. Malhotra [7] defines knowledge ecology that “treats knowledge creation as a dynamic evolutionary process in which knowledge gets created and recreated in various contexts and at various points of time”.

### 6. *THE LaaN THEORY*

The Learning as a Network (LaaN) theory draws together some of the concepts behind connectivism [8], complexity theory [9], [10], and double-loop learning [11]. An abstract view of LaaN is depicted in Fig. 1. Connectivism focuses on making connections (at external, conceptual, and neural levels) and seeing patterns. However. Connectivism misses some of the double-loop learning concepts, which are crucial for learning, such as learning from failures, error detection and correction, and inquiry. On the other

hand, double-loop learning aims at detecting and correcting errors by changing the values, strategies, and assumptions of the theory-in-use according to the new setting. Double-loop learning, however, does not recognize the power of connections/networks that can help us operate in highly dynamic and uncertain knowledge environments, characterized by increasing complexity and fast-paced change. Within LaaN, connectivism, complexity theory, and double-loop learning converge around a learner-centric environment. LaaN starts from the learner and views learning as the continuous creation of a personal knowledge

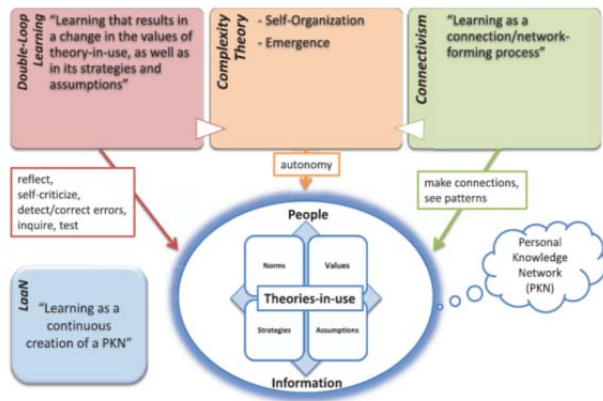


Figure 2 The LaaN Theory

network (PKN). A PKN shapes the knowledge home and the identity of the individual learner. For each learner, a PKN is a unique adaptive repertoire of (a) Tacit and explicit knowledge nodes (i.e., people and information) (external level) (b) One's theories-in-use: This includes norms for individual performance, strategies for achieving values, and assumptions that bind strategies and values together (conceptual/internal level). In LaaN, the result of learning is a restructuring of one's PKN, that is, an extension of one's external network with new knowledge nodes (external level) and a reframing of one's theories-in-use (conceptual/internal level) [12].

LaaN-based learning implies that a learner needs to be a good knowledge networker as well as a good double-loop learner. A good knowledge networker is one who has the ability to:

- Create, harness, nurture, sustain, and widen her external network to embrace new knowledge nodes.
- Identify connections, recognize patterns, and make sense between different knowledge nodes.
- Locate the knowledge node that can help achieving better results, in a specific learning context.
- Aggregate and remix.
- Cross boundaries, connect, and cooperate.
- Navigate and learn across multiple knowledge networks.
- Help other knowledge networkers build and extend their networks.

### 8.1 LaaN AS A BRIDGE BETWEEN KM AND e-Learning:

LaaN views knowledge as a personal network rather than as a thing or process. In LaaN, work/learning is viewed from a knowledge worker/learner perspective, and KM and e-Learning are seen as being primarily concerned with a continuous creation of a Personal Knowledge Network. This ensures that the differences between KM and e-Learning are converging around a knowledge worker/learner-centric work/learning environment and makes that the roles of KM and e-Learning are blurring into one, namely supporting the knowledge worker/ learner in continuously creating and optimizing their PKNs. In this sense,

KM and e-Learning are not the two ends of a continuum but the two sides of the same coin. Moreover, LaaN enables the seamless integration of learning and work. The view of learning as the continuous creation of a PKN makes learning and work so intertwined that learning becomes work and work becomes learning. According to Wright [13], PKM "focuses on how individual workers apply knowledge processes to support their day-to-day work activities—broadly characterized as problem solving—and learning practices". LaaN views knowledge as a personal network. LaaN shares with these models a core proposition, that knowledge and learning are fundamentally personal in nature. However, the LaaN view of KM as a continuous creation of a PKN, at both internal and external levels, encompassing theories-in-use, tacit knowledge nodes (i.e., people) and explicit knowledge nodes (i.e., information) are quite distinctive. Moreover, LaaN puts a heavier emphasis on the network dimension of PKM. In LaaN, PKM occurs within knowledge ecologies, which are self-organized and emergent networks of PKNs. Knowledge ecologies house self-directed learning that occurs in an open and bottom-up manner, rather than learning that functions within a structured context shaped by command and control, such as working groups and CoPs. Furthermore, in contrast to the proposed PKM models, LaaN stresses the learning dimension in KM and provides a framework for the integration of KM and TEL around a learner-centric knowledge environment.

### 9. Challenges in Mongolia:

Knowledge Management System in Mongolia is still at nascent stage where HEIs are striving at the stage of knowledge identification. Knowledge Creation and Management will follow the suit.

The role of a HEIs in modern informational society requires a new innovative view into knowledge management and creation of a knowledge management system for HEIs. Knowledge management combines the parts of organization into one unity: processes, people, and technologies. Knowledge is that basis on which the competitive advantage of the organization is being built. Knowledge becomes valuable not because of the information it carries, but the actions and ability to take the step.

In a non-standard situation the actions require processes and phenomena require the understanding of their interrelation. This gives the basis to conclude that the function of knowledge management has become knowledge control—the entity of processes and technologies, aiming to find out, create, spread, process, preserve and present for the usage inside the organization. In scientific literature the process of knowledge management is studied well enough and is described from the aspect of clear, obvious and formalized knowledge processes. The main tool of such knowledge management becomes the nets of informational technologies, first of all internet.

To exchange not obvious knowledge, the special social nets are required and they are not well studied.

### Referencing:

- [1] I. Nonaka and H. Takeuchi, *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford Univ., 1995.
- [2] Allee, V. "eLearning is Not Knowledge Management", <http://www.linezine.com/2.1/features/vaenkm.htm>, [online] retrieved on May 13, 2013
- [3] World Wide Web Consortium Web Ontology Group, <http://www.w3.org/2001/sw/WebOnt>
- [4] Lenat, D. "CYC: A Large-Scale Investment in Knowledge Infrastructure", Nov. 1995, Vol. 38 No. 11, *Communications of the ACM*, 1995.
- [5] Woelk, D. and C. Tomlinson, "The InfoSleuth Project: Intelligent Search Management via Semantic Agents", Second Intl. World Wide Web Conference, October, 1994.



- [6] G. Por, "Nurturing Systemic Wisdom through Knowledge Ecology," *The Systems Thinker*, vol. 11, no. 8, pp. 1-5, 2000.
- [7] Y. Malhotra, "Information Ecology and Knowledge Management: Toward Knowledge Ecology for Hyper-turbulent Organizational Environments," *Encyclopedia of Life Support Systems (EOLSS)*, UNESCO/Eolss, 2002.
- [8] G. Siemens, "Connectivism: A Learning Theory for the Digital Age," *Int'l J. Instructional Technology and Distance Learning*, vol. 2, no. 1, [http://www.itdl.org/J/Jan\\_05/article01.htm](http://www.itdl.org/J/Jan_05/article01.htm), 2005.[online] accessed on June 1st, 2013
- [9] D. Snowden, "Complex Acts of Knowing: Paradox and Descriptive Self-Awareness," *J. Knowledge Management*, vol. 6, no. 2, pp. 100-111, 2002.
- [10] J.H. Holland, *Emergence: From Chaos to Order*. Addison-Wesley, 1998.
- [11] C. Argyris and D.A. Scho'n, *Organizational Learning II: Theory, Method and Practice*. Addison-Wesley, 1996.
- [12] M.A. Chatti, M. Jarke, and C. Quix, "Connectivism: The Network Metaphor of Learning," *Int'l J. Learning Technology*, vol. 5, no. 1, pp. 80-99, 2010.
- [13] K. Wright, "Personal Knowledge Management: Supporting Individual Knowledge Worker Performance," *Knowledge Management Research and Practice*, vol. 3, pp. 156-165, 2005.

# Improvement of Methods for Assessment of Speech Information Security from Leak on Technical Channels

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**Abstract** - The paper presents a new approach to improving the security assessment method of speech information from leaking via technical channels.

Emergence of new information technologies and development of powerful computer systems of information storage and processing annually raise requirements to level and efficiency of information security. So gradually information security becomes obligatory: various documents on information security are worked out, recommendations are formed, and even Federal Law about information security which considers problems and objects of its protection is carried out.

Thus, information security threat made means of information security ensuring one of the obligatory characteristics of information system.

In turn, it causes cardinal changes in approaches to ensuring the information security (IS) of corporate IT-infrastructure. The IS agenda is quite wide and covers both program and technical aspects of company performance, and organizational features of business operating.

No matter how the IT-infrastructure (servers, local data-processing network with application of various firewalls, hardware-software protection means) is protected, however it remains not protected! Company staff in a mode of communication discusses innovative projects, carry out online – conferences and telephone negotiations with clients. Such indoor information is fluently scanned by technical intelligence means from windows, walls, ventilation and heating and it is also simply overheard. There are various methods to estimate quantitatively the possibility of acoustic information leak on technical channels (e.g. Pokrovsky's, Bykov's, Sapozhkov's techniques, AI, STI, RASTI) [1]. In Russia as a basis the formant method[2] is assumed. It implies the following:

- whole frequency range of a speech signal breaks into 5 octave-frequency bands with the central frequencies 250, 500, 1000, 2000 and 4000 Hz;
- for each i-that band the noise level  $B_{ni}$  and level of mix a signal + noise level  $B_{(s+n)i}$  is measured by i;
- signal levels for each octave-frequency band are calculated:

$$B_{si} = 10 \lg(10^{0,1B_{(s+n)i}} - 10^{0,1B_{ni}})$$

- effective level of formant feeling is figured:

$$E_i = B_{si} - B_{ni} - \Delta A_i$$

where  $\Delta A_i$  – difference between spectral levels of speech and formants;

- on known dependence of P(E) coefficients of perception  $P_i$  are calculated for each octave-frequency band;

- the formantn legibility of speech is calculated:

$$A_F = \sum_{i=1}^5 P_i \cdot k_i$$

where  $k_i$  – contribution of i-that octave-frequency band to total legibility (they are known from formant distribution of the Russian speech)

- on known dependence on formant legibility it is passed to the verbal legibility.

This method has some shortcomings:

- insufficient frequency resolution (usage of only 5 octave-frequency bands that theoretically leads to "loss" of 9% of formant legibility);
- "mechanical transfer" of articulation tests results on the basis of uncorrelated tables on information security objects (coherent texts);
- lack of the received values reliability estimates W (estimation error) [3].

According to the aforesaid, the purpose of the work was the research of assessment reliability of speech information security from leak on technical channels by verbal legibility criterion and its improvement.

For a quantitative assessment of possible legibility of speech changes for coherent texts, the experiment was planned and carried on. Its essence (if not to penetrate into details) consists in the following: [4]

- the set of 35 pieces of coherent texts (conversation, discussion) lasting 3 minutes everyone was created;
- the team of auditors in number of 20 people (10 men and 10 women) aged from 20 till 30 years without obvious deviations of hearing was completed;
- integrated speech level is equal 70 dB (average loudness speech);
- the following types of noises were created: white, pink, speech-like noises, a speech noise (speech chorus from pieces of coherent texts), a formant-like noise (a

noise with envelope corresponding to a range a formant). Tests were carried out in 7 octave-frequency bands.

- for each type of a noise integrated level of 70 dB was set, so that after signal and noise mixing the integrated signal-to-noise ratio (SNR) of -20, -15, -10, -5, 0, +5, +10 (dB) was provided.

Thus, the set of records was shown to each auditor, and after numerous listening of it the auditor defined coefficient of verbal legibility.

Results' tests and processing was carried out according to GOST P 50840-95.

In Fig. 1 average (on 20 auditors) dependences of verbal legibility W on integrated SNR for different types of noises are shown.

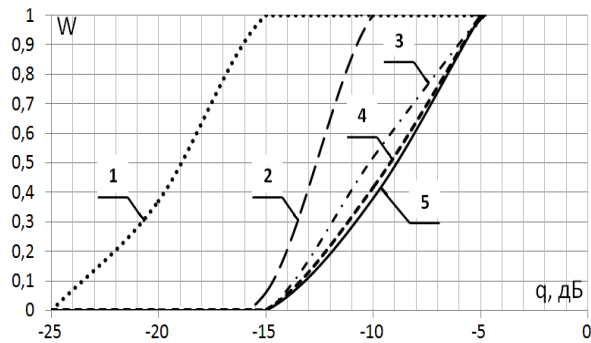


Fig. 1. Experimental dependences of verbal legibility on the integrated SNR for different types of noises (1 – "white" noise; 2 – "pink" noise; 3 – speech chorus; 4 – speech-like noise; 5 – formant-like noise)

The similar dependences received on a traditional method are given in Fig. 2 (the author's designations are kept there).[5]

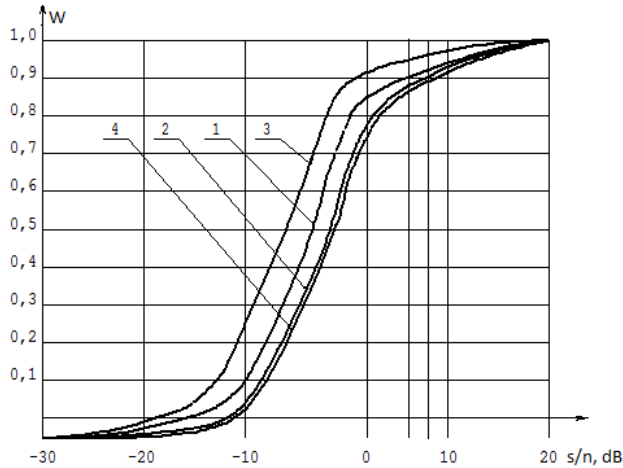


Fig. 2. Dependence of verbal legibility on the integrated SRN for different types of noises by a traditional method (1 – "white" noise; 2 – "pink" noise (3 dB/Oct); 3 – "brown" noise (6 dB/Oct); 4 – "speech-like" noise)

Comparison of experimental dependences with similar received on a traditional method showed essential changes of verbal legibility coefficient when using of coherent texts. So, for white noise at SRN of 20dB, W raises with 0.03 to 0.4, for a speech-like noise at SRN of 10 dB, W

raises from 0.15 to 0.4. The types of dependences also changed significantly and became steeper.

It is obvious that demanded speech information security can be provided while using of different types of noise, however their efficiency will be various; meanwhile the smallest excess of integrated noise level over integrated speech level at the set legibility is the criterion of efficiency. At the same time, the approach based on the responsiveness to weighting coefficients, reflecting a contribution of each octave-frequency band to total legibility is rather obvious. Having distributed energy of a noise signal on octave-frequency bands according to these coefficients it is possible to receive an optimal noise, Tab. I-II.[6]

TABLE I.  
WEIGHTING COEFFICIENTS (OCTAVE-FREQUENCY BAND CONTRIBUTION TO TOTAL LEGIBILITY)

k	Center band frequency, Hz						
	125	250	500	1000	2000	4000	8000
k	0,01	0,03	0,12	0,20	0,30	0,26	0,07

TABLE II.  
RECEIVED INTEGRATED OPTIMAL NOISE LEVELS

B, dB	Center band frequency, Hz						
	125	250	500	1000	2000	4000	8000
B, dB	50	55	62	63	64	63	57

Carrying out the analysis and calculation of an absolute and relative methodical error of indirect measurements of verbal legibility taking into account only analytical expressions (i.e. an error of formulas) was the following stage of researches. It lets to know what share of divergence is brought by design formulas.

Below analytical expressions used at calculation of verbal legibility are given:

$$B_{si} = 10 \lg(10^{0,1B_{(s+n)i}} - 10^{0,1B_{ni}})$$

$$E_i = B_{si} - B_{ni} - \Delta A_i$$

$$P_i = \begin{cases} \frac{0,78 + 5,46 \cdot \exp[-4,3 \cdot 10^{-3} \cdot (27,3 - |E_i|)]^2}{1 + 10^{0,1|E_i|}}, \forall E_i \leq 0 \\ \frac{1 - 0,78 + 5,46 \cdot \exp[-4,3 \cdot 10^{-3} \cdot (27,3 - |E_i|)]^2}{1 + 10^{0,1|E_i|}}, \forall E_i > 0 \end{cases}$$

$$A = \sum_{i=1}^5 P_i \cdot k_i$$

$$W = \begin{cases} 1,54 \cdot A^{0,25} \cdot [1 - \exp(-11A)], \forall A < 0,15 \\ 1 - \exp\left(\frac{-11A}{1 + 0,7A}\right), \forall A \geq 0,15 \end{cases}$$

In Fig. 3 results of design formulas absolute error calculation for the most widespread "white noise" and the most effective "formant-like noise" are shown:

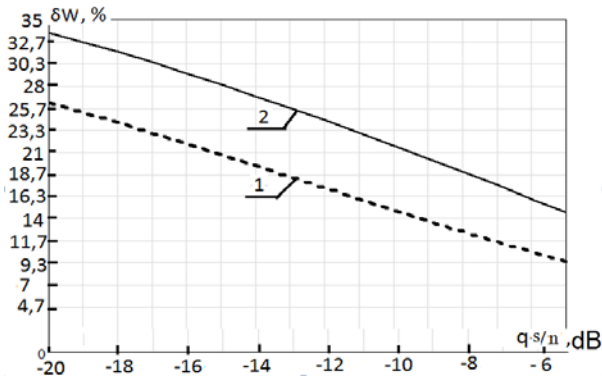


Fig. 3. Dependence of an absolute error ( $\Delta W$ ) on the SNR ( $q$ ) (1 – "white" noise; 2 – "formant-like" noise)

On graphs it is visible that the absolute error of only design formulas reached 7%.

Now let's pass from considering of absolute error to relative error.

In Fig. 4 dependence of a relative error of design formulas on the SNR for the same noises is shown.[7]

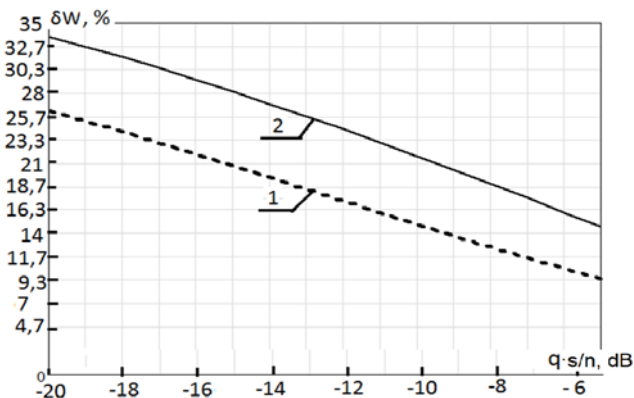


Fig. 4. Dependence of a relative error ( $\delta W$ ) from the SNR ( $q$ ) (1 – "white" noise; 2 – "formant-like" noise)

So having such error and an essential divergence of design data with experimental, the method improvement is required. As it was already mentioned, results of  $W$  assessment on a classical method significantly differ from results on the basis of experiments with coherent texts. Therefore, calculation according to a classical method doesn't guarantee speech information security from its leak.

Before passing to method improvement, let's pay attention that working on speech information security verbal legibility range of from 0 to 0.6 is especially interesting range, because at verbal legibility higher than 0.6 information is considered unprotected. This conclusion is made particularly in A.A. Horev's and his colleagues' works.

Apparently from Fig. 5 graph, the curve segment for  $W=0 \dots 0.6$  is almost linear, therefore, it is possible to replace it by simple linear function  $W(A)=6A$ . Meanwhile

on a segment from 0.6 to 1 the overestimated values will be received, but in information security objects it's a question of no importance, because at  $W \geq 0.6$  information remains unprotected.

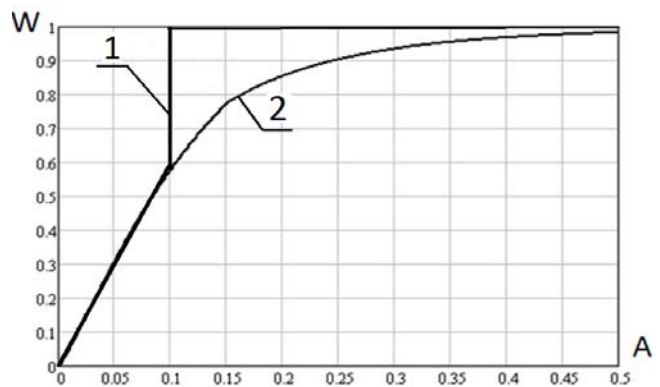


Fig. 5. Dependence of verbal legibility on the formant function  $W$  (A) (1 - linear  $W=6A$  on an interval from 0 to 0.1; 2-traditional)

Proceeding from results of articulation tests with coherent texts, it is possible to conclude that for considered types of noise at the SRN more 5dB,  $W$  makes 90-100%, and at -25dB it is equal to zero.

It is possible to assume that the  $P(E)$  function is linear in these segments (linear dependence is probable because received experimentally graphs of  $W(q)$  also have almost linear dependence). The offered function  $P(E)=0.05E+1.25$  is given in Fig. 6.

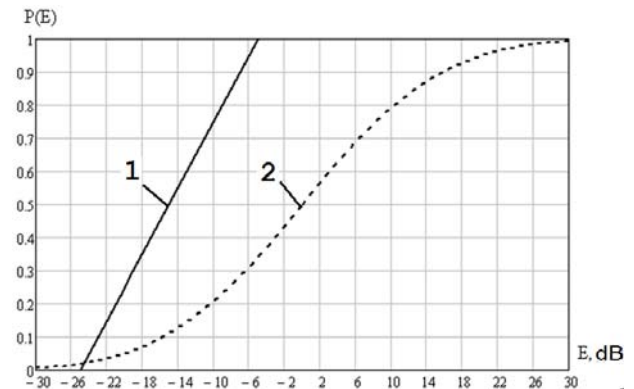


Fig. 6. Dependences of perception coefficient on feelings a formant level  $P(E)$  (1 – offered dependence  $P=0.05E+1.25$ ; 2 – by a traditional method (Pokrovsky's dependence))

In Fig. 7 and 8 it is shown the dependence of verbal legibility on the SRN on the example of pink noise and a formant-like noise after the method improvement.

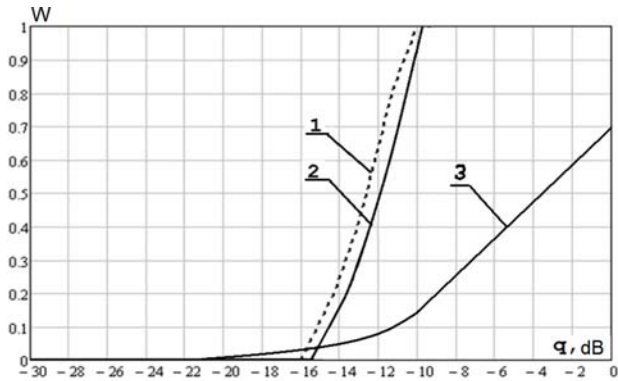


Fig. 7. Dependences of  $W(q)$  for "pink" noise (1 – received by results of tests (experiment with coherent texts); 2 – by an improved method; 3- on the existing method)



Fig. 8. Dependences of  $W(q)$  for "formant-like" noise (1 – received by results of tests (experiment with coherent texts); 2 – by an improved method)

Thus the results of  $W$  estimates became more exact to coincide with the obtained experimental data (coherent texts) after improvement, coinciding practically for 90%. Also signed formulas became much simpler and the methodical error considerably decreased ( $\Delta W$  made 1%).[8]

## REFERENCES

- [1] I. Reva, "Comparative analysis of objective methods for legibility of speech assessment," *NSTU the collected scientific papers*, No. 1(59), pp. 91-102, 2010.
- [2] N. Pokrovskiy, "The calculation and measurement of speech intelligibility," *M: Svyaz'izdat*, pp. 391, 1962.
- [3] V. Trushin, I. Reva, and A. Ivanov, "About methodical errors of an assessment of verbal legibility of speech in the information security objects," *TUSUR the reports*, No. 1(25), part 2, hh. 180-185, 2012.
- [4] I. Reva, "Organization of experiment on legibility of speech assessment with coherent texts," *NSTU the collected scientific papers*, No. 1(62), pp. 125-132, 2011.
- [5] V. Zhelezniak, J. Makarov and A. Horev, "Some methodological approaches to evaluating the effectiveness of protection of speech information," *Special Appliances*, № 4, 2000.
- [6] V. Trushin, I. Reva, and A. Ivanov, "Realization of an optimal noise at protection of speech information from leak on acoustic and vibroacoustic channels," *NSTU the scientific reporter*, No. 4(45), pp. 151-154, 2011.
- [7] V. Trushin, I. Reva, and A. Ivanov, "Calculation of a methodical error of legibility of speech assessment in the information security objects," *The 10th Belarusian-Russian scientific and technical conference "Technical information security means"*, Minsk: BGUIR, pp. 22, 2012.
- [8] V. Trushin, I. Reva, and A. Ivanov, "Improvement of a method for legibility of speech assessment in the information security objects," *POLZUNOVSKY the reporter*, No. 3/2, pp. 238-241, 2012.

## Evaluation in Distance Education and E-learning: The Unfolding Model

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*Abstract. This article is a summary of Ruhe and Zumbo's unfolding model, a new approach to evaluating distance education and e-learning courses and programs. Book review references are at the end of the article.*

In our book, we turn Messick's (1989) model of test validity into a practical and useful model for evaluating distance education and e-learning courses and programs. Messick's framework is a comprehensive approach to evaluating the merit and worth of standardized tests. [1] Our Unfolding Model is based on Messick's framework, and our adaptations provide a "road map" to guide a comprehensive investigation of the merit and worth of innovative courses. [2].

### The Unfolding Model

Ruhe and Zumbo's model consists of four overlapping boxes: Scientific evidence, Relevance, Cost-benefit, Underlying values and Unintended consequences. In the first box in the first row, Scientific Evidence refers to quantitative and qualitative methods, including surveys and interviews of learner satisfaction. The second box in the first row, Relevance and Cost-benefit, refers to scientific evidence specific to these aspects of the value of a course. Next, in the second row, Underlying Values includes the course goals and objectives, rhetoric, theories of learning and technology, ideologies and stakeholder roles and influence. The fourth box, "Unintended Consequences" includes instructional and social consequences. To evaluate any course, we prefer mixed methods, which allow us to investigate both outcomes and process, that is, how the course as implemented on a daily basis.

### An Adaptive, Dynamic Model

The unfolding model is adaptive and dynamic, because each of the four boxes unfolds to show a menu of diverse tools and strategies applicable to various distance and

e-learning contexts. For example, Scientific Evidence unfolds to include all types of scientific evidence including survey and interview data, outcomes, checklists and course management data. Each of these categories unfolds in turn. For example, Surveys and Interviews unfolds to show the dimensions of learner satisfaction, specifically:

- Tutor
- Online Discussion Group
- Course Package
- Textbook
- Course Web Pages

Similarly, Outcomes unfolds to show:

- Grades
- Assessment/Feedback
- Completion Rates
- Quality Control

While surveys and interviews with learners are used to measure learner satisfaction, and are essential to our approach to evaluation, evaluators can also select other tools and strategies, depending on the course and information needs. Grades and completion rates are informative, but may not always be available, so we provide other options. Checklists can be used to evaluate web pages or competencies, while progress tracking statistics can be used to evaluate the learning process.

All four boxes of our framework unfold. Relevance unfolds to include 1) alignment between the course and needs of society, 2) meaningfulness of course to learners and 3) transfer of learning to authentic contexts. Cost-benefit unfolds to include 1) costs to the university and 2) costs to learners.

Finally, our model is dynamic in that all four boxes are intertwined, an insight with important implications for evaluation practice. Analyzing the data across the four overlapping boxes generates specific recommendations for course improvement. The reviews of our book have been very positive. [3-11]

#### REFERENCES

- [1] S. Messick, Validity. In R. L. Linn (Ed.), *Educational Measurement* 3rd ed., New York: American Council on Education/Macmillan, 1989. pp. 13-103.
- [2] V. Ruhe and B. Zumbo, *Evaluation in Distance Education and E-learning: The Unfolding Model*. New York: Guilford Press, 2008.
- [3] A.W. Bates, "Review of Ruhe, V. and Zumbo, B. D. 'Evaluation in Distance Education and E-Learning'" 2009. [Online]. <http://www.tonybates.ca/2009/05/04/reviews-of-evaluation-in--distance-education-and-e-learning/>
- [4] T. A. Chapman "Review: Evaluation in Distance Education and e-Learning: The Unfolding Model". *Amer. J. Pharm. Educ.*, 74 vol. 1, p. 17a, 2010.
- [5] G. Jones "Valerie Ruhe and Bruno Zumbo, *Evaluation in Distance Education and E-Learning: the Unfolding Model*" Book Review", *J. Res. in Internat. Educ.* vol. 11, issue 1, 2011. <http://jri.sagepub.com/content/11/1/106.full.pdf+html>
- [6] M. F. Kennedy, "Book Review: Evaluation in Distance Education and E-Learning: The Unfolding Model New York: The Guilford Press (306 pages). \$34.00." *The Internat. Rev. Res. in Open and Distance Learn. (IRRODL)*, vol. 10, issue: 2, 2009. <http://www.irrodl.org/index.php/irrodl/article/view/717/1222>
- [7] J. A. Lytle "Evaluation in Distance Education and E-Learning: The Unfolding Model– By Valerie Ruhe and Bruno D. Zumbo". *Teach. Theol.& Relig.*, vol. 13, pp. 287–289, 2010. doi: 10.1111/j.1467-9647.2010.00632.x
- [8] K. McShane-DeBacco "Evaluation in Distance Education and E-Learning: The Unfolding Model [Book Review]" *Eval. J. Australasia*, vol. 11, no. 1, pp. 54-57, 2011. <<http://search.informit.com.au/documentSummary;dn=430914335522143;res=IELNZC>> ISSN: 1035-719X. 2
- [9] R. Smyth "Evaluation in distance education and e-learning – By Valerie Ruhe & Bruno D Zumbo." *Brit. J. Educ. Tech.*, vol. 40: 1150–1151. 2009. [Online] Availability: doi: 10.1111/j.1467-8535.2009.01026\_9.x
- [10] A.Thomson "Book review: Evaluation in Distance Education and e-Learning: The Unfolding Model." *Comm. College Enterprise*, vol. 15 issue: 2, 2009. [Online] <http://www.freepatentsonline.com/article/Community-College-Enterprise/213083698.html>
- [11] N. Tran "Evaluation in Distance Education and E-Learning: The Unfolding Model", *J. Educ. Admin.*, vol. 51, issue: 1, pp.100–102, 2013. [Online]. Availability: <http://www.emeraldinsight.com/journals.htm?articleid=17076530&show=abstract>

# A Robot Companion as mobile *Edutainer*

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**Abstract**—This paper describes a robot companion in a museum area. As a mobile mediator it directs the attention of the visitors between the real exhibits and a virtual interactive interface which provides additional information to the exhibits. The provision of the additional information takes place as for instance of background information and films and/or animation of technical processes. The visitor gets much more insight in the exhibits and accordingly in the functionality of technical devices. This opportunity increases the learning effect of the visit. Affected by the combination of the real exhibits and virtual interface the museum becomes to a public place of learning.

**Keywords**— robot companion, mobile edutainer, e-learning, human-robot interaction, interactive interface, edutainment.

## I. INTRODUCTION

Within the interdisciplinary project “*CrossWorlds*” a concept of a service robot is going to emerge. This robot project is designed for a museum context, more precise for the Industrial Museum Chemnitz.

The idea of a museum robot is not new. A lot of different achievements have been described. For example the interactive tour-guide robot *RHINO* [3], its primary purpose is the safe navigation through the museum and crowds and also the interacting with people. The visitors of the museum can send it to a specific target location via a web interface. *Minerva* [15] is also a museum robot which connects the people on a social level. It can express four emotions with the face: smile, neutral, sad and angry. But the primary purpose is also the navigation through the environment. The three robots in the “Museum für Kommunikation” in Berlin, *Komm-rein*, *Also-gut* and *Mach-was* [6] are darlings of the public. They combine the navigation through the museum and a special character in order to communicate with the visitors. *Robotinho* [5] goes one step further, it explains the exhibits. It guides visitors through the exhibition and presents the exhibits in the guided tour.

All these examples let something missing. The visitors of the exhibition have no chance to explore the exhibit by themselves. Time to explore and additional information about the exhibits are not provided from these projects.

The aim of the project which is described in this paper is to provide additional information to the exhibits. The robot accompanies the visitors from one to the next exhibit (III.A.). On every exhibit the robot implements the interactive interface which provides the additional information (III.B.) and the robot alternates between the companion and the mediator. As mediator it directs the attention of the visitors from the exhibit to the additional

information (III.C.). The mobile robot mediator increases the concentration of the visitors and the interactive interface offers a public learning management system in the museum.

## II. PEOPLE’S NEEDS

Nobody can say this in general. But the observations in the industrial museum and many conversations evinced that visitors are interested in copious information about the exhibits. They want to know dates, descriptions of the source, manufacturing and functionality and more background information. Several of these information are offered in terms of charts in the near of the exhibit and additional information on special information terminals in the center of the showroom.

However, these capabilities can not solve one problem: The visitors can’t take a look inside and see how the technical device works.

Some visitors adept in technical mobile devices procured additional information via these mobile devices. They search for apposite answers and by the way they check e-mails, the daily news and post ‘I am here’. This distracts the attention of these visitors. And the digital outsiders [7] can’t even search for information.

Both of them need a method which connects the real environment with additional information. This method has to combine the experience of see, smell and touch of the real exhibit and with the information offered in form of a *virtual interactive interface*. This method is called *virtual overlay (mixed reality)*. Thus the visitors have no split attention between real and virtual and no isolated information to the exhibits. With the help of this method the visit of the museum will be an *edutainment experience*.

## III. MOBILE EDUTAINER

The term *edutainment* is a art term composed of *education* and *entertainment* as personification *edutainer*. Edutainer primary contains the interactive form of knowledge transfer. That means the transfer of knowledge is playful and enjoyable. This kind of knowledge transfer can happened in robotics. [11]

The robot contains the three parts for an *edutainment* trail through the museum. The first part which is needed for an *edutainer* is an attentive host. This host greeted the visitors and accompanied them through the exhibition. The edutainment interface is the second and main part for the *EDUCation* of the edutainer. Third part is the mediator and together with the companion they are enterTAINER of



the edutainer. These parts are depicted in figure 1 and described hereinafter.

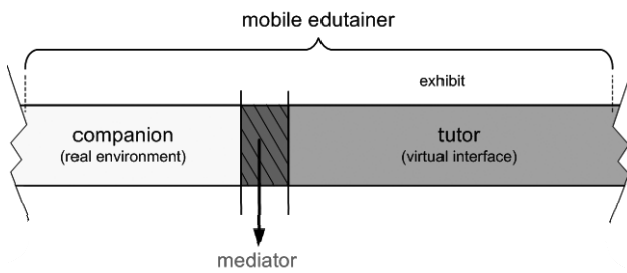


Fig. 1. Extract of the 'robot-human interaction sequence'.

### A. Robot Companion

What does *companion* means? A companion is a system which operates individually. The companion works adapted for the capabilities and requirements of the user. [2] "Robot companions are expected to communicate with non-experts in a natural and intuitive way" [4].

The mobile robot companion is composed of a small robot platform with a light metal frame which carries an additional computer, a projector with low consumption and other technical devices [14].

The greeting is the first exercise for the companion. For an attentive host of the museum the first contact is important. In this way the visitors can get to know the robot and the robot can convene the visitors. The perception of the human beings and there properties is important for the system to interact with the visitors individually. The results of the perception defines the further steps. For example, if a group of people perceives, the edutainment interface will provides other content respectively the content is shown in an other kind as if one individual identified. With this group of interested people the companion steers from one exhibit to the next. Its tour is arranged as thematic tour like the genesis of the sewing machine or as chronological tour like developments in the 19th century. In the order of the arrangement the robot stops at the exhibits and initializes the interactive interface.

### B. Edutainment Interface

First and foremost a museum offers real authentic objects. To see and witness these exhibits is the intention of visitors. But a visitor wants also further information about the objects. With charts on the exhibits the museum try to accomplish this need. However these charts are not convenient to present all the needed information, the information are bounded. The most of the museums offer additional information to the exhibits on central information terminals. This is a possible way, but the connection between the real exhibit and the additional information is not given.

The further information have to connected with the exhibit. The virtual interactive interface creates this opportunity. With the help of the projector which is inside the robot becomes the exhibit to an interactive surface. All information about the current exhibit are projected on the

exhibit itself. This technique enables to take a look inside the technical device.

This hybrid arrangement of learning is a chance for the visitors to have an autonomous experience. This concerns the real exhibits and the virtual exhibits. And an other benefit of this arrangement is the interpersonal communication between the visitors. [8]

By the projected interface on the surface of the exhibit originates a large interaction interface. This projection in a public area invited people not only to interact with the information further more they interact together and communicate together. This also supported the term *edutainment*. A relaxed learning situation including communication with friends and other visitors of the museum. It accrues a large interactive edutainment public screen on the exhibit surface.

With the help of a infrared pointing stick it's possible to interact with the provided information. This pointing stick is like a baton which indicates the visitor who is interacting. Because the visitors recollects the pointing stick in school is the general handling no problem.

All of this is the groundwork for the learning management system. The interface is constructed like the exhibit itself. The user of the system see the same object twice – the first in real and second virtual projected on the real. So it originates a mixed reality and a content link for the transfer of knowledge. This simple depiction enabled the user a reasonable interaction. If a visitor wants to know more about the engine room of exhibit like a steam locomotive he can click at this area on the projection and additional information are displayed. This simple structure allows also digital outsiders the interaction with the interface. They need a manageable and comprehensible process to interact with the content by themselves [7]. One further benefit of the construction of the interface is, that only content about the current exhibit is presented. When the group of visitors arrived on the next exhibit, the interface presents only information about this exhibit. This determination connects the content with the object and concentrates the attention of the visitors.

The interactive interface is constructed like a storybook. All information are transported by pictures. These pictures are informing pictures which are distinguishable from artwork [16]. The pictures depicted embodiments of the exhibits, graphics about technical processes, animation of engineering proceedings, films of the assembling of an exhibit and much more. This enumeration includes animation and films as a special kind of pictures; Animation and films are an array of frames. The different between the animation and the film is the level of reality; A film has a high level of reality and an animation is a figurative depiction which changes in structure and feature across the time. [10] The interface forgoes textual contributions. For visitors it is troublesome and exhausting to read text which is shown in a digital way [1]. This is not only a point for a better learning for adults, this is also positive for children. They can learn together with the adults and have no detriment.

The outlined above descriptions explain a learner controlled interface (fig.2). This figure shows at a first point the introduction. The introduction equally the finish is realized by the mediator, described in III.C. Such an

interface is explained by three processes: information demand, demand analysis and information presentation. These three processes work in a circle so long the user interacts with the interface. The visitor can interact free with the system – the system does not regulate the user. For an other situation as in a museum this seem not a suitable form of learning. But with the background of edutainment it is a relevant opportunity.

Such a learner controlled interface required three parts. The first is that the system depicts the content in this scenario it is depending on the current exhibit. Second part is that a human pinpoints the content. The content is separate in units of learning. In a museum these units are not complex. Certainly, the content of history, assembling, construction and engineering proceedings of each exhibit is complex but a museum not exists for a detailed learning program. A museum has to awaken interest with profound information. The learning units are arranged for instance in a temporal or a developing way which shows the progress of the construction of automobiles. The last part is the possibility of the user to interact with the system in an individual way. The visitor has all capabilities to choose what he wants. The visitor in this case the learner has the freedom to select more technical details or more background information. Also the system pinpoints not the order of the approach of the user. The user has all freedoms, the freedom of time, order and content.

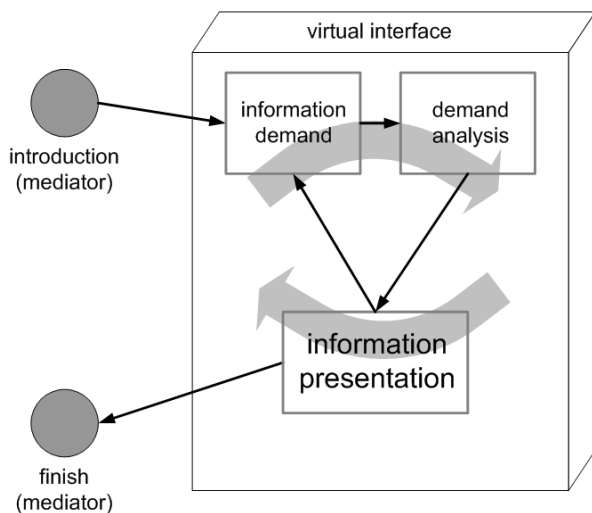


Fig. 2. Learner controlled interface.

Further, the total system include the robot companion/mediator can enlarged to a *simple tutoring system*. In the opposite to a learner controlled interface a simple tutoring system functioned also as tutor. Thereby the individual learning of the visitor is not have gone. The tutor only directs the learning units.

One step on this way is the already mediator which directs the learner attention and explains the handling of the interface. The next step is the robot as tutor. The robot has the technical and pedagogical competence like a human tutor. This requires that the robot system has an extensive interaction competence. For this kind of human-

robot interaction it is necessary to perceive user utterances. [9]

The developing of an *intelligent tutoring system (ITS)* is a protracted developing process and requires an intensive interdisciplinary cooperation between social scientists and developers or engineers [12]. An ITS is a desirable status of the interaction interface but at first the current status of the interface has to tested.

After the tests next step will be a simple tutoring system as *drill and practice system* [9]. This system is realizable in the near future and can be a predecessor of the ITS. Together with the human user or in this case learner the system goes a compulsory learning track through the museum. The mobile robot follows a logical and educational track through the learning units like a human tutor. This compulsory way allows a connection to the next exhibit and this learning unit equally to the previous exhibits and these learning units.

By the help of games and puzzles the learning status of the user is analyzed. The analysis of the learning status allows the mobile system to change the strategy. It can drive to an other exhibit with a similar technical process and so the user has a chance to repeat the learning unit. After every exhibit/learning unit the user can see the progress of the total learning track. This can be an instrument for motivation.

The museum is mostly not a place where humans go alone. The described interactive interface possesses opportunities for joint interaction. With the large projection all people can see the depicted content. They can communicate about the exhibit, the puzzles or other content. The technology creates the possibility for interpersonal communication and a joint learning.

### C. Mediator

The mediator occurs between the companion and the interactive interface. It directs the attention of the visitors and the concentration in general. With the using of mobile technical devices users are not concentrated – not at the real and the virtual. By means of the mediator the attention is interfered between the real exhibition environment and the virtual interface which projects the additional information and vice versa. [13]

In the learning situation the mediator has an other function as well. The mediator takes over the introduction and finish of the virtual interface (fig. 2).

The introduction is necessary for the handling of interaction interface. The mediator explains the interaction pointing stick and the opportunities of interaction. This happened in a way that a person who not interacts the first time is not bored. During the phase of initialization the projection shows a pictogram and the mediator declared the procedure. The finish is the counterpart. If the interacting person closes the learning unit the mediator directs the attention from the virtual interface to the real environment. The robot mediator leads to the next exhibit. With facts and stories about the next time period or the next developing.

The mediator is a attentive friend. Both, the companion and the mediator escorted the visitor on the way through the exhibition. They have a factor of entertainment. The

loose contact with the visitors, the relaxed kind of communication and the factor of sympathy for the robot are points for a favorable interaction between human and robot. Because of this favorable human-robot interaction the learning situation can be successful for both sides. On the one hand the visitor learn more about the exhibit, technical details and the whole exhibition. On the other hand the museum as an place of imparting of knowledge and conservator of historical devices passes the knowledge of the history of humankind on.

#### IV. CONCLUSION

The robot which is described is a mobile *edutainer* between the exhibition and the offered additional information. The interactive learner controlled interface facilitates the learning in the museum from the versed user to the digital outsider.

By the virtual overlay projection a connection between real exhibit and additional information accrues. This method permits a virtual direct interaction with the exhibit respectively the projected interface. Thus the visitors can explore the inward of the exhibit. This interface enables the visitors to learn more about construction and technical processes.

Because the components are given it is possible to extend the learner controlled interface to a simple tutoring system. This allows the user a structured learning with small test for instance in the form of games. So the visitor is encouraged to learn more about the exhibits and background information.

With the deployment of a mobile robot as edutainer and combined with a tutoring system accrues a win-win situation for the visitor and the museum. the museum passes the knowledge of the human history and the visitors learn all about the exhibits and there technical processes. In this manner the visit of the museum and the learning situation becomes to an informative adventure through technical devices.

If one *take a look in the future*, it can be possible that the robot can be steered from home through the museum. When the robot is not booked by visitors of the museum or outside the opening hours, users can control it from home. With help of cameras the user can see the real exhibit on screen. The normally projected additional information are also shown of the screen at home. Via split screen the user can interact with information about the exhibit. If it not possible to visit the museum in real for whatever reason – this can be a substitute for a real visit.

#### REFERENCES

[1] S.-P. Ballstaedt, *Wissensvermittlung die Gestaltung von Lernmaterial*, Weinheim: Beltz 1997.  
 [2] S. Biundo and A. Wendemuth, Von kognitiven technischen Systemen zu Companion-Systemen, *Künstliche Intelligenz (2010) 24*: pp.335-339  
 [3] W. Burgard, et al., “The Interactive Museum Tour-Guide Robot”, in *Proc. of the Fifteenth National Conference on Artificial Intelligence (AAAI-98)*, Madison, Wisconsin, 1998.

[4] K. Dautenhahn, et al., “What is a Robot Companion – Friend, Assistant or Butler?”, in *IEEE/RSJ International Conference on Intelligent Robots and Systems, 2005. (IROS 2005)*, pp.1192-1197.  
 [5] F. Faber, et al., “The Humanoid Museum Tour Guide Robotinho”, *The 18th IEEE International Symposium on Robot and Human Interactive Communication*, Toyama, Japan, 2009.  
 [6] B. Graf, W. Baum, A. Traub, R. D. Schraft, „Konzeption dreier Roboter zur Unterhaltung der Besucher eines Museums“, in *VDI-Berichte 1552*, VDI-Verlag 2000, pp.529–536.  
 [7] Initiative D21, TNS Infratest (pub.), *Digitale Gesellschaft 2011*, TNS Infratest 2011.  
 [8] D. Klinkhammer and H. Reiterer, “Blended Museum-Vielfältige Besuchererfahrungen durch hybride Vermittlungsstrategien“, U. Lucke (pub.), *Workshop Proceedings der Tagungen Mensch & Computer, DeLFI 2008 und Cognitive Design 2008*, Berlin: Logos-Verlag 2008, pp. 424-428.  
 [9] M. Lusti, *Intelligente tutorielle Systeme Einführung in wissensbasierte Lernsysteme*, München: Oldenbourg Verlag 1992.  
 [10] H. M. Niegemann et al., *Kompodium multimodales Lernen*, Berlin Heidelberg: Springer-Verlag 2008.  
 [11] R. D. Schraft, M. Hägele and K Wegener, *Service Roboter Visionen*, München: Carl Hanser Verlag 2004.  
 [12] A. Tallig, „Roboter-Mensch Interaktion: Modell interdisziplinärer Zusammenarbeit“, *Workshop Proceedings der Tagung Mensch & Computer 2013*, Bremen.  
 [13] A. Tallig, W. Hardt and M. Eibl, “Border Crosser: A Robot as Mediator between the Virtual and Real World”, A. Marcus (Ed.): *DUXU/HCI 2013, Part III, LNCS 8014*, pp. 411-418. Heidelberg: Springer 2013.  
 [14] A. Tallig, *Grenzgänger-Roboter als Mittler zwischen der virtuellen und realen sozialen Welt*. Chemnitz: Chemnitzer Informatik-Berichte CSR-12-05, 2012.  
 [15] S. Thrun, et al., „Probabilistic Algorithms and the Interactive Museum Tour-Guide Robot Minerva“, in *International Journal of Robotics Research, Vol. 19, No. 11*, 2000, pp. 972-999.  
 [16] B. Weidenmann (pub.), *Wissenserwerb mit Bildern instruktionale Bilder in Printmedien, Film/Video & Computerprogrammen*, Bern: Huber 1994.

# Progress Result in the Development of Open Online Learning System

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**Abstract** —Today online learning systems such as VLE, Blackboard, WebCT, Moodle and Frontier are widely used in the world. These systems give more attention on their online learning management part rather than teaching techniques and methods. Most learning management systems offer a limited number of teaching methods to trainers. There is not a nationwide online learning management system in Mongolia. Mainstream universities have started using UNIMIS and UNIFIS. These learning management systems are suitable for formal education systems and their fee and payment transactions methods are based on training supplier model. However they do not offer full open access. This research work has several aims: analyse main factors that are influencing learning management system and their interrelations in the process; identify key aspects that need to be addressed in order to improve learning management teaching methods; and translate online learning user survey results into a statistic presentation. Evaluation the statistical presentation identified key aspects that need to be addressed.

**Keywords**—Electronic Learning (EL), Learning system (LS) and Content management open system

## I.BACKGROUND

We aimed to assess the needs of building an online learning system that is independent from training suppliers based on tutor and learner model or education organisations and to identify the structure of such a system.

Our main focus was to design a system that enables trainers to develop programmes for learners, provides multi-choice payment methods, and requires minimum knowledge on software management, gives total freedom for trainers in teaching techniques and methods and creates a stress free learning environment for learner and suitable for formal and non-formal education training and most importantly the system suits peculiarities of Mongolian education system.

### 1.1 Current issues

Not only in Mongolia but also in the world internet service has reached to the level that it can be used for online learning. The number of students using online learning systems is constantly increasing. However the number of teachers providing online training has not met

the demand and the lack of their knowledge of online technology and methods developing online training become issues that need to be addressed.

We believe that it is very important to address the lack of Content Management Open System (CMOS).

Open system does not always mean that it is free of charge. Trainers will have free access to open and use an account and it is their choice if they sell and rent the content of the learning programmes that they developed.

Knowledge and skills acquired through online learning is differ and stressful experience of facing some structural and system difficulties make learners disinterested in online learning.

Teaching methods /methodology of trainers and quality of the content of programmes are key contributing factors and also simplicity of structure and programme layout design and balanced combination of teaching methodology and system management are influential as well. Addressing all above mentioned aspects/issues thoroughly and improving methods of the open online training become priority.

### 1.2 Purpose of this project

The purpose of this research work is to bring the understanding of online teaching methods to a new level by identifying issues and bringing them to teachers and programme designers, also to identify key factors that have negative effects.

All main instructions and training manuals as well as supporting guidelines are being reviewed.

## II.RESEARCH BACKGROUND

The key for any successful e-learning is effective relationship between teacher/trainer-content-learner, teacher/trainer – learner and learner – teacher/trainer. Another words it is crucial to have a well thought design /layout of online training management that would be managed by trainer/teacher, stress free learning environment for learners, interface of uploading content and navigation and effectiveness on programme types, scheme, drop down choices, content expanding and narrowing functions.

It was decided to develop the System Universal Recession (??) that contains above features and to test it as an open online learning system.

The survey was done based on the related materials for answering through the conclusion making based on the information and facts. Research of the survey was divided into the following stages:

1. Online training system. Whether the online learning systems used more widely in the learning and teaching organizations and institutions around the world is convenient for both the instructor and trainee, if the system is easy to use, understandable, easy to be used for teaching and learning, and the training methods related to this system is accessible, and more development needed.
2. Direct and indirect impacting aspects: To determine the direct and indirect impacting factors of online learning system and online learning methods more convenient to the condition of Mongolia
3. Mathematics statistics: to develop the sample, determine the methods of evaluation using the mathematics statistics for the result of the survey and customer satisfaction

### 2.1. Online learning systems

The most common systems used in other countries (VLE, Blackboard, WebCT, Moodle, Frontier etc.) have been developed for the educational organizations and institutions, and within the frame of those systems, the traditional teaching methods and ways have been developed and changed more into the online learning system. Observing the activities of development of conclusion, evaluation system for the conditions of the above mentioned, this online learning system could become the facility for money making for the training and educational organizations and institutions, for the students and teachers, the online learning system could be understood not so much of the useful. [1]. This can be seen more clearly from the training curricula of the world's leading organizations and institutions.

All those mentioned systems are not to be easily used for any teachers to spread out their any existing level of education and make profit, instead the teachers and learners are frustrating to use the system based on their level of education and ability of information and technology.

Therefore, several of us had established "E-learning national center" Non-governmental organization and developing and practicing an open e-learning system for not educational organizations, but for only "Teachers" to study any teaching and learning context of any countries of the world. We are focusing more onto the developing level of it and developing along with the demo of how to use the system based on the teaching methods of teachers and learning methods of the students.

Besides, we carried out the survey on learning and teaching methods of the learner and teacher during the update of the context of the teachers into the system and interested candidates learning the updated context, and focus more into the development stage of the system. These are:

- 1) To carry out close survey on the satisfaction of the customers by giving the chance to study the context of the teacher. When to carry out this survey, we had focused on the customer interface section design, study the related topic context, structure of the participation and communication section,

payment system of purchasing important context, search section of the context and the value of it.

- 2) To develop the system based on the survey, develop and establish different contents of the survey, interface samples and let the teachers to try and practice them
- 3) to plan and develop electronic context, carry out methodological survey and research and convert into online type and upload it online, use the up to dated technology of information and technology, make them easy to use and observe if it is still easy for use.
- 4) to organize introduction of online learning system, use all sorts of introduction methods.

### 2.2. Directly and indirectly impacting factors

The online learning systems under the consumption today has the tendency to only be useful for the teachers within the frame of their own activities and more there are direct and indirect aspects impacting the teachers are more the following consumption matters. The online learning system established the difficulties should be open and devoted for instructor and learners in real.

In order to develop the e-learning system used both in other countries and in Mongolia and its level of consumption, the following aspects impacting it directly and indirectly are concerned as follows: 1) Aspects impacting the level of the consumption of the teacher \context developer\, 2) Structure and arrangement of the section for potential customers or the trainee 3) valuable condition of the learning context, methodology and technical development of the updated info and depth 4) admin section for the teachers or context developer, customer interface section design and structure.

Aspects impacting the consumption section which shall be developed into the online learning system structure:

1. Trainer.
  - Anyone who concerns oneself as a teacher can use the system and carry out the training
  - To develop the system with any given information which can be useful for human being
  - To develop the context matching to his or her teaching methods
  - To sell his or her context(required to have his own system linked to the banking system)
  - To get registered as an inventor or have the copyright for the new information or context developed by special methods and get the benefit of it.
  - Use from the database of the context
  - Required to have the system which consists of the possibilities of statistic survey, database and information collecting and carry out the forum
2. Trainee.
  - Anyone, any existing trainee can access and log into the context of any trainers, search and study from his or her own profile.
  - To study the context without the matter of time and distance matter

- The context which is considered important can be studied by paying the fee online if it is not free of charge. (Required to have the payment facilities of the online banking system.)
  - The trainee by his or herself can be the teacher by itself.
  - to organize forum on any interested topics
  - The trainee can establish a network for trainees, study the context out of it and rent an access of the study and can lend it as well
  - To get a certificate for formal or informal education gaining by this system
  - To have his or her own education and ability be evaluated or get evaluated
3. Content.
- Have sufficient and enough selection or choice of the context in the trainee section
  - Should have section for level determination or ability determination
  - The context shall be normal, but should be scientific and has its own system
  - During the study period of the context, this shall get more richer and intensive
  - The context should consist of the ability to be used again and again
  - The evaluation method shall be interesting
  - The evaluation shall be done official or unofficial form
4. Interface and design
- The teachers' context, admin and management section shall be in formal format
  - When teacher works with the context, this shall not require the teachers to work with HRML, code and other knowledge
  - The e- context shall not be saved in index.html format, instead this shall be saved in EXE, SWF, FLV and can be uploaded and at this moment, this can be linked using the facility of the control system
  - This shall be stress free, has leading structure and this can be developed by the cooperation of both the teachers and trainee. If the system consists of all of the above mentioned, this can be considered as the real living system which shall be implemented and easy for development.

### 2.3. Mathematic statistics sample

In order to determine the impacts of the result for teachers and trainees using, consuming, and developing the context of the online learning system, mathematic statistic methods shall be used for the result of the satisfaction survey. We had used ordered validation model within the discreet models.

The selection made from out of the given selections is randomly done and can be displayed by the function of determining the highest result. [3].

$$y_i^* = \beta'x_i + \varepsilon_i, \quad (1)$$

Here:  $y$  – alternative or consumer selective concept  
 $\beta$  – Index

$x$  – Concepts of the impacting aspect

$\varepsilon$  – acceptable loss

The selection of the customer or trainee and developer or the teacher shall be discreet /numerical/, and shall be the ordered concepts. The highest score giving choices can be done from the following ordered selections.

$$\begin{aligned} y_i &= 0 \text{ if } y_i^* \leq \mu_0, \\ &= 1 \text{ if } \mu_0 \leq y_i^* \leq \mu_1, \\ &= 2 \text{ if } \mu_1 \leq y_i^* \leq \mu_2, \\ &\dots \\ &= J \text{ if } y_i^* \geq \mu_{J-1}, \end{aligned}$$

Here:  $\mu$  - convertible concept (the selection converting concept)

When implementing the calculation by this given model, the concept of J is always selected by the numbers up to 5. On the other hand, the selector always chooses the points of 1-5 which can get the highest score for the selecting person. The numerical concepts of the above mentioned model shall be collected by the survey and theory shall be developed.

### III. SURVEY, RESEARCH METHOD

The advanced conclusions were made based on the numerical concepts using the methods of comparison concerning the aspects for the development of interface design, contexts, section for the trainee and the instructor or developer. Not only the general structure of the system but also observing the planned and developed activities of us for the online learning system and its practice. After all these, we are carrying out the activities for development based on the conclusion carried out by the model of collecting numerical results of the survey based on the condition of the SUR online learning system and its conditions.

#### 3.1. Methods of collecting information

We collected information from amongst the teachers and trainees consisting of 45 questions for the teachers and students using SUR online learning system in 2011-2012 related to the system operation. The survey covered about 200 students and 36 teachers using the system.

The first 37 questions of the questionnaire were evaluated 5 points for the first 4 arguments (1 the worst, 5 the highest) mentioned in chapter 2.2 and determined the satisfactory of the customer. The last 8 questions were developed to be selective or fill out form to determine the impacting aspects. All the aspects impacting the teachers, students, contents and interface mentioned in chapter 2.2 were included in here.

The questionnaire was carried out by handing out the questionnaire paper and collected them back right after the introduction of the project No. 1 on the 20th of May, 2012. The 2nd project introduction and practice is planned to be carried out on the 21st of November 2012.

#### 3.2. Calculation, diagnosis

The numerical information of the survey collected and the most important aspects have been determined. From the result of the survey how easy and understandable of SUR system access, log in, start the program, work with the program, do the assignments, participate in the evaluation and testing, contacting, participating in the

forum shows that the program is not fully understandable for the students. (picture 1).

This is caused as of the level of the attitude, experience and the knowledge of the information technology of the students, but also it shows that we need to develop the system and make it even claim easier for the first time users. We consider that it is important for us to develop whether this belongs to the aspects impacting the methods of the section for the customers. We are still carrying out the survey and practice for it. In the teacher subject context, home works uploading section requires more time and activities from the teachers and more stressful. (Picture 2). From this section, we can realize that the teacher or admin section should be made more easier for use.

If you consider the general access of the registration of the logging information of the students learning the online context learning, the customer evaluation section, teachers' context development stress evaluation are directly impacted.

If you see the line access of the results of the new session of the school year, the result appear these decreasing is directly related to the teachers' methods of teaching and value; it is indirectly related to the suitable condition of the system and the ease of use. The reason is that the teacher has less possibilities of preparing important and useful context for not suitable system.,

As a result of our 2nd project, the access tends to be increased. This is related to the development of the interface design, and developed the program more convenient and easy for use. And also the difficult section of the admin or the developer was changed and made more easy for them to use. When the teacher section became more convenient and easy for use, the context developing quality increased and probably the value was increased as well. Based on the admin section operation, the development level can be various and not teaching the teachers to use the difficult system, changing the operation of the context developing section more easy.

Also the electronic context shall impact the teachers' financial resources directly. In this case, the methodological level of the teachers and interest and motivation will be increased.

In realistic, the tendency of the teachers to learn using the context preparation software depends on the finance directly.

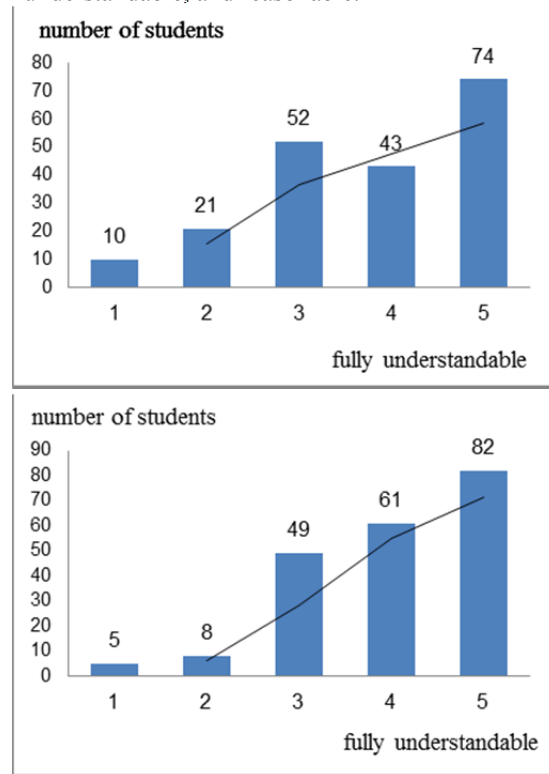
Observing the answers of the students whether they want to take online learning system using the school, internet café, at home or the mobile network or has enough facility, the tendency for it cannot be seen. (picture3). From this result, we can see that there are certain number of difficulties which impact the online learning system efficiently and frequently such as the lack of internet access, internet café is in the distance from home or school, less experience of online learning system, the consumption of information technology is below the level etc.

All these aspects are impacting online learning system negatively. 55% percent or 110 students participated in the survey answered "no internet at home or in the dormitory, the internet café is in the distance from home and dormitory, hard to get there", the remaining percent of the students answered that they have lack of facility or equipment.

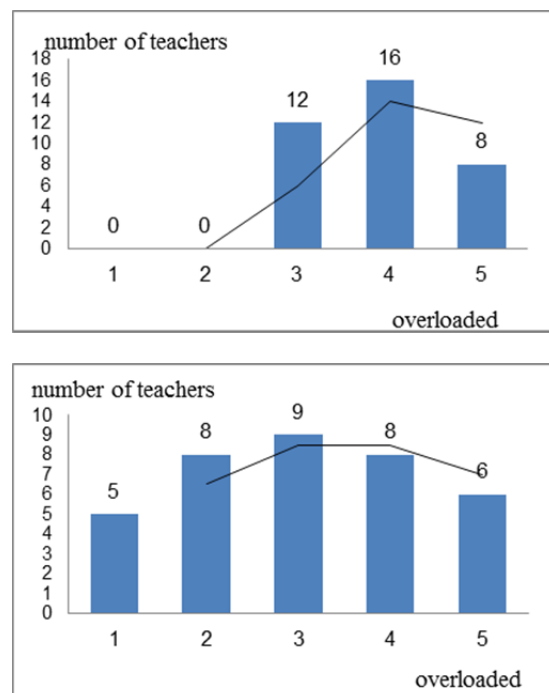
If you see the tendency of learning online learning "35% at home, 35% mostly at the internet café, 26% by mobile network and the remaining 4% of them answered they are possible to study the online learning context at school.

From these answers, we are in lack of internet access and equipments for every single student and trainee to access and learn online learning. Therefore, the students answered it was hard for them.

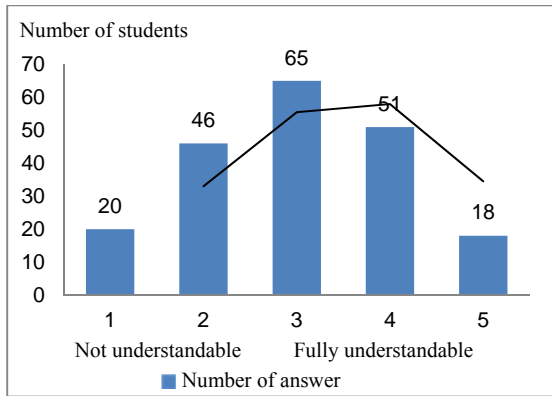
When evaluating the strength of spreading out the information of SUR system, we chosen to show "understandable, and reasonable."



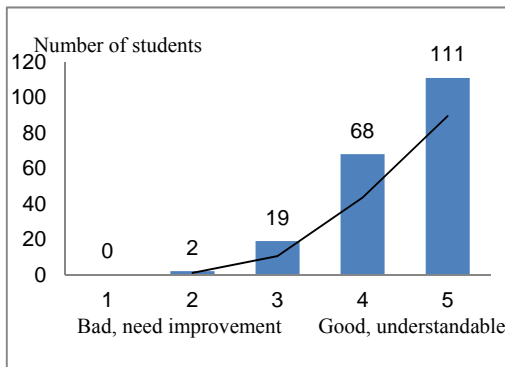
Pic 1. Comparison of evaluation of the consumer section



Pic 2. Comparison of evaluation of instructor content development



Picture 3. Evaluation of environment.



Picture 6. Strength of information transferring evaluation of SUR system /after the 2<sup>nd</sup> project/

After the mapping method, we selected the most important and impacting aspects from the results of using ordered probate method using NLOGIT 4.0 program observing the impacting aspects. Total of 7 models were tested and made the acceptable concepts of every single model determination index (Pseudo R-Squared) and selected the models and results of models related to the subject load (R-Squared=0.075), model related to the online learning context (R-Squared=0.01).

#### IV. RESULTS OF THE CALCULATION, MATTERS TO BE MORE CONCERNED IN THE FUTURE

The concept of the argument was replaced by the results of the student evaluation concepts which reflects how the online learning subject loads impacts the learning process of them and the total time of learning was replaced by the impacting aspects and determined how the online learning activities, other subjects and their time consuming, assignments, individual works were modeled and calculated. The results can be seen from the following chart (table 1).

The total credit of the selective subjects were 19.7 per school session mentioned by the students participated in the survey. And when learning online learning subjects, the impact of the other subjects are huge. (Index=0.374). As of it, the proposed and planned learning subject load is huge during the official educational system; it is impacting to the online learning. This is the important aspect for the teachers and professors of the higher education unit to develop the online learning system very much based on the survey and research and correlation of the other subjects and their load on to the students. The students who are learning the subjects over the e-learning system cannot gain enough knowledge of the certain subjects, and re-study the subject in the next

session as of the failed and the teachers are required to pay much more attention not to make the students to fail on the given subjects and re-study them again.

Impact factor	Index	t statistic	P(Z>z)
Probability index and functions			
Stable	-5.421	-1.5	0.133
Selective subject credit	0.374	2.019	0.043*
Limit features			
μ 1	0.499	1.449	0.147
μ 2	1.526	4.978	0.000***
μ 3	2.829	7.737	0.000***

Apparent: \*p < .05, \*\*p < .01, \*\*\*p < .001

Chart 1. Ordered probate model regular subjects impact on online subjects

The most important complain which raises from the students is that they spend useless much more time on the processing of the training material for completing the assignments of the online learning, not enough time consuming for online learning, and as of this, they do not have enough implementation for the evaluation which is complete and accurate.

In order to determine the reason of it, we had studied e-lecture, introduction, e-book, handouts, individual works, graphics, works done by the previous course students and reached out to the conclusion which impacts the students to complete their works and homework. Please refer to the following chart (chart 2).

Impact factor	Index	t statistics	P(Z>z)
Probability index and functions			
Stable	1.704	1.959	0.050*
E-lecture, introduction	0.438	0.574	0.566
e-book, handouts, demo for individual work	0.106	0.543	0.587
Samples and works completed by students	0.214	0.314	0.754
Limit features			
μ 1	0.623	2.077	0.0378
μ 2	1.412	5.029	0.000***
μ 3	1.922	6.27	0.000***

Apparent: \*p < .05, \*\*p < .01, \*\*\*p < .001

Chart 2. Ordered probate model regular subjects impact on online assessment

From the result of the data given in the above chart, there is not any impact (p>0.566) of the e-lecture, other introductory materials, possibilities of searching and studying the hand outs have not much negative impacts on the students learning process of e-learning. But there might be other impacting aspects than the ones which used for the survey in here.

This shows that the value of the online context is not much when there is a context published and printed on the paper in the hands of the students. Therefore, developing the context of the e-learning more by increasing the context of the published materials make it powerful or make the methodology easier.



## V.CONCLUSION

The new online training system which we had developed and used can be determined as one of the possible, useful online training system for both the instructor and trainee. But the project proposal for developing SUR system which is under development, shall be enriched, and get developed more.

- To bring the planned learning hours for the trainee to be free as for the last version of the project development, impact the time usage more efficient
- The other subject stress shall be well in advance calculated and estimated for the trainees who are choosing to study online training system and give a chance to the trainee to organize his or her own time for online learning and direct them to the way of individual works and besides make this online learning system and its context more valuable.

and convenient for the learner, registration, payment, and other statistics researches shall be more convenient for the teachers to complete online

- To develop the software convenient for any methods of the pedagogy easy for the teachers to use their own methods of teaching which is widely used throughout Mongolia. More over establish and publish advisory methods for trainers. There is lack of advisory publication methods software for using any types of training methods for online training.

## Reference

- [1] Kh. Tamir, B. Bolormaa “Formulating didactic basics of electronic learning.” MUST, Scientific Publishing-7/123, 147 Page, UB. 2012
- [2] B.Munkhchimeg, Kh. Tamir “Methods of developing software for E-learning” MUST, Scientific Publishing-7/123, 172Page, UB. 2012

# Distance learning from Asia to the Europe

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**Abstract**—This paper presents case study and some problems of managing, teaching and learning experience between Europe and Asian countries by distance learning course. Distance learning course implemented via tele lectures which designed and recorded by Computer Science Department of Chemnitz University of Technology. The participants were from Asian countries: Mongolia and Thailand. In distance learning used learning management system OPAL of Chemnitz University of Technology. This paper discusses the e-learning development background in Mongolian University of Science and Technology, the OPAL e-learning platform development in Chemnitz University of Technology, and case study with tele lecture with discussion of Mongolian participant.

**Keywords**— distance learning, e-learning, tele lecture.

## I. INTRODUCTION

The Mongolia has not yet three million populations, but population is very young. The young people are dreaming to study outside of home country. But it is no possible for every one because of financial need and requirement. In this case distance learning from home country to outside is one of big opportunity for learners. The Mongolia has good developed internet access base for distance learning.

There are over 120 internet cafes and game houses in Ulaanbaatar city, which are connected to high speed Internet. The services offered at Internet cafes vary from access to Internet, use of computers and basic services, such as photocopying, scanning documents and taking photos.

According to the recent survey conducted by Intec (<http://www.itconsulting.mn>), IT consulting company of Mongolia, among the Internet cafes and game houses in the rural parts of Mongolia covering 16 aimags of Mongolia, the estimation is that there are about 3-5 Internet cafes or game houses in each aimag center, leading to conclusion that there are 80-100 Internet cafes outside of Ulaanbaatar city, and over 200 Internet cafes and game houses nationwide.

There are 24 ICT educational institutions in Mongolia, which train ICT professionals, of which 7 are public institutions, and the remaining are private institutions. There are over 6,000 students studying in those institutions, specializing in software engineering, network administration, information systems and management, hardware engineering, telecommunications engineering, postal services, electronics engineering, optic communications, television and radio technology, satellite and wireless communications, information technology, etc.

The Informatics Institute of Mongolian Academy of Sciences of Mongolia has been established in 1987. The primary objective of Informatics Institute is to conduct research and development in the areas, which will facilitate development of policy to improve government policies. The researches related to Information technology and applications, establishment of geo-information systems and development of knowledge base related to land and geography were carried out.

The tertiary education institutions, such as Mongolian University of Science and Technology (MUST) and National University of Mongolia (NUM) have been conducting a number of researches and development works on ICT. The School of Information Technology and School of Mathematics and Computer Science of NUM and Computer Science and Management School and Communications and Information Technology school of MUST are the primary institutions, which carry out different researches and development.

The Education reform project currently implemented at Ministry of Education, Culture and Science of Mongolia has big component related to ICT, which includes development of Master plan of ICT in Education sector, addressing issues of ICT policy, infrastructure, hardware, software, human resource development and capacity building and content development etc. There is an Open Education Management Information System being currently pilot tested in Mongolia. The Open EMIS has been developed by UNESCO Paris office to address the need of members-countries to have unified management information system. Its open source code based software and piloted only in Mongolia.

## II. MONGOLIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

The Mongolian University of Science and Technology (MUST) is a multidisciplinary and multileveled university for education, training and scientific research. It is also one of the largest centers for scientific and cultural exchanges in Mongolia. MUST is one of primary university of Mongolia where started implemented e-learning into to higher education.

The MUST is key university of e-learning in country. There are many activities running parallel for develop and successful implement e-learning for education.

One of main mission of MUST is to become First E and Open University of Mongolia. With this target MUST implementing several phase of master plan.

- In 2007 Mongolian University of Science and Technology confirmed first Development plan for e-learning until 2010. This historical plan had

15 different main targets (Master plan for e-learning in MUST, 2007):

1. E-learning development like basic future teaching direction of main education system of university
2. To develop of "UNIMIS" monitoring and advising platform
3. Cooperation with internal and external partners in e-learning developments
4. Start develop e-course and implemented these to teaching process
5. To develop LMS for e-learning platform
6. To develop of technical equipments for e-learning courses
7. To create and implement ate of virtual laboratories
8. To do research in applications and software which using in other local and international universities
9. To develop e-library in MUST
10. To develop law issue for e-learning in MUST
11. To define role of professors and students in e-learning environment
12. To develop e-courses curriculum
13. To define credit system for e-learning system
14. To define role of tutors in e-learning system
15. To define exam methods for students in e-learning system

In 2010, the Information Technology Centre and ICT Teaching Methodological Centre were joined on the basis of Order No.183 of Minister of Education, Culture and Science and according to Order No. 28 of the Rector, E-Open School was founded to administrate distance-learning activities of the University and it has been working with below structure since January, 2010 (E and Open University Story, 2012)

- Training & Teaching Methodological Team
- Information Technology & Software Team
- Internet & Hardware Team
- Online Testing room
- U-CLASS distanced-learning room
- Online & Video Conference hall
- Multimedia Studio with full equipment

From 2007 start release master plan of e-learning into life. From Table 1. can see how developed e-learning in MUST. In 2007 MUST had only 62 e-students which selected 19 different e-courses.

Table 1. E-learning development in MUST

Academic year	Semester	Number of e-Students	Number of e-courses
2007-2008	Spring	62	19
2008-2009	Autumn	81	8

	Spring	59	13
2009-2010	Autumn	116	20
	Spring	113	20
2010-2011	Autumn	251	23
	Spring	447	43
2011-2012	Autumn	532	71
	Spring	976	124
2012-2013	Autumn	1205	150

This statistic increased from year to year and in this year 1205 students learning 150 different e-courses (see Figure 1).

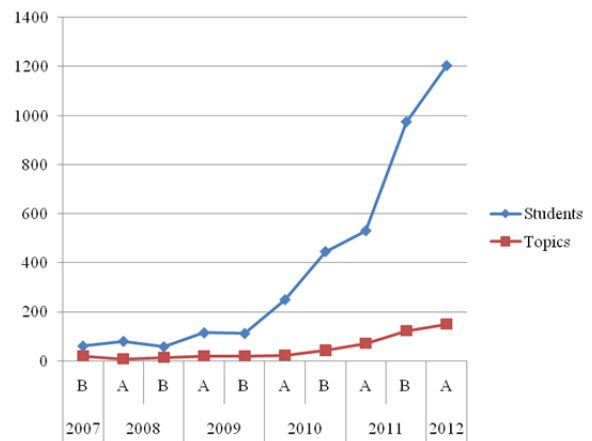


Figure 1. Statistic chart of e-learning in MUST

### III. THE OPAL E-LEARNING PLATFORM OF CHEMNITZ UNIVERSITY OF TECHNOLOGY

Since September 2005 started develop learning platform **OPAL** (Online Platform fur akademisches Lehren und Lernen) in Chemnitz University of Technology. The OPAL based on the open source learning platform OLAT which developed by Zurich University from 1999. Since 2007 the OPAL became basic e-learning platform for Saxony which covered 17000 learners.

The Computer Science Department of Chemnitz University of Technology started some projects for e-learning. The Department trying development international computer science e-courses not only for Germany, the faculty planned attract to e-course foreign students especially Asian students.

This idea was implemented by Tele Lecture. When try start projects appear several problems before faculty:

- an serious problem is big distance: bring the people to the knowledge is to time and cost intensive,
- Bandwidth is limited in many cases
- Teaching systems in universities of different countries may differ enormously

For solve these problems faculty used different methods and technology.

- ✓ Create video lectures to solve destination problem
- ✓ To reduce bandwidth is limited faculty did offline recording, this allows individual progress

with our video lecture teaching systems in universities of different countries this gap can be bridged

Some future plan for development of tele lecture is:

- planning to add further lectures, especially for basic knowledge, e.g. programming
- planning to add more interactive components, e.g. live sessions for coaching and review

Future target of Computer Science Department is

- expands relations with East Asia
- have more international students connected to our faculty
- teach students from different countries in one course
- find out how difficult is this course for students from other countries

get experience in coaching students within this lecture

#### IV. CONCLUSION

Many Asian students and researchers would like to study in European countries, especially in Germany. But big distance and finance difference between countries become main problem for such us study. E-learning especially distance learning method is one best way to get start impression about education system and requirements in other faraway country. Distance learning could be good basic preparation and integration start point for students who want to study in developed countries.

Tele lecture is one of sensible case study for e-learning, distance teaching and evaluation. The Computer Science Department of CUT is developing tele lecture idea for developing countries especially for Asian pacific area. It is new opportunity for Asian students and researchers study from home country in developed country and take experience in e-learning and in distance learning study method.

The Asian developing countries need such us support from developed countries universities and it will be good keep and distribute such us ideas into other universities in European countries.

#### REFERENCES

- [1] Ehlers, U.-D., Pawlowski, J.M. (2006): Handbook of Quality and Standardisation in e-learning. Springer Heidelberg.
- [2] Bauer, H. (2001). *Measure and Integration Theory*. Gruyter – de Gruyter Studies in Mathematics, Berlin.
- [3] Bruner, J. (1990). *Acts of Meaning*. Cambridge: Harvard University Press.
- [4] Grif, M., Uranchimeg, T., Tsoy, E.B. (2004): Man Machine Systems Design Methods, KORUS 2004, Proceedings, pp. 42-45.
- [5] Khan, B.K.(2005): *Managing e-learning: Design, delivery, implementation and evaluation*. Hershey, PA: Information Science Publishing.
- [6] Kirkpatrick, D. L. (1998): *Evaluating Training Programs. The Four Levels*. San Francisco.

- [7] Kulasekara, Geetha Udayangani; AlmonteAcosta, Sherlyne A. & Tudevtagva, Uranchimeg, Intercultural Understanding among Asian Participants in a Blended e-Learning Course, *1<sup>st</sup> international conference on open and distance e-learning 22-24 February 2012, Manila, Philippines*
- [8] Stufflebeam, D.L. (2002): The CIPP Model for Evaluation. In: Stufflebeam, D.L., Madaus, G.F., Kellaghan, T.: *Evaluation Models. Viewpoints on Educational and Human Services Evaluation*. Second Edition, e-Book, New York, pp. 290-317.
- [9] Uranchimeg, T., Batshagai, B. (2010): Research and usage of virtual laboratory in teaching. *Proceedings of 'International Conference of 50th Anniversary of Power Engineering School of MUST, Ulaanbaatar*, pp. 26-31.
- [10] Uranchimeg, T., Hardt, W., A new evaluation model for eLearning programs, *Technical Report CSR-11-03, Chemnitz University of Technology*, e-library format, Chemnitz, Germany, 2011.
- [11] Uranchimeg Tudevtagva, Wolfram Hardt, Tsoy Evgeny and Mikhail Grif, New Approach for E-Learning Evaluation, *Proceedings of the 7th Annual Conference of International Forum on Strategic Technology*, CD-Format, Tomsk, Russia, September 17-21 2012, (pp. 712-715)
- [12] Peter, H. R., Howard, E. F.(1993): *Evaluation a systematic approach*. 5<sup>th</sup> ed., SAGE Publications, Thousand Oaks, California.
- [13] Ricouer, P. (1985). *Time and narratives*. Chicago: Chicago University Press.
- [14] Yin, R. (1994). *Case Study Research*, 2<sup>nd</sup> ed. London: Sage Publications.
- [15] White Paper on ICT Development, Mongolia – 2011, Information, Communications Technology and Post Authority of Mongolia,
- [16] <http://must.edu.mn/beta3/menu312> - Master plan for e-learning in MUST
- [17] [http://www.must.edu.mn/must\\_en/modules.php?R\\_Id=28](http://www.must.edu.mn/must_en/modules.php?R_Id=28) – E and Open University of MUST
- [18] <http://www.nso.mn/v3/> - official web site of National Statistical Office of Mongolia

# Pro-Active Pedagogical Agents

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**Abstract**— This paper describes the proposal to scientifically research whether or not the higher production effort for enhanced and reactive communication capabilities of a pedagogical agent will influence the learners ability to succeed. Furthermore, if it is possible for the system to compensate for learner-centered signs of fatigue, lack of interest or distractions.

**Keywords**— Pedagogical Agent, Pro-Active, E-Learning, compensation, learner-centered design

## I. INTRODUCTION

A weak point in the field of human-machine-interaction is the limitation to fewer channels for communication. Usually, in a real-world face-to-face communication, the main aspects of information will be transported verbally. But besides the verbal content during a communication, other types of information are transmitted and received as well. For example, within the auditory domain, there is intonation that allows the recipient of the communication to make assumptions regarding the emotional state or subtext of the sender. In addition, the visual channel allows for assumptions about the counterparts non-verbal signs like attention and motivation.

## II. Pedagogical Agents

Pedagogical Agents have been supporting the knowledge acquisition of students since the 1990s. The current empirical research is heavily invested in testing different strategies for material presentation, being either displayed animated or as a static image [1]. Other research is focused on the form of interaction, e.g. the manners and the appearance of the agent itself [2], even regarding the choice of words and the social amicability of the software by focusing on the conversational style and topics besides the learning material [3]. The meta-analysis of Heidig and Clarebout [4] offers a broad overview about the general effectiveness and the various aspects being researched over the last years.

While research is heavily focused on the facets of depicting a pedagogical agent, the technological advances, which might lead to a more productive interaction with the learning system in general, are being widely ignored. Reeves and Nass [5] established the theory of media-equation that states the human tendency to act socially even if their counterpart is a machine. Following this paradigm, people tend to apply human to human interactional patterns even when they are interacting with a computer system. Accordingly, a computer based training system shows better results of knowledge transfer by depicting an agent on screen which led Lester et al. [6] to the conclusion that there is a persona effect.

Consequently, a learner might even be inclined to expect adequate social-cultural communication behaviour from the pedagogical agent itself.

But this anticipated behaviour, expected during a normal human face-to-face interaction nonetheless, is not limited to a one-way exchange of information. Interestingly enough, empirical research concerned with attributes of pedagogical agents is focused on its appearance, e.g. making it seem more lifelike by applying facial expressions to provide non-verbal cues for the user in front of the screen. But the research focus has not yet shifted onto the non-verbal cues a learner might want to transmit or even the environmental information which influences the learning process.

## III. RESEARCH OUTLINE

A scenario in which the pedagogical agent itself, supported by a sensory-surveillance module, would be able to interpret this new types of information requires the implementation of adequate sensory hardware. Most obviously, a webcam and a microphone would allow for the learning program to both 'see' the user and observe his or her behavior, as well as to 'hear' relevant auditory information.

Modern webcams are able to correctly identify a user's face and eye position up to the detail level of eye rotation, which enables the agent module to anticipate a user's visual attention. In addition, a microphone can continuously check for the environmental sound level and detect possibly negative impact on the learner's ability to follow the presented learning material (see Fig.1).



Fig. 1. Sensory-enhanced pro-active pedagogical agent

The integration of those two rather simple sensory hardware devices would not just allow the learning module to react, it would enable it to be pro-actively

engaged. In fact, this module would theoretically be able to allow other technical systems like televisions or media-presenting equipment to be more susceptible to interfering and disruptive elements of the environment or to missing attention by the user. For example, hand-held devices could automatically stop a video as soon as the user is not looking at the screen anymore. Televisions could activate their timeshift automatically when a phone or the doorbell starts ringing.

#### IV. HUMAN-COMPUTER-INTERACTION IN LEARNING MODULES

Before we have a look at the current forms of human-computer-interaction-research regarding pedagogical agents, we have to differentiate between the two possible forms of an interaction during a learning-session. One is the simple, rather mechanical form of user inputs, including the use of a mechanical input device like clicking a mouse button, pressing a key or changing the volume with the gain control.

The possibilities of an eye-tracker-based mouse-replacement has already been deemed feasible after some training, and tracking cameras could allow for a hand-gestured interaction like the often cited version that can be seen in the movie 'Minority Report'. Based on the impressive advances in voice-recognition-software, tracking-cameras or even eye-tracking-cameras might soon be able to provide such an alternative and touch-free interaction without any mechanical input. For the time being, simply pushing a button is still a very effective way of interacting with a machine.

Nevertheless, the focus of this paper is the other form of interaction. Namely, to allow a learner to interact with the software on a content-centered level while the software is able to conclude pro-actively mitigating strategies from environmental cues like noise or visual attention deviation by the user.

In order to create a successful learning environment, a large number of important aspects have already been identified over the last decade. First off, manner is of relevance. The behaviour of an agent as well as the communication of the system with the person in front of the screen should be of good address [7], [8], [9], [2]. The same applies for the appearance of the agent, e.g. in term of clothing and cleanliness. The appearance should lead to a sympathetic visual impression [9], [10]. The agents anthropomorphical appearance should be interchangeable since it appears to be beneficial if the own peer-group is represented inside the learning context. Apparently, it makes a difference whether or not one is interacting with a representative of one's own age, gender or even ethnicity [11], [12], [13], [14]. Whenever the contents of the learning module are being communicated not textually but verbally, the natural appearance of the voice is the key factor. Text to speech software, although remarkable improved over the last years, is perceived as strange and henceforth insufficient compared to a natural human voice [15], [16], [17], [18]. Analogously, the graphical animation features of the agent's body should be as lifelike as possible as well. This is especially important in regards to the facial animations [19], [1], [9], [20]. Another important aspect of interaction is the system's

ability to interact with a certain level of social intelligence [21], [2]. This perspective is best described by Kim and Baylor [22] in their proposition to establish pedagogical agents in a way that allows the forming of an amicable relationship between learner and agent. They furthermore contend agents need not be established as the ones that convey knowledge, but rather could simulate a peer which is learning together with the person in front of the screen.

#### V. ESTABLISHING NEW CHANNELS

Within the context of dialogue systems (so called 'conversational agents'), research is being done to allow for a more comprehensive communication structure. A weak point in human-machine interaction is the limitation to only a few channels of communication. In a real-world face-to-face communication setting, much more additional information is being conveyed during a conversation. In addition to the verbally communicated content, a number of other information is also transmitted. In the auditory domain for example, the intonation enables the communication partner to conclude a state of emotion or allows for an underlying information transfer like irony. Furthermore, a visual channel allows the assessment of the other person in terms of non-verbal communicative indicators such as attention or motivation [23].

Since all of this research is focused on the appearance or the social behavior of an agent, research regarding pedagogical agents should broaden its view to not just instructional design methods and agent appearances, but also to facilitate communication structures and behaviours as any real-world teacher would possess. If there is an audible deviating noise from a bell, any teacher would stop the presentation and repeat the last sequence from before the distraction or at least ask if everybody understood it. Regarding this form of mutual interaction and interpretation capabilities, this would allow for a learning module to perceive and to react to environmental problems during stages of knowledge acquisition. Knowledge gaps could easily be avoided by simply assessing and interpreting surveyed cues according to a real world behavior.

This combination of established forms of instructional design, learning material preparation, interactive delivery methods and active as well as passive elements for environmental sensing appear to be the next logical step to improve both communication and interaction with pedagogical agents and computer systems with a strong reliance on user input in general.

#### VI. METHODOLOGICAL APPROACH

To test for the assumed beneficial effects of the described environmental input, the following empirical experiment is planned. The sensory input will be programmed inside a standalone module called the 'Electronic-Educational-Instance' (EEI). It is meant to be viewed as an add-on component which could quite easily be ported to any other form of technical equipment which conveys information like Smart-TVs or mobile devices.

Three groups will be tested (traditional vs. traditional with controls vs. EEI module) using the well established and replicated (e.g. [24]) testing material of Mayer and

Moreno [25] about meteorology, especially the formation of lightning. A convenience sample of undergraduate students will be randomly assigned to the different experimental conditions and pre- as well as post-tested using an electronic version of the assessment tests provided by Mayer and Moreno [25]. During the pre-test assessment, the participants are asked to complete a questionnaire using a 5-point Likert scale (from 1=strongly disagree to 5=strongly agree) with items like ‘I can distinguish between cumulous and nimbus clouds’.

After the pre-test, the participants are asked to learn using the provided program. Since the possible side effects of a deviation and a not-pro-actively engaged pedagogical agent during the learning process are key to this research, all participants are instructed to work on a second task simultaneously. This task requires the participants to walk over to another computer to push a button. Afterwards, they have to return to the learning module and continue their studies until the second task becomes active once more. The two computers will be linked so the task always manifests itself at the same time for all of the participants.

The participants in the first group will be learning with a pedagogical agent and its traditional peculiarities. It will explain the material and continue at its own speed until it reaches the end of a segment where it will pause until the user confirms to continue. Experimental group two will be learning with a traditional agent, but in addition to group one, they have buttons to control the program in regards of pause/play and rewind-options. The third experimental group will be learning with the pro active pedagogical agent and the EEI. They are guided through the learning module just as the other two groups have, but when the participants are checking the second task or leaving their seat, the presentation is stopped. When they return to their seat in front of the screen, the pro-active pedagogical agent suggests to repeat the last sequence.

Conclusively the post-test is presented. It is, in accordance with the original design, divided into three tests regarding retention, matching and transfer. For the retention test, the participants are asked to explain the formation of lightning in their own words. The matching-category will be tested by the presentation of images from the learning module where adjacent textual descriptions have been removed. The post-test assignment for the participants will be to circle certain aspects of the image like ‘cold wind’ or ‘downdraft’. Finally the transfer will be tested by asking the participants to explain in their own words about topical adjacent but specific meteorological occurrences like ‘What influences the intensity of a lightning strike’[25].

Furthermore, as the authors suggested, the results of the pre-test will allow to check for the acquired knowledge during the learning process, while, in addition to the transfer, the effectiveness of the pro active agent on participants with high, medium or low levels of previous knowledge can be checked for influences from the expertise-reversal-effect[26].

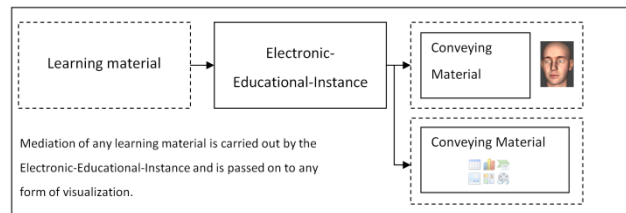


Fig. 2. The Electronic Educational Instance

## VII. CONCLUSION

Although this paper only outlines a scheme for an experimental research, current forms of scientific level of knowledge about pedagogical research is presented and linked to the hypothesized pro active pedagogical agent. This enhanced form of electronic mentor is able to react to auditory as well as visual stimuli and can suggest mitigating actions to the learner once a distraction has occurred. The described empirical research regarding the Electronic-Educational-Instance is planned for the fourth quarter of 2013 and will be presented shortly afterwards.

## ACKNOWLEDGMENT

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## REFERENCES

- [1] Lusk, M. M. & Atkinson, R. K. (2007). Animated Pedagogical Agents: Does Their Degree of Embodiment Impact Learning from Static or Animated Worked Examples? *Applied cognitive psychology* 21, pp. 747-764.
- [2] Wang, N., Johnson, W. L., Mayer, R. E., Risso, P., Shaw, E. Collins, H. (2008). The politeness effect: Pedagogical agents and learning outcomes. *Int. J. Human-Computer Studies* 66, pp. 98-112.
- [3] Veletsianos, G. (2012). How do learners respond to pedagogical agents that deliver social-oriented non-task messages? Impact on student learning, perceptions, and experiences. *Computers in Human Behavior* 28, pp. 275-283.
- [4] Heidig, S., Clarebout, G. (2011). Do pedagogical agents make a difference to student motivation and learning? *Educational Research Review* 6, pp. 27-54.
- [5] Reeves, B., Nass, C., 1996. *The Media Equation. How people treat computers, televisions, and new media like real people and places.* New York: Cambridge University Press.
- [6] Lester, J.C., Converse, S.A., Kahler, S.E., Barlow, S.T., Stone, B.A. & Bhogal, R.S., (1997). The persona effect: affective impact of animated pedagogical agents. In: S. Pemberton (Ed.), *Human Factors in Computing Systems: CHI '97 Conference Proceedings* (pp. 359-366). New York: ACM Press.
- [7] Chan, T.W., & Chou, C. Y. (1997). Exploring the design of computer supports for reciprocal tutoring systems. *International Journal of Artificial Intelligence in Education* 8, pp. 1-29.
- [8] Graesser, A. C., Person, N. K., Harter, D., & Group, T. R. (2001). Teaching tactics and dialog in AutoTutor. *International Journal of Artificial Intelligence in Education* 12, pp. 257-279.
- [9] Kim, Y., Baylor, A. L., & Shen, E. (2007). Pedagogical agents as learning companions: The impact of agent emotion and gender. *Journal of Computer Assisted Learning* 23, pp. 220-234.
- [10] Domagk, S. (2010). Do pedagogical agents facilitate learner motivation and learning outcomes? The role of the appeal of agent's appearance and voice. *Journal of Media Psychology* 22(2), pp. 82-95.

- [11] Nass C., Isbister K., Lee E. J. (2000). Truth is beauty, researching embodied conversational agents. *Embodied conversational agents*. The MIT Press, Cambridge, pp. 374–402.
- [12] Baylor A. L., Rosenberg-Kima R. B., Plant E. A. (2006) Interface agents as social models: The impact of appearance on females' attitude toward engineering. Conference on human factors in computing systems (CHI'06), Montreal.
- [13] Huang, H.-H., Cerekovic, A., Pandzic, I. S., Nakano, Y., Nishida, T. (2009). Toward a multi-culture adaptive virtual tour guide agent with a modular approach. *Artificial Intelligence and Society* 24, pp. 225-235.
- [14] Kim, Y., Wei, Q. (2011). The impact of learner attributes and learner choice in an agent-based environment. *Computers & Education* 56, pp. 505-514.
- [15] Moreno, R., Mayer, R. E., & Lester, J. C. (2000). Life-like pedagogical agents in constructivist multimedia environments: Cognitive consequences of their interaction. Paper presented at the World Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-MEDIA 2000). Montreal, Canada
- [16] Mayer, R. E., Dow, G. T., & Mayer, S. (2003). Multimedia learning in an interactive self-explaining environment: What works in the design of agent-based microworlds. *Journal of Educational Psychology* 4, pp. 806–813.
- [17] Atkinson, R. K., Mayer, R. E., & Merrill, M. M. (2005). Fostering social agency in multimedia learning: Examining the impact of an agent's voice. *Contemporary Educational Psychology* 30, pp. 117–139.
- [18] Veletsianos, G. (2009). The impact and implications of virtual character expressiveness on learning and agent–learner interactions. *Journal of Computer Assisted Learning* 25, pp. 345–357.
- [19] Baylor, A. L., & Ryu, J. (2003). The effects of image and animation in enhancing pedagogical agent persona. *Journal of Educational Computing Research* 28(4), pp. 373–395.
- [20] Agada, R., Yan, J. (2012). Research to Improve Communication by Animated Pedagogical Agents. *Journal of Next Generation Information Technology* 3(1), pp. 58-69.
- [21] Lepper, M.R., Woolverton, M., Mumme, D.L., Gurtner, J., (1993). Motivational techniques of expert human tutors: lessons for the design of computer-based tutors. In: Lajoie, S.P., Derry, S.J. (Eds.), *Computers As Cognitive Tools*. Erlbaum, Hillsdale, NJ, pp. 75–105.
- [22] Kim, Y., Baylor, A. L. (2006). A Social-Cognitive Framework for Pedagogical Agents as Learning Companions. *Educational Technology Research and Development* 54(6), pp. 569-596.
- [23] Frechette, C., Moreno, R. (2010). The Roles of Animated Pedagogical Agents' Presence and Nonverbal Communication in Multimedia Learning Environments. *Journal of Media Psychology* 22(2), pp. 61-72.
- [24] Craig, S. D., Gholson, B. & Driscoll, D. M. (2002). Animated Pedagogical Agents in Multimedia Educational Environments: Effects of Agent Properties, Picture Features, and Redundancy. *Journal of Educational Psychology* 94(2), pp. 428-434.
- [25] Mayer, R. E., & Moreno, R. (1998). A split-attention effect in multimedia learning: Evidence for dual processing systems in working memory. *Journal of Educational Psychology*, 90, 312–320.
- [26] Sweller, J., Ayres, P. L., Kalyuga, S. & Chandler, P. A. (2003). The expertise reversal effect. *Educational Psychologist*, 38 (1), 23-31.



# Methodology research on developing online learning content

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## ABSTRACT

The Internet has brought about, according to many a revolution in the educational field, more precisely in online education. Online education helped remove many barriers to education due to its relatively low price and high flexibility in the study modes.

In this study, we carry out a undergraduate programs at universities and colleges are usually run in line with approved standards, and it takes time to do specialized research on identifying needs for integrating online learning programs into the university and college curricula. With all these in mind we have tried to reveal some possibilities for replacing traditional face-to-face training content by electronic, developing interactive models of teacher-students relationships and putting these ideas into practice.

In order to start integrating online learning into regular training curricula, we have implemented a piloted program for teaching "Computer-Aided Mining design" course, the main discipline of the undergraduate bachelor degree program at the School of Mining Engineering.

## General Terms

Experimentation

## Keywords

Online learning, a model of online learning,

Placeholder for ISB Copyright Information

interactive model, algorithm

## INTRODUCTION

In relation to the development progress of information and communication technology educational services are rapidly changing in terms of methodology and forms of training which can be clearly observed within the practical implications. To improve quality of educational programs and their outcomes, it is crucial to set up favorable teaching and learning environment taking into account the learners' needs and interests. Therefore the government is giving a great priority to this issue and emphasizes the importance of organizing training programs based on the progressive technology.

During carrying out the research we developed methodology for the content of online learning, planning and curriculum, a sample lesson plan and implemented all of them which intensified development and implementation of the Open University learning content.

This research study introduces definitions of teaching and learning, development of technology of education and its trends, online training forms, its infrastructure and content defining components, pedagogical background, modeling design, international practices, standards, course curriculum supported by supplementary materials and tools, teacher-students-course correlations, students' individual and cooperative work, and online learning methodology. Based upon research findings online course content development and implementation, technology, methodological grounds for communication activities and research aims and objectives have been identified.

## Aim of the Research Study

The aims of the current research are to study theory and methodology of online learning for bachelor degree programs, analyze students' readiness for online learning, design algorithms for replacing face-to-face training by an online form and develop recommendations for new models with online content and their implementation.

## Objectives of the Research Study

The objectives of the current research are defined as follows:

1. Study theoretical and methodological grounds for online training;
2. Analyze students' readiness for online training program involvement;
3. Develop algorithms for replacing face-to-face training by an online form;
4. Identify technological process for developing online learning content;
5. Develop teacher-course-students interactive model for online learning.

## 1. PILOT TESTING RESULT

This chapter describes the piloted models, their structure, procedure and outcomes of the piloting. (Figure 1)

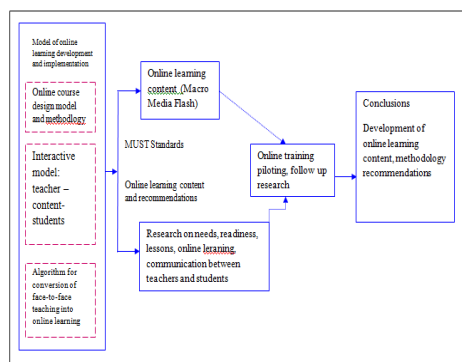


Figure 1. Development and piloting procedure of the online course.

## 1.1 A model for developing and implementing the online course

Based upon research findings the model of online course has been developed (Figure 2), algorithm has been used to convert face-to-face teaching content into electronic and online learning has been organized accordingly.

There are 6 steps for developing and implementing the online course and particular activities are inserted into each step. These steps are made one by one. However steps 4, 5 and 6 are made based on the previous ones. If there is no need for training teachers, it is possible to go from step 3 straight to step 5. Depending on the assessment outcomes the decision will be made whether planning or model design and content implementation need to be modified.

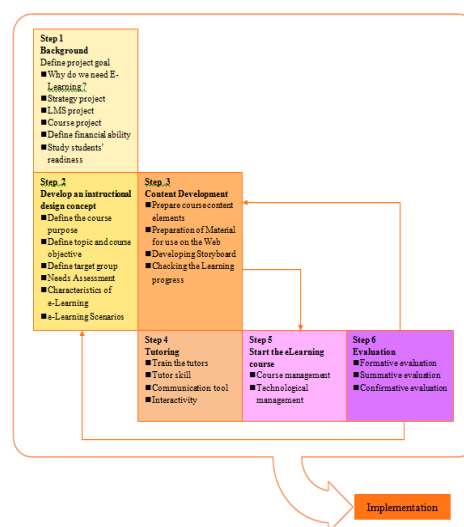


Figure 2. A model for online learning development and implementation [2]

Although there was our intention to pilot this online course using the Mongolian University of Science and Technology, some technical problems occurred because the MUST standards different. That is why the course content has been modified within different technology and converted into local program. So the 'Teacher-

Content-students' interactive online model' proposed within the current research has been successfully piloted as it was planned, and the piloting outcomes have been compared with the outcomes of the traditional face-to-face training.

### 1.2 A 'Teacher-content-students' interactive model

Every single educational activity is relied on the communication. 'Communication' is a concept that refers to information exchange, relationships between a teacher and students, mutual understanding and collaboration.

Online learning is a model that defines teacher-content-students communication, their roles and responsibilities, scope of communication, principles and so on, which altogether constitutes an interactive model (see Figure 3).

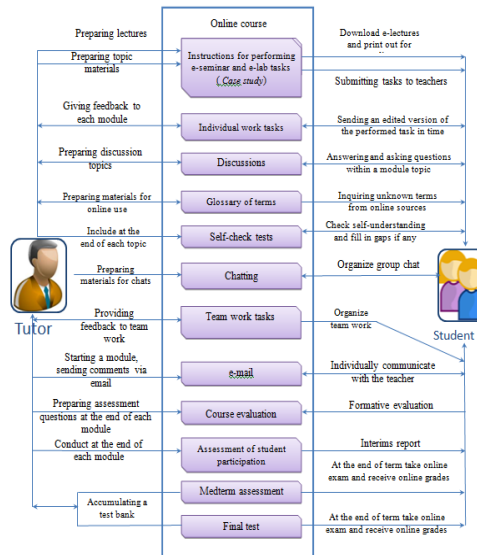


Figure 3. A 'Teacher-content-students' interactive model

In our proposed model arrows show directions in communication, feedback is illustrated in teacher-students' roles and relationships between them, and training tools included in the training

content are presented in the squares of the next illustration.

The illustration demonstrates that online learning is not effective because of merely content design but also communication between a teacher and students the same as in the case of face-to-face learning.

This model has been piloted within the current research study.

### 1.3 Algorithm for conversion of face-to-face teaching to online mode

It needs 50% more time to prepare online lesson, therefore we suggested an algorithm for converting face-to-face teaching into online mode (see Figure 4).

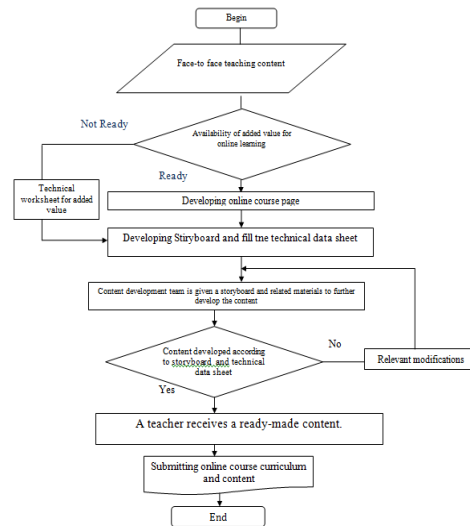


Figure 4. Algorithm for conversion of face-to-face teaching to online mode

ng the models of a model for developing and implementing the online course, teacher-content-students interactive online model and an algorithm for conversion of face-to-face teaching to online mode along with supplementary tools within the "Computer-Aided mining drawing" course piloting we came up with strengths and

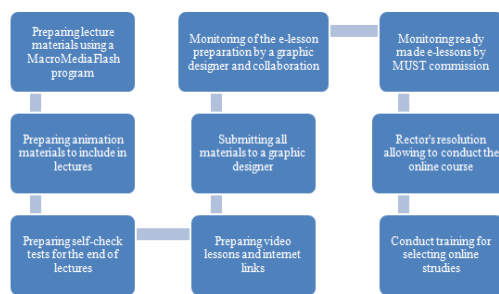
weaknesses of online learning and identified some difficulties. We developed and piloted two versions of the online course content.

**Version A** – face-to-face teaching content is converted to the online mode according to the MUST Open School standards using Macro Media Flash

**Version B** – “Computer-Aided mining drawing” online course content is developed in a form of module in English using Open source content authoring tools ExE Learning.

Descriptions of methodology for each version’s content development are included in the study.

**Methodology of version A:** Below we introduce principles to follow while converting face-to-face teaching into online (Figure 5).



**Figure 5. Procedure for converting face-to-face teaching into online [1]**

Students taking an online course use UNILMS internet system for selecting elective courses, making their own schedule, looking at course outline, checking records, searching for books in the digital library, looking at payment information, receiving and sending e-mails, taking tests, sending files, placing some information with the help of a program designer.

Presently a teacher prepares face-to-face teaching content and gives to the professional team for more elaboration and once the content is ready MUST commission approves, and online learning can be started. This requires preparation and development of methodology set, pilot and evaluate within the process and at the end.

**Methodology of version B:** This was developed in a form of module and implemented step by step as shown in figure 2 and figure 3.

## 2. OVERALL CONCLUSIONS

The current research covers the study of an online learning model which is suitable for the information society of the new century, raised some issues, and proposed converting face-to-face teaching to online by developing relevant content and methodology. Based upon research findings the following is considered the main conclusions:

1. It was proved that face-to-face teaching can be fit the online learning model, which can be used in bachelor’s degree engineering program at universities and specialized educational institutions.
2. Studying the online training mode and developing a particular model and relevant instructions we came up with the conclusions that it is possible to implement it successfully in a given period of time and therefore raised a need for developing the online learning module with its methodology.
3. Converting to the online learning mode doesn’t mean only transferring the course content to the electronic and interactive form and placing in the link, but also it requires considering teaching and learning being comprehensive and developing designated models. Therefore each online learning component needs to be developed in terms of the content. The research study suggests using the algorithm for converting face-to-face teaching into online and dealing with a student -teacher communication model within its implementation. Based upon these models methodology for the course content development, and management, monitoring and organization of the students’ learning process has been developed and proposed.
4. Developing and piloting models for an online learning content and teacher-content-

students communication, it is considered possible to organize such kinds of bachelor training program within the “Computer-Aided Mining Drawing” course. The pilot program was organized along face-to-face traditional training and students’ abilities to use the AutoCAD software program, manage study time, work individually and cooperatively, have been assessed and compared. There was no difference between students’ progress, however the methodology for online learning has been proved to be effective.

5. During the piloting there have been observations of students’ learning and also surveys conducted at the end of the piloting, and it was noticed that it was necessary and possible as well for teachers and students to insert continuous information on time and provide reliable and efficient conditions for their communication.
6. Due to the rapid development of the roles of laptops, tablets and mobile phones in educational programs, it is right to say that the future of mobile training development is getting close. It is noticeable that there is a need to provide teachers with training for the improving skills of designing and developing curriculum, and planning teaching based on information and communication technology, prepare specialists for designing professional instructions and accrediting training programs, look back at the copy rights issues, revise teachers’ teaching weekly loads (24/7) and establish a new system of

incentives suitable for all these modifications.

7. In the future there is a need to develop online training content and design and follow the standards for supplementary tools to raise its values; use licensed software programs and train teachers within specialized programs.

### 3. REFERENCES

- [1] Alimaa J., *Development of e-learning and its implementation*. – Doctorate students’ papers. MUST-School of Computer Management. Ulaanbaatar, 2011.
- [2] Alimaa J., Baigaltugs S., Munkhchimeg B. *Challenges for Mongolian e-Learning and an Improved Method of Implementation*. International Workshop on ‘Innovation technologies for an effective geospatial management of earth resources’, Ulaanbaatar, 2010.
- [3] Alimaa J., *Computer-Aided Mining Drawing course: ExE Learning based e-learning Model*. International Workshop on ‘Innovation technologies for an effective geospatial management of earth resources, Ulaanbaatar 2010.
- [4] Alimaa J. *Research on possibilities for online learning*. ‘Advanced training and technology innovations’ conference, doctorate students’ conference, MUST, Ulaanbaatar, 2012.
- [5] Alimaa J. *Methodology research on developing online learning content*. Ph.D. Thesis, Mongolian University of Science and Technology, Ulaanbaatar, 2013.

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