Mental Health Promotion System

Umar Farooq, Dae-Geun Jang, Jae-Keun Jang, Seung-Hun Park

Abstract—**Mental activity promotion system is presented that analyzes, quantifies, trains and prescribes based on analysis of logical, memorizing, concentrative, decisive, in conditions where time and space is involved, possibility of dementia, and on evaluation of lifestyle of subjects. Special consideration has been made to make the system motivational, persuasive, attractive and fun to use. The system has been successfully deployed in Bitgeoul Senior health town, Gwangju, South Korea.**

I. INTRODUCTION

According to the statistics for year 2009, elderly population above 65 years in South Korea comprise 10.7 % of total population [1]. Percentage of elderly population will be more than 14% in 2018 and expected to reach 20% in year 2026 [1]. Elderly population is particularly prone to chronic diseases. U-Health technologies in this regard have shown promising potential in improving lifestyle and quality of life for elderly. Majority of u-Health technologies focuses on cure of diseases, very little attention has been made on preventive measures that analyzes, quantifies the incidence, prevalence and risk factors associated with diseases.

Lifestyle behavioral factors such as sleep deprivation, over/under weight etc. may contribute significantly towards the incidence and prevalence of such chronic diseases [2].

While ample evidences associated to u-Health technologies for maintenance and monitoring of physical health can be observed in hospitals and gymnasiums, little evidence has been observed targeting the mental health of elderly population.

Recent advances in technology, behavioral and medical knowledge led to the paradigm shift from healthcare to wellness. Need is therefore to analyze and design a platform that advances from the u-Health to u-Wellness paradigm (i.e. from cure based paradigm to preventive paradigm).

In this paper we focus on design and implementation of mental health promotion system that analyzes and quantifies cognitive abilities and possibility of dementia. Further the system analyzes and evaluates the lifestyle of elderly subjects.

U. Farooq, J. K. Jang and S. H. Park are with U-Health Lab, Department of Biomedical Engineering, Kyung Hee University, South Korea.

D. G. Jang is with Speech and Audio Information Lab, Department of Electrical Engineering, Korea Advanced Institute of Science and Technology, South Korea.

(Corresponding author: Seung-Hun Park. phone: +82-31-202-2686; fax: +82-31-205-9062; e-mail: parksh@khu.ac.kr).

Section II details the overview of our proposed system. Details pertinent to the proposed mental health promotion system are shown in section III.

II. SYSTEM OVERVIEW

Fig. 1 shows overall architecture of HIMS (Health Improvement & Management Systems) Health Assessment Systems. In figure we envision an application server, communication gateway and a central DB. The application server communicates over the internet with geographically distributed health assessment systems and heterogeneous client systems through communication gateway.

- Health assessment system can acquire, retrieve, analyze, monitor the health status of subjects and provides instruction/ prescription if necessary to the subjects. The health statuses of subjects are stored in local and central DBs of health assessment systems and application server respectively. The health parameters and test results stored in local DBs are utilized for performance evaluation and rank evaluation in comparison to other subjects.
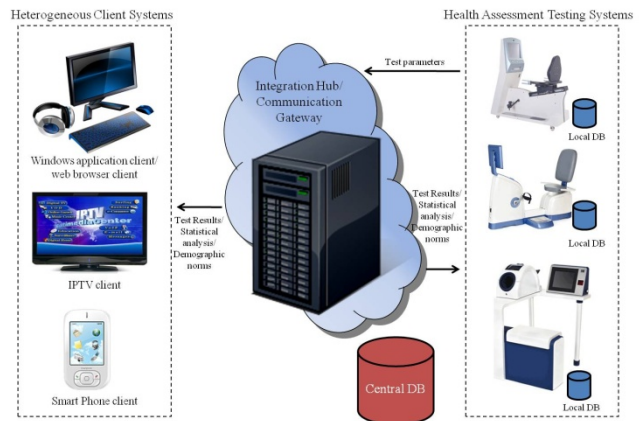

Fig. 1. Overall architecture of proposed Health Assessment Systems.

- Application server is envisioned as the intelligence for the environment. It has central DB and gateway for communication over the internet with health assessment systems and heterogeneous client systems. Application server analyzes the test results acquired from health assessment systems and generate prescriptions, evaluate performance and ranks. The envisioned application server is required to estimate prevalence, incidence and risk factors for health decline, along with the platform to understand the pattern changes in health status and subject

behavior. Further the application server is envisioned to collect health parameters from globally distributed health assessment systems and establish demographic norms for various health parameters and indexes.

- Subjects can view their progress, health risk factors, comprehensive health reports, health status in comparison to the demographic norms, diagnosis, treatment and prescription in heterogeneous client systems.

III. METHODS

A. Overall Architecture

The overall architecture of the system is as follows:

HIMS (Health Improvement & Management System) web server provides platform for the authentication/verification of users and storage/retrieval of record from the database.

KIOSK is provided with a platform for generating queue for the users. KIOSK contains special program for the registration of users to the system. Users can register by providing basic information such as name, gender and age. The information is written in the RFID card and also stored in the HIMS User DB for later authentication and verification of users for the usage of HIMS Brain system.

HIMS Brain system is our proposed mental health promotion system. Users are authenticated by verifying their RFID card from the HIMS User DB via HIMS web server.

B. HIMS Brain

HIMS Brain is the proposed mental health promotion system. Design consideration for HIMS Brain also involves a platform design for elderly cohort population studies.

The system outline is as follows:

- System input consists of questionnaires about lifestyle, possibility of dementia and cognitive ability of users.
- The system provides a platform to estimate prevalence, incidence and risk factors for cognitive and dementia decline.
- The system provides a platform to understand the pattern of cognitive change.
- The system provides a platform to understand the pattern change leading to the possibility of dementia.
- The system provides a platform for establishing link between lifestyle of users and cognitive abilities and dementia.
- The system provides a platform for establishing connection between pattern changes in lifestyle and pattern changes in cognitive ability and possibility of dementia.
- The system provides a platform for establishing demographic norms for measuring mental health status.
- The system outputs an evaluation report based on

the analysis of lifestyle of users, possibility of dementia and cognitive abilities of brain.

- System also contains platform for training the cognitive ability of brain.
- Special considerations are made for making the system persuasive, motivational, attractive and fun to use.

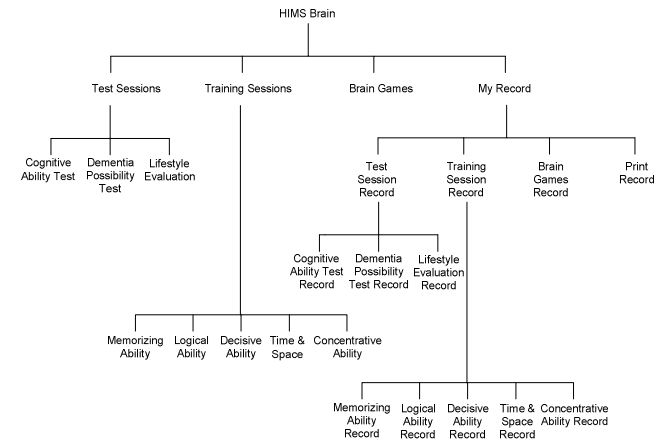Fig. 2 shows hierarchical structure of accessibility to users.

Fig. 2. Hierarchical structure of system menus accessibility to the users.

The lifestyle evaluation parameters considered for the proposed system are 1) Self-State, 2) Smoking, 3) Alcohol, 4) Sleep, 5) Exercise and 6) Diet. Table I shows each category and questionnaire related to life style.

The dementia possibility evaluation questionnaire consists of 14 general questions for evaluation of possibility of dementia. Table II shows questionnaires related to the possibility of dementia.

TABLE I
LIFESTYLE EVALUATION QUESTIONNAIRES

Category	Questions
Self state	What do you think about your health condition?
Smoking	Do you smoke? How many cigarettes you smoke in a day? How many days you smoked in last month?
Alcohol	How many times you drink normally? How many times you drink beer over 5 glasses in a month? How much you drink in a party?
Sleep	How much time you sleep in a day? Do you get proper sleeping time in a day to keep your body healthy? Do you get satisfactory rest time?
	What is the level of your physical activity in a day? How many times you did physical activity that made your breath hard and heartbeat faster than normal for a span of at least 10 minutes?

Exercise	How many times you have exercise similar to over physical activity? How many days you did physical activity that made your breath hard and heartbeat faster than normal for a span of at least 10 minutes during last week? How much time do you normally exercise in a day? How many days do you walk over 10 minutes during last week? How much time do you walk in a day?
Diet	What is your diet intake regarding corn, vegetables, fruits, fish and milk products? What is your diet intake regarding salty food? Do you eat adequately and increase your physical activity to maintain healthy weight? Do you eat happily and do breakfast daily? Do you arrange hygienic food and according to the need? Do you enjoy eating rice every day?

In order to evaluate and improve cognitive abilities of subjects special games have been designed that generate random questions related to the logical, memorizing, decisive and concentrative abilities and also in situations where time & space is involved.

Fig. 3. User Interface

The system design has been particularly targeted for the elderly population.

TABLE II
DEMENTIA POSSIBILITY EVALUATION QUESTIONNAIRES

Questions
Do you know what is date and day today?
Do you forget often your daily usage utensils?
Do you repeat same questions?
Do you forget your belongings at visiting place?
Do you often forget names?
Do you feel being absentminded during conversation?
Do you often forget roadmap?
Do you feel your logical ability is depreciating? (e.g. difficulty in calculating the price and return money)
Do you forget the usage of utensils? (e.g. washing machine, rice cooker, cultivator)
Do you feel your house management skills are depreciating?
Do you feel problems in judging clothes according to weather?
Do you feel problem in taking public transportation and reaching destination alone? (if you have some physical disability, just pass this question)
Do you feel problem in recognizing your clothes cleanliness and tidiness?

Special consideration has been made on the font sizes, color schemes and user interface. Fig. 3 shows the user interface to the system. User can access the system through their RFID cards and can utilize the whole system using the keypad interface as shown in fig. 3. This reduces the constraints and complexities offered by mouse and keyboard to the elderly population who are not much acquainted with standard PC use. Fig. 4 shows graphical user interface related to the lifestyle questionnaire session.

Finally, the report generated for the individual subject is shown in Fig. 5.

Fig. 4. Graphical user interface of sample lifestyle questionnaire

C. Software Architecture

The object oriented concept is used for designing and implementing the mental health promotion system. It involves six main controllers; HIMS Brain main controller, user interface controller, cognitive test and training controller, lifestyle and dementia questionnaire controller, database controller and report print controller. The controllers act as individual units and report to the main controller in the form of events. The flow model for control and report back procedure is detailed in Fig. 6.

(a)

(b)

Fig. 5. Sample report printout (a) front side page, (b) back side page

IV. CONCLUSION

We developed a mental health promotion system that evaluates lifestyle of elderly population, possibility of dementia and cognitive abilities of elderly subjects. In comparison to the traditional approach, we developed a practical interactive system that quantifies and establishes the relation between lifestyle, dementia and cognitive abilities. Further the system generates test report, prescription and provides a training platform for decreasing the possibility of dementia and improving cognitive abilities.

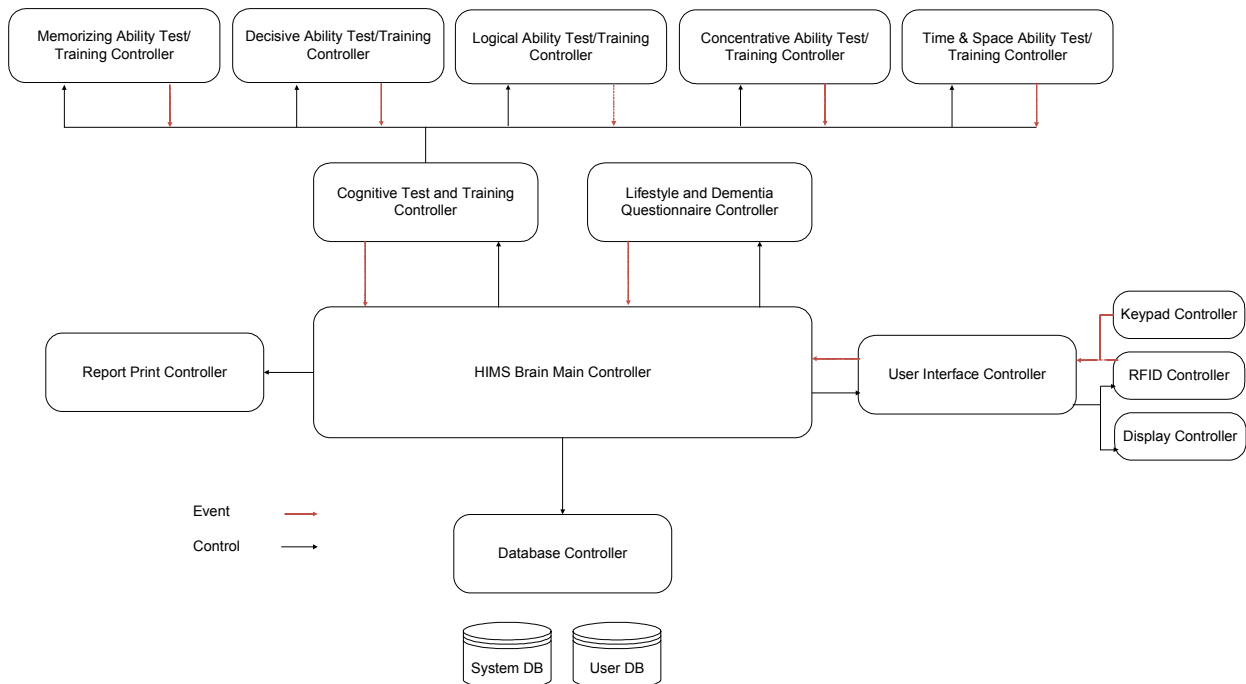Future work includes implementation and realization of complete envisioned system shown in fig.1. This will enable us to perform comprehensive long-term cohort study on prevalence and risk factors for various parameters of health decline and also on establishing the demographic norms for various health indexes.

HIMS Brain system discussed in section III is successfully deployed in Bitgeoul senior health town Gwangju, South Korea [3] and is practical in use. Currently we are investigating the practical problems of this system through feedback trials from the subjects.

REFERENCES

[1] Statistics Korea, available online : http://kostat.go.kr
[2] J. Korhonen, E. Mattila, A. Ahtinen, J. Salminen, L. Hopsu, R. Lappalainen, T. Leino, " Personal Health Promotion through Personalized Health Technologies –Nuadu Experience," *31st Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, pp. 316 – 319, 2009.
[3] Bitgeoul Senior Health Town, available online: www.bitown.or.kr

Fig. 6. Control and events flow model for HIMS Brain software.