Advanced Science and Technology Letters
Vol.63 (NGCIT 2014), pp.122-124
http://dx.doi.org/10.14257/astl.2014.63.25

Design of an Intelligent Sensor Algorithm to classify the Level of Risk of Diabetes in a u-Health Service

Un Gu Kang[1], Byung Mun Lee[2]

Dept. of Computer Engineering, Gachon University, Seongnam, GyeongGi-Do, Korea,
{ ugkang, bmlee } @gachon.ac.kr

Abstract. Most diabetic patients apply self-management using the glucose data obtained from the display of an existing personal glucose meter. However, if they want to know the exact level of risk of their diabetes, other elements must be taken account such as their blood pressure and obesity as well as their first-degree relatives with diabetes. Therefore, we have proposed an intelligent sensor algorithm in which other risk factors are considered, including diabetes data in order to classify the level of risk of diabetes in the u-Health service based IoT. The effectiveness of the self-management of patients will increase if the intelligent sensor algorithm is embedded in virtual diabetes meters in the future.

1 Introduction

Glucose meters are widely used as medical equipment in hospitals as well as homes. They are important as equipment for medical self-management for patients with diabetes[1][2][3]. In addition to diabetes, patients with metabolic syndrome can also monitor their own glucose data using glucose meters. However, the recommendation from the World Health Organization and American Diabetes Association is to measure glucose data while also taking into consideration the various risk factors, instead of simply measuring the glucose data only[1][2]. However, most patients determine the level of risk of diabetes simply by using glucose data alone. In order to improve this, it is possible to develop a new type of intelligent diabetes sensor taking into consideration the multiple risk factors applying the IoT(Internet of Things) technology which has been studied recently[4][5][6][7].

In this paper, we propose an intelligent sensor algorithm, which will play a role in an intelligent virtual diabetes sensor for type 2 diabetes. It is judged to be the technology which is necessary to develop the u-Health service as an IoT application for healthcare.

2 Intelligent sensor algorithm for diabetes

In this study, the risk factor criteria for the diagnosis of diabetes are HbA_{1c} , FPG, 2-hr(2 hours) plasma glucose, random plasma glucose and other risk factors, which are elements defined by the American Diabetes Association. The level of risk is identified

ISSN: 2287-1233 ASTL

by the diagnostic criteria according to the specific range in each risk factor as shown in Table 1. The risk level is divided as CRITICAL, NORMAL, and WARN. The level of the risk factors will be determined according to whether the measured data falls within a range of levels. In addition, the risk factors to be used are hypertension, BMI, age, first-degree relative with diabetes, and HDL cholesterol..

Table 1. Classifications of Blood Pressure, Diabetes and Obesity

Risk Factors / Risk Level	HbA_{1c} (%)	Glucose (Diabetes) (mg/dl)			Other risk factor	
		FPG	2h-PG	Random	Hypertension	≥ 140/90
					HDL choles-	< 35
NORMAL	< 5.7	< 100	< 140	< 140	BMI	≥ 25
WARN	5.7-6.4	100-125	140-199	140-199	Age	≥ 45
CRITICAL	≥ 6.5	≥ 126	≥ 200	≥ 200	First-degree relative with diabetes	

FPG Fasting Plasma Glucose**, 2h-PG** 2 hours Plasma Glucose, **BMI** Body Mass Index

Applicable priorities in the algorithm are based on the order of HbA_{1c}, glucose data, and metabolic syndrome risk factors. If the data to be evaluated is not available on a device, the data from the IOTsvr(IoT Server) will be evaluated instead of that. Nevertheless, a next risk factor for the priority will be processed if no data is retrieved from the IOTsvr, as shown in Figure 1. IOTsvr provides the patient's medical information such as age, BMI data, and first-degree relative with diabetes. In addition, the IOTsvr also provides some lab tests data, which were stored from the glucose meter (IOTgl), blood pressure monitor (IOTbp), and weighing scale (IOTwt).

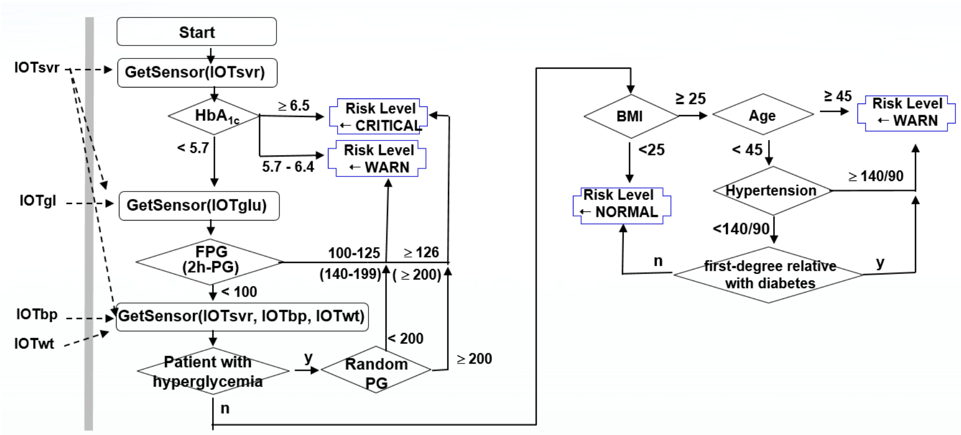

Fig. 1. Intelligent sensor algorithm for diabetes

The algorithm shows the diagnosis by integrating various risk factors to the process. This differs from the conventional method of diagnosing the level of risk to the glucose data only. For instance, in Figure 1, HbA_{1c} is obtained from the function named

GetSensor(IOTsvr), because the data is only obtained from a hospital lab. According to the data, the level of risk can be determined. If the level determined is NORMAL , the next function named GetSensor(IOTglu) will be called to get glucose data from IOTgl or the IOT server if it is not available on the IOTgl. If the level determined is still NORMAL, next prior factors must be evaluated. If the level is WARN or CRITICAL, the diabetes virtual sensor notifies it to the patients. If the patient has some metabolic syndrome such as hypertension, obesity, or high HDL cholesterol, the level of risk will be determined to WARN even if his data are in the NORMAL range.

3 Conclusions

In this paper, we designed an intelligent sensors algorithm to diagnose the level of the risk of diabetes by considering glycosylated hemoglobin, glucose data, and metabolic syndrome risk factors. If the intelligent sensor algorithm is embedded in virtual diabetes meters in the future, it will play a significant role in the smart u-Health service. In addition to that possibility, it can be expected to be a more effective model because the patient performs self-management effectively by knowing a more exact diagnosis if using this model.

The seamless distributed processing is significant between other devices in an IoT network. Therefore, some further studies will be needed for collaborating network protocols in an IoT system for healthcare.

References

1. American Diabetes Association, Standards of Medical Care in Diabetes – 2010, Diabetes Care, Vol. 33, Supplement 1, (2010).
2. Joint National Committee: Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. the 7th Report of the JNC, U.S. Dept. of Health and Human Services (2004).
3. Richard K., Ele F., John B., Michael S.: The Metabolic Syndrome Time: for a Critical Appraisal. Diabetes Care. Vol. 28, No. 9, 2289--2304 (2005).
4. Min C., Jiafu W., Fang L.: Machine-to-Machine Communications: Architectures, Standards and Applications. KSII Trans. on Internet and Information Systems. 480--497 (2012).
5. Sarita A., Manik L. D.: Internet of Things – A Paradigm Shift of Future Internet Applications. Institute of technology Nirma University, 1--7 (2011).
6. B. M. Lee and J. Ouyang, "Application Protocol adapted to Health Awareness for Smart Healthcare Service", In the proc. of International Workshop of Multimedia 2013, Advanced Science and Technology Letters, Vol. 43, 101--104, (2013).
7. B. M. Lee and J. Ouyang, "Intelligent Healthcare Service by using Collaborations between IoT Personal Health Devices", International Journal of Bio-Science and Bio-Technology, Vol. 6, No. 1, 155—164, (2014).

