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DESIGN AND DEVELOPMENT OF SMART GLUCOSE MONITORING SYSTEM

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ABSTRACT

This article describes the design and implementation of a mobile based system for the diabetes patient. Diabetes is a chronic disease that needs to be consistently monitored to maintain the blood glucose levels within normal ranges. This paper proposes compatible glucometer for continuous glucose management system for critically ill adults. This System has been designed to be a long term health companion for patients with diabetes. It allows the patient to get connected to their physician constantly. The application records the glucose level of the patient, confirms it whether it is high, low or normal and tells what immediate steps needs to be taken in a critical situation and also informs the same to the doctor and the caretakers, who have been registered, through a notification.

KEYWORDS : ***Android Smart Phone ,Glucomate,Glucose.***

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INTRODUCTION

The use of Continuous Glucose Monitoring (CGM) has evolved from being a research tool to serving as a device useful for outpatient clinical care in patients with type 1 and type 2. Designed to successfully improve glucose control without the addition of medication in ambulatory patients, CGM provides information about glucose concentration, direction, and rate of change over a period of several days. Because it provides glucose values every 5-10 minutes 24hours a day, CGM may have an advantage over POC testing with respect to reducing the incidence of severe hypoglycemia in acute care.[24-25] Here two types of CGM device are commercially available: retrospective and real-time CGM. Retrospective CGM is a Holter-type device that measures interstitial glucose levels and stores the information over a period up to 7 days to facilitate insulin adjustment, recognition of daily Blood Glucose (BG) fluctuations, and prevention of hypoglycemia.26 Its retrospective nature, however, represents a significant limitation, because patients are unable to react to BG changes before they reach abnormal ranges.27-32 In contrast, real-time CGM technology provides current BG estimates and direction and magnitude of glucose trends, thus allowing patients to take necessary actions to reduce glycemic excursions outside a target range.26 Real-time CGM technology has been shown to facilitate glycemic control and to reduce hypoglycemia in insulin-treated patients.26,33-35 Recent guidelines, however, have recommended deferring the use of CGM in the adult hospital setting until further data on accuracy and safety become available. In this study, we review the advantages and disadvantages of the use of real-time CGM in the management of dysglycemia in the hospital setting. Diabetes is divided into two type's type 1 and type 2. A type 1 patient has no insulin production and has to inject insulin during the day.[1] A patient with type 2 diabetes is usually not treated with insulin and doesn't have to take measurements as frequently. They are instead recommended to have a healthier life-style Patients have difficulties in controlling their blood glucose level because of problems with either producing or absorbing insulin. Trobe able to measure the glucose level during the day, most of the patients carry a blood glucose meter to avoid acute and chronic complications. Smart Device using laser without a worn by the patient in his/her hand in order to monitor blood glucose level at regular interval. Diabetes-Beats (Android application) is developed to monitor the glucose level, medicine intake also triggers alert at critical criteria [2]. The reports will be forwarded to the doctor via SMS and E-mail (user choice). Doctor could send medicine intake via SMS which is been decoded by the android application. It also monitors the medicine intakes and alerts the user at the time of medicine consumption.

Related work

The Bluetooth module is used to connect the smart device with the android application. The device provides the monitoring the blood glucose level of the patient's and sets alarms to prevent high-risk situations. The machine records the contractions and the data is transmitted via a low poser wireless connection to the smart-phone and further using the data connection to a central monitoring server. More and more aspects of the medical monitoring process are taken by automatics to transfer the blood glucose level of the patient. If the patient blood glucose level is very low or high (80-120) normal blood glucose level of (patient) it automatically sends the data from user (patient) to doctor via E-mail or SMS and WhatsApp. To deliver data in near real time to a monitoring and analysis infrastructure/server. There are a few approaches of using the underlying messaging infrastructure provided by Health Level 7 (HL7) in order to carry time series-like data. A custom XML schema built on top of HL7, version 3.0 and provide an implementation of a simple C# application for exchanging simulated real time data with a HL7 compatible data store. They don't present actual hardware devices exploiting these new possibilities, but avenues of investigation are left open for various communication protocols and standards. Some of the difficulties faced by health monitoring systems are listed as follows:

- These systems are not easily extensible, maintainable or scalable.
- At times of overload, information cannot be extracted quickly from the server. This annoys the victims who require immediate access to information.
- Efficiency in these systems is low and is not contextual in nature.

System architecture

Our proposed framework is to produce a diabetes monitoring system based on mobile platform (Android Technology). This system can monitor the glucose level without taking blood according to the glucose level readings, intake food, medication, and physical activities. Doctor could send medicine intake via SMS which is been decoded by the android application. It also monitors the medicine intakes and alerts the user at the time of medicine consumption [4]. The people will aware of diet maintaining, exercise via video. This is for accomplish data accuracy and follow-up daily activities at the same time.

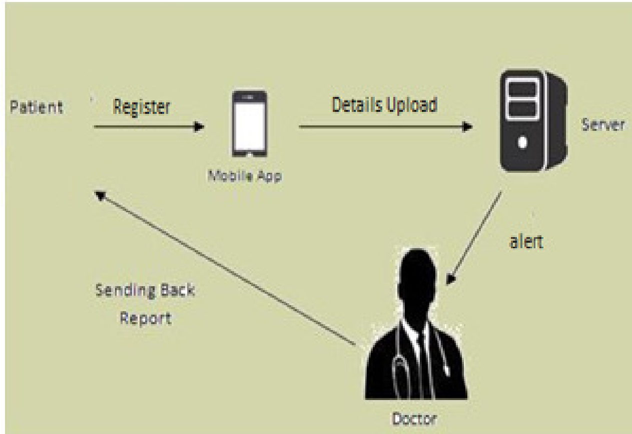

Figure 3.1.
System Architecture of Glucose Monitoring System

The patient's sugar level is measured using the Smart Device. Using Bluetooth technology, the data from the device is transferred to the patient's Smart Phone Application. If any of the critical criteria occurs, the data is intimated to the Doctor via a SMS or an E-Mail. The Doctor immediately prescribes the medicine by responding to the SMS or E-Mail. In case of normal situation, the Pills for the patient's is remained by calendar.

Module description

Information entry

The main functionality of the application is to log information. Many of the design choices have been around how to serve a large audience where every age and life-style is represented. The application has support for input of four main parameters: blood glucose, medicine dosage, exercise and meals. Of these the most important point of data is the blood glucose value [5]. All four inputs are based on a similar system where the user inputs: the date and time of the measurement, the value and some optional notes. These are saved into a database structure and can then later be accessed. When using the application the only thing the user has to input is the actual value, as time and date by default is set to the current time and day (but can be changed). This is of course to make the interaction as quick and easy as possible when using the application. When the user wants to edit an existing entry the Activity for that type of entry is started and all the fields are populated using information from the database.

Daily report

Daily reports are a way to send glucose values by SMS to a care-taker. When enabled, reports are assembled automatically at a customizable time during the day, preferable the evening, by fetching all the values from this date and assembling them into a message. The messages are then sent by SMS to a specified number using the SMS Manager. All this is done without user interaction. To be able to schedule an event for later processing a Service could be implemented that runs in the background but that will consume unnecessary resources. Instead it's recommended that the Alarm Manager is used, which is a system service where events can be scheduled to happen at a certain time using Broadcasts. Share Data is the GUI part of the application where the user can specify; if the service should be enabled, the time and phone number to send the reports[10-13]. These settings are then saved to the database and a call will send the actual SMS using information from the database [6]. One complication with the Alarm-Manager is that it's cleared if you reboot the device, fortunately a Broad Cast is also send when the device has been rebooted. Alarm Receiver listens for this Broad Cast and then calls Alarms which will then set the alarms again [14-15].

Mobile architecture for diabetes management

In Figure 4.1 illustrate the mobile phones with a multi-access service for the management of diabetic patients which was designed to collect data, either manually or automatically from the blood glucose meter to the patient's android device [7].

Figure 4.1
Mobile Architecture for Glucose Monitoring

EXPERIMENTAL RESULTS

The patient must able to know about their glucose level. And also the Doctor should be able to give their feedback. Depending on the authentication function some other modules and functions became active for patients, who have session. Modules in the application are given below.

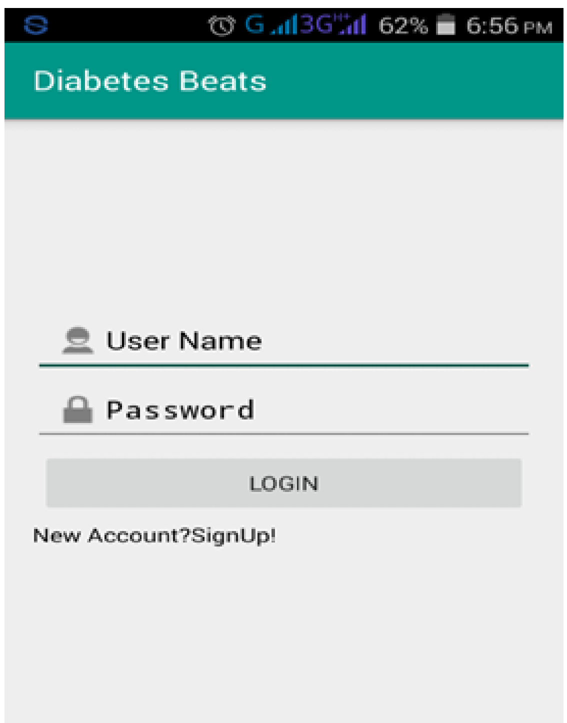

Figure 5.1
Registration for Glucose Monitoring System

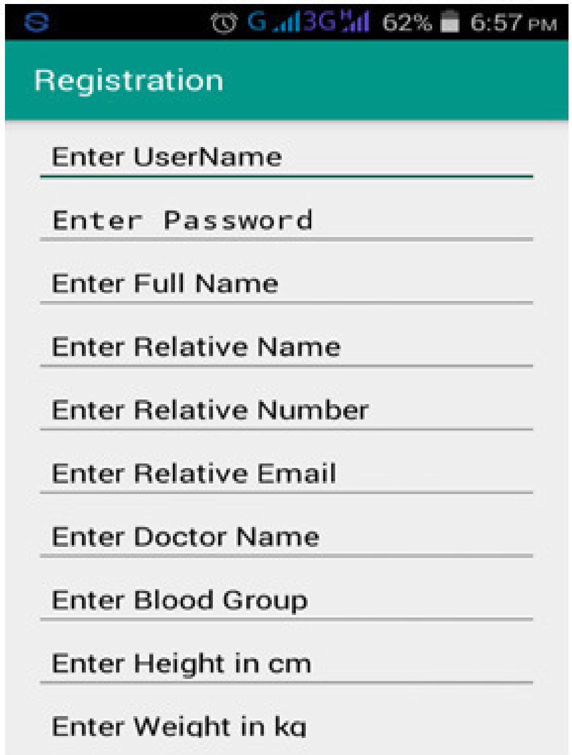

Figure 5.2
Patients Details

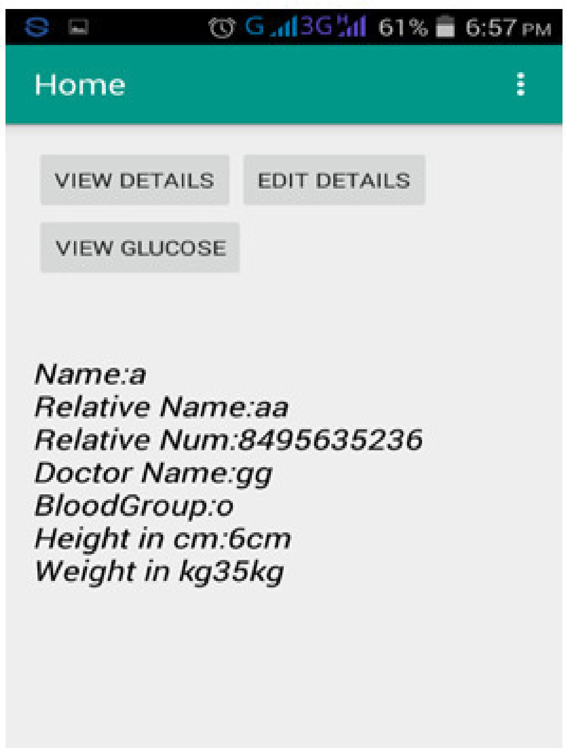

Figure 5.3
Home Panel

Figure 5.4
Report of Glucose Level

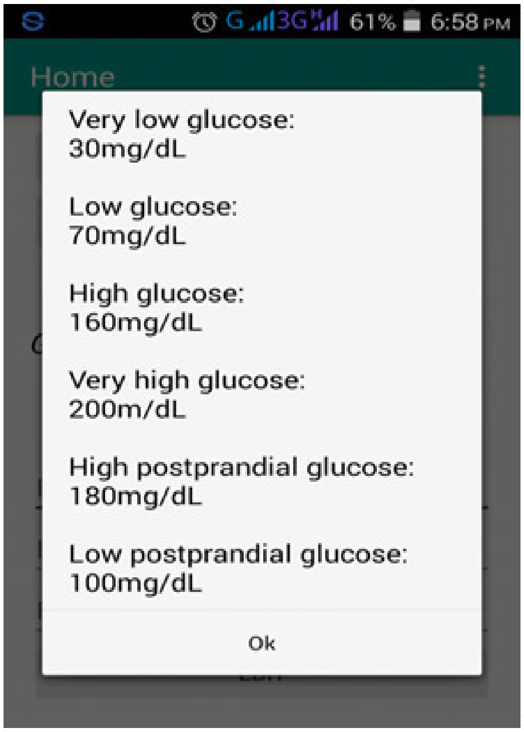

Figure 5.5
Levels of Glucose

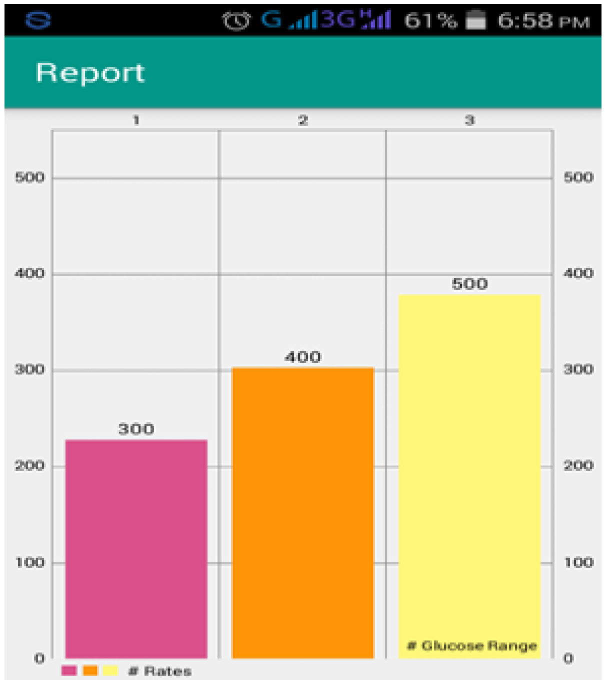

Figure 5.6
Report of Patients

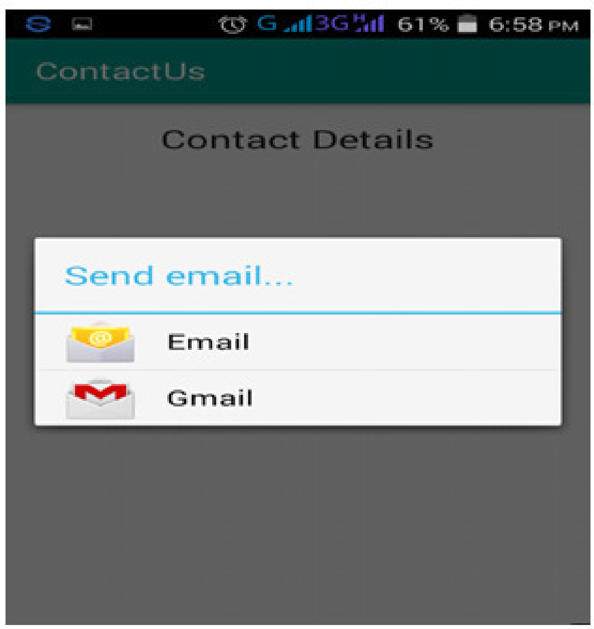

Figure 5.7
Doctor's Communication Module

CONCLUSION

This paper presents a personal diabetes monitoring system which integrates wearable sensors, 3G mobile phones, smart home technologies and Google sheet to facilitate the management of diabetes conditions. The system further integrates with GPS, Google search and Google map functionalities to facilitate the user to find all hospitals near to his/her current location including address, phone number, directions to the selected hospital and street view of any of the selected hospital. In this, the use of BioHarness™ BT to monitor physiological signs during the exercise and use Nexus One smart phone with Android platform to collect live streaming data packages from the BT monitor. The whole system runs more than 2 hours collecting heart rate, breathing rate and skin temperature from BioHarnes BT monitor. From the experiment, we find the system is robust. And collecting data, displaying data on the cell phone and pushing data into Google sheet are all done by one button click. It is simple enough for the end users, especially for the elderly users to use in their daily exercise. This diabetes monitoring system not only assist with the tasks of diabetes management, but also improves the medicine and food safety by taking full advantage of features in existing subsystems in smart home and related cutting edge technologies.

Future enhancement

The current research focused on collecting data from glucose and blood pressure sensors by using Bluetooth API for Android phone. The glucose and blood pressure sensors have some challenges working with Android smart phone. We have improved the accuracy of automatically collected exercise information and getting feedbacks from real users. The system is developed and tested in the smart home lab. The future work is planned to get a number of users with diabetes to use the system and get the users' family members and health caregivers involved. We are expecting tons of feedbacks from the users which will help us to improve the system further; It will be integrating with diet system developed at the smart home lab to check food allergies, daily consumption history and conflicts between food and medicine.

CONFLICT OF INTEREST

Conflict of interest declared none.

REFERENCES

1. Bonnie Katalenich, "Evaluation of a Remote Monitoring System for Diabetes Control", Elsevier HS Journals, April 2015;37(6):1216 – 1225.
2. Anbumani.S,Kavin.R,Saranya.A, "An Intelligent Patient Tele-Monitoring System Using Android Technology", IJRET, Feb 2015;4..
3. E.Udayakumar, S.Dhivya, M.Pugalarasi, Dr.K.Srihari and Dr.S.Karthik "Certain Investigation on Human Body Using Various Algorithms", Australian Journal of Basic and Applied Sciences, AENSI Journals, March 2014;8(10):559 – 564.
4. Mashael Saud Bin-Sabbar,Mznah Abdullah Al-rodhaan ,"Diabetes Monitoring System Using mobile Computing Technologies",IJACSA, 2013;4(2).
5. Ana Maria Gomez, Guillermo E. Umpierrez, "Continuous Glucose Monitoring in Insulin-Treated Patients in Non-ICU Settings", IJACSA, 2014;8.
6. Supriya H S, Mrs.Rekha R J, "A Blood Sugar Monitoring Application Using Android", IJACSA, 2015;4.
7. Sang-Joon Jung,Risto Myllyla,Wan-Young Chung,"Wireless Machine-to-Machine Healthcare Solution Using Android Mobile Devices in Global Networks", IEEE Sensors Journal, 2013;13.
8. E.Udayakumar, S.Santhi, K.Yogeswaran and J.Rama "Automatic Detection of Diabetic Retinopathy through Optic Disc using Morphological Methods", Asian Journal of Pharmaceutical and Clinical Research, Innovare Academic Sciences, April 2017;10(4):28 – 31.
9. [9] Lazar I, Hajdu A. Microaneurysm Detection in Retinal Images Using a Rotating Cross-section Based Model. In: 2011 IEEE International Symposium on Biomedical Imaging, 2011;1405-9.
10. Agurto C, Barriga ES, Murray V, Nemeth S, Crammer R, Bauman W, et al. Automatic detection of diabetic retinopathy and age-related macular degeneration in digital fundus images. Invest Ophthalmol Vis Sci 2011; 52(8):5862-71.
11. Giancardo L, Meriaudeau F, Karnowski TP, Li Y, Tobin KW, Chaum E. Microaneurysm Detection with Radon Transform-based Classification on Retina Images. Proceeding IEEE Annual International Conference EMBC; 2011; 5939-42.
12. Abràmoff MD, Reinhardt JM, Russell SR, Folk JC, Mahajan VB, Niemeijer M, *et al*. Automated early detection of diabetic retinopathy. Ophthalmology 2010;117(6):1147-54.
13. JBDC database Access [Internet]. February 2013 Available from: http://docs.oracle.com/javase/tutorial/jdbc/overview/index.html.
14. WAMP server [Internet]. February 2013.Available from: http://www.wampserver.com/en/.
15. Medical News Today [Internet]. May 2012, Available from: http://www.medicalnewstoday.com/.
16. Niemeijer M, van Ginneken B, Cree MJ, Mizutani A, Quellec G, Sanchez CI, *et al*. Retinopathy online challenge: Automatic detection of microaneurysms in digital color fundus photographs. IEEE Trans Med Imaging 2010;29(1):185-95.

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