CDSS : 만성질환 환자들을 위한 사회적 상호작용과 지능 공간의 통합

이람 파티마, 무하매드 파힘, 이영구, 이승룡
경희대학교
e-mail : {iram.fatima, fahim, sylee}@oslab.khu.ac.kr, yklee@khu.ac.kr

CDSS: Integration of Social Interaction and Smart Space for Chronic Disease Patients

Iram Fatima, Muhammad Fahim, Young-Koo Lee, Sungyoung Lee
Dept. of Computer Engineering, Kyung Hee University, Korea

Abstract

Chronic disease may leads to other life threatening health complications like heart disease, stroke, diabetes and peripheral vascular disease that diminished quality of life. This paper points out the importance of social interaction and smart space integration in existing CDSS for chronic diseases. Social interaction allows the patients to interact with system, through this continuous learning and digesting patient experience, our CDSS becomes intelligent and dynamically enhanced. Smart spaces automatically provide new knowledge and construct the behavioral profile by monitoring the daily life activities. Through these features, patients can get continuous relevant recommendations from the system, so they can get a chance to improve their health condition which in terms keeping on their quality of life. It also helps the health practitioners in better decision making about medication and living patterns.

1. Introduction

Chronic disease accounts for more than 75% of health care expenditure and nearly an equivalent percentage of disease-related deaths [1]. Its disorders are characterized generally by long duration and slow progression. With enough care and supervision, usually these patients health condition could be improved.

The most common applications of a CDSS include alerts and reminders, diagnostic assistance, prescription decision support, information retrieval, image recognition and interpretation, therapy critiquing and planning [1-2]. Although the applications of clinical decision support system are diverse and have different goals, most of them focus on providing diagnostic assistance to medical doctors and healthcare professionals [3-5].

We aim to improve the patients' health by suggesting them appropriate life style patterns. For example, after observing a patient for one month, our CDSS finds some problems with this patient's life pattern. He/she usually sleeps late; does not exercise regularly; does not take medicine on time; eats too much. Obviously, these life styles are not good for chronic disease. Our CDSS system can recommend the patients to change these harmful life patterns.

With above goals, our CDSS has been designed with several novel ideas. Firstly, it is socially interactive, here socially interactive means that our CDSS can interact with users and automatically learn new knowledge from users' experience. This is different with conventional CDSSs which usually utilize static knowledge. Secondly, it supports user high-level context recognition ability. Most traditional CDSSs need patients or doctors to manually input patient-related information, which is then used for decision making. To monitor a patient's life style and give suggestions/alerts, it is not efficient and realistic to frequently ask the patient to manually input his/her information. By using smart space, CDSS can automatically get these information, thus saves user's effort.

2. Proposed Integrated CDSS Design

The proposed integrated CDSS design composed of four components named: social interaction, smart space, database tier and health care services. Figure 1 shows the proposed integration design.

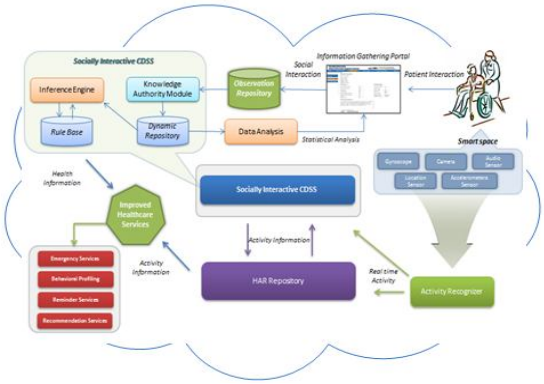

Figure 1. Proposed Integrated CDSS Design

2.1 Database Tier

Database tier includes observation repository, dynamic repository and HAR Repository.

a) Observatory Repository
   It stores the user provided social interactive (structured and unstructured) information without any pre-processing.

b) Dynamic Repository
   It is an evolutionary database that stores the processed information through Knowledge Authority Module (KAM) module of CDSS. It facilitates the rough based inference engine to automatically generate the rules.

c) HAR Repository
   It stores the raw data collected by sensor and stores the high level context recognition which facilitates the health care services module and provides activity information to socially interactive CDSS.

2.2 Social Interaction

This feature is enabled by socially interactive CDSS module of the proposed architecture. It contains two major modules Knowledge Authority Module (KAM) and Rough Set based Inference Engine. The KAM captures user feedback, converts it in the system understandable form, verifies its integrity and relevancy, and finally stores it in a dynamic CDSS database. It can process well formatted data such as EMR, paper chart [1] and unformatted input data like email and short messages. KAM provides an open platform to acquire / share clinical knowledge from society which can reflect user experiences in clinical knowledge management.

Rough set based inference engine provides stable and incremental learning ability to efficiently handle dynamic user feedback. Machine learning reasoning is required since we cannot frequently ask the experts to analyze the data which is dynamically added. Rules are automatically generated on the behalf of social feedback; this new rule set becomes the part of inference engine. Domain experts can validate the knowledge and remove some unreasonable rules as user's provided data is not very reliable due to their knowledge limitation in medical area. In our previous work [1], technical details of developed KAM and inference engine are explained.

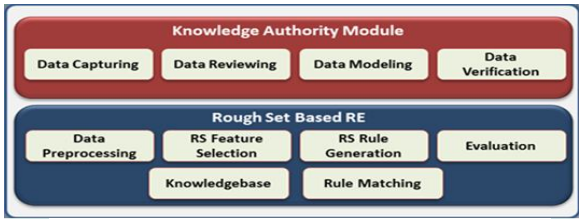

Figure 2. Socially Interactive CDSS Modules

2.3 Smart Space

Smart spaces are well-equipped with the sensor technology to recognize the activities of daily living. Our focus is to recognize the high level context of patients which predicts the daily life patterns. Our developed activity recognition technology identifies the activities accurately and provides the results in reasonable time [2]. These results are stored in HAR repository and processed by our CDSS. It provides valuable lifestyle analysis to increase the quality of life and recommendation about the healthy life style.

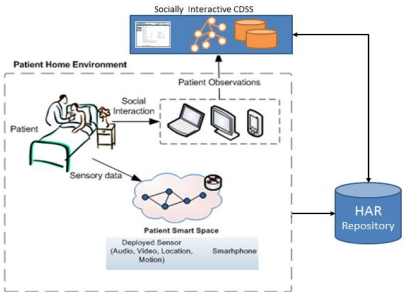

Figure 3. Patient Home Environment

2.4 Health Care Services

By integrating social interaction and sensor technology, we provide different kind of health care services like emergency service, behavior profile, reminder services and recommendation services. Emergency service helps to reduce certain risks which lead to life threatening situations. Behavior profile helps to evaluate daily life pattern and provide recommendation about healthy life style. Furthermore, reminder service generates the alerts to provide better assistance for medication intake, exercise and eating habits.

3. Conclusion

This paper presented socially interactive and smart space integrated CDSS design. It helps to provide different health care services for chronic disease patients in order to improve the quality of life. Integrated CDSS design is a combination of various technologies with novel proposed ideas.

We are planning to work on and provide more services to different kind of disease patient's such as; Stroke, and Parkinson disease patients. A number of wirelesses medical sensors are under development for more sophisticated collection of health data of patient's.

Acknowledgement

This research was supported by the MKE (Ministry of knowledge Economy), Korea, under the ITRC (Information Technology Research Center) support program supervised by the NIPA (National IT Industry Promotion Agency)" (NIPA-2009-(C1090-0902-0002)).

References

[1] Fatima I. et.al, "Socially Interactive Cloud Based CDSS for u-life care", 5th International Conference on Ubiquitous Information Management and Communication, Seoul, Korea, February 2010.

[2] Fahim M. et.al, "A Multi-Strategy Bayesian Model for Sensor Fusion in Smart Environments", 5th International Conference on Computer Sciences and Convergence Information Technology, Seoul, Korea, November 2010.

[3] Osheroff JA. et.al, Improving medication use and outcomes with clinical decision support: a step-by-step guide. The Healthcare Information and Management Systems Society. IL: Chicago, 2009

[4] Iqbal A.M et.al, "An Ontology-Based Electronic Medical Record for Chronic Disease Management", IEEE 44th International Conference on System Sciences, China, 2011

[5] Osheroff JA. 2009. Improving medication use and outcomes with clinical decision support: a step-by-step guide. The Healthcare Information and Management Systems Society. IL: Chicago