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Patient Self-Controllable Healthcare Monitoring System Using Android Smart Phone

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Abstract – Presents a prototype machine-to machine (M2M) healthcare solution that combines mobile and IPv6 techniques in a wireless sensor network to monitor the health condition of patients and provide a wide range of effective, comprehensive, and convenient healthcare services. A low-power embedded wearable sensor measures the health parameters dynamically, and is connected, according to the concept of IPv6 over low-power wireless personal area network, to the M2M node for wireless transmission through the internet or external IP-enabled networks via the M2M gateway. A visualization module of the server program graphically displays the recorded biomedical signals on Android mobile devices used by patients and doctors at the end of the networks in real-time. Our approach for a global M2M healthcare solution is managed to process the large amount of biomedical signals through the extended network combining IPv6 technique and mobile technology for daily lifestyle to users appropriately.

Index Terms – Distributed cloud computing, BLE (Bluetooth low energy), security, intrusion, m-healthcare.

1. INTRODUCTION

Information and communication technologies are transforming our social interactions, lifestyles, and workplaces. One of the most promising applications of information technology is healthcare and wellness management. Healthcare is moving from an approach based on the reactive responses to acute conditions to a proactive approach characterized by early detection, prevention, and long-term management of health conditions. The current trend places an emphasis on the monitoring of health conditions and the management of wellness as significant contributors to individual healthcare and wellbeing. This is particularly important in developed countries with a significant aging population, where information technology can significantly improve the management of chronic conditions and thereby improve quality of life. In particular, the continuous or even occasional recording of biomedical signals is critical for the advancement of diagnosis as well as treatment of cardiovascular diseases by using wireless wearable sensors.M-healthcare cloud computing systems have been increasingly adopted in the distributed environment which plays the vital role in monitoring the personal health information. In m-healthcare social networks, the personal health information is always shared among the patients located in respective social communities suffering from the same disease for mutual support, and across distributed healthcare providers (HP) equipped with their own cloud servers for medical consultant. A wireless M2M healthcare solution using the Android mobile devices is successfully implemented in a global network with the help of the IPv6 technique. The M2M devices are designed and used for the measurement of BEETS BLU signals and their transmission to a server PC through the IP-enabled internet, while the Android mobile device is used to provide a mobile healthcare service by means of an Android application running on a Samsung Galaxy S or any android device with wireless internet access.

2. RELATED WORK

A. SMART VEST: WEARABLE MULTIPARAMETER REMOTE PHYSIOLOGICAL MONITORING SYSTEM

The deployment of Wearable Health Monitoring Systems (WHMS) is expected to address several important healthcare-related issues such as increasing healthcare costs, the rising number of the elderly population and treatment of chronic conditions. However, most of the currently developed WHMS simply serve as ambulatory physiological data loggers and transmitters in order to make the recorded bio-signals remotely available for inspection from a supervising physician. we describe our efforts towards setting up a WHMS prototype that is capable of providing individualized embedded decision/diagnosis support for round-the-clock remote health monitoring of people at risk. To realize this goal an ANN-based approach is adopted, whereby a supervised learning period is required in order to embed patient-specific medical knowledge into the system, which will then enable it to make more accurate and "safer" estimations about the user's health condition.

The fact that the global population is both growing and aging poses a series of challenges to health care providers worldwide. Furthermore, the total number of people suffering from some type of disability (either lifelong, or injury related or more commonly related to chronic conditions) will continue to rise . These issues along with the issues of managing and treating several chronic diseases, such as diabetes, congestive heart failure and obstructive pulmonary disease, have created a requirement for new and innovative ways to deliver health care to patients. Information and communication technologies are expected to provide the means to realize personalized and citizen-centered health care solutions to address the previously stated challenges as well as rising health care costs.

B. PHYSIOLOGICAL SIGNAL ANALYSIS FOR PATIENTS WITH DEPRESSION

Depression is a Common and serious mental disorder. About 1.9 million people in Taiwan are identified as having depression. There is a trend of increase of the prevalence of depression, three times more depressed persons within the past six years. A few patients with depression were in treatment. Therefore, an available algorithm will be built to measure the neurophysiology of depression. In this study, the physiological signals from depressed patients will be compared with those from normal people. This experiment use different pictures expresses happiness, sadness fear, and disgust to cause the emotion of subjects. The physiological signals of the patient are measured at the same time. The preliminary results show that the galvanic skin response, heart rate variability, and blood volume pulse of patients with depression is lower than the normal people does. More subjects will be evaluated in the project for investing the clinical significance.

3. PROPOSED MODELLING

This project can monitor the patient's heartbeat in a secure environment. Bluetooth low energy (BLE) sensor will be used to transmit heart rate from the patient.

An android mobile phone will capture that BLE signal and transmit to the cloud in secure way. The receive phone should possess a decryption key to understand the medical data. Alert notification will be provided if heart rate reduces or increases to certain threshold level. The notifications can be a sms, email to the caretaker. Only authorized persons in medical consultation can access and share the data. List of modules in the health system are as follows:

1. Transmitting Heart Rate to Android Device using BLE
2. Sending Data to Database via Rest Service
3. Intrusion Detection
4. Security Levels
5. Retrieving Data from the Database

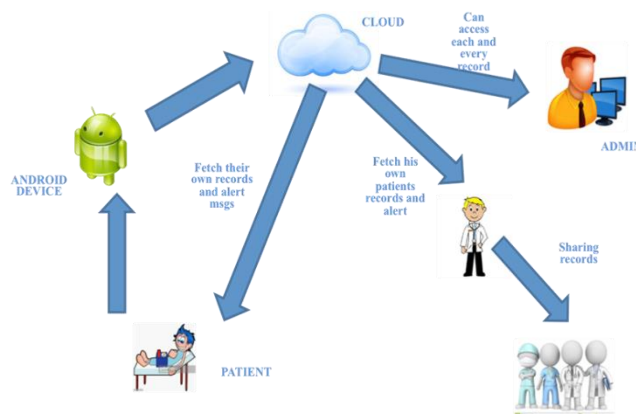

Fig 1. System Architecture

1. Transmitting Heart Rate to Android Device using BLE

The heart rate monitor uses Bluetooth 4.0 low energy profile. BLE devices use low energy to transmit the heart rate to android phone. The range of that BLE will be 10 to 60 m.

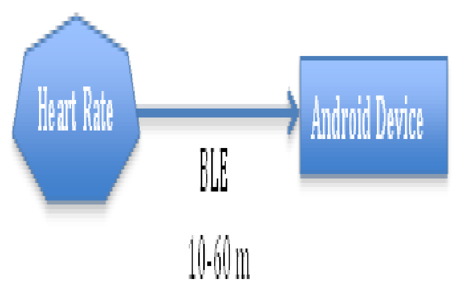

Fig 2. Heart Rate Transmission

2. Sending Data to Database via Rest Service

Once the data is received in the android we plot it in the UI screen and send the heart rate value to the REST service (Http Service running in Amazon Cloud). We use Android's AsyncTask to send the data to the REST service. Once the data reached the REST Service we store it in NOSQL DB called Mongo DB.

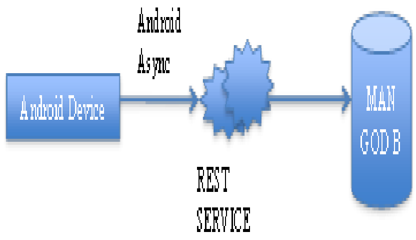

Fig 3. Cloud Storage

3. Intrusion Detection

The REST layer also checks the data using the state table stored in the Mongo DB and detect the intrusion detection

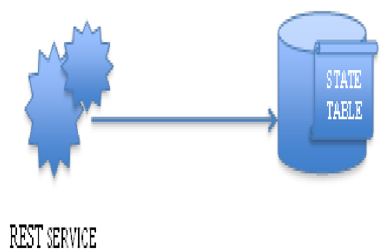

Fig 4. Intrusion Detection

4. Security Levels

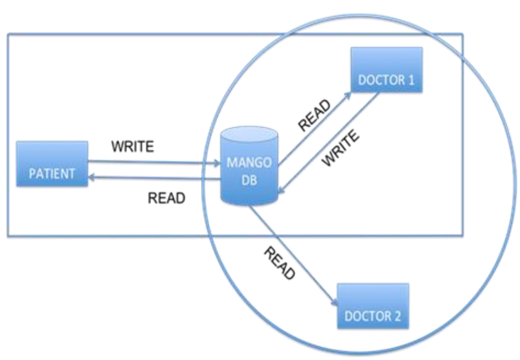

Fig 5. Security Level

Three levels of security have been achieved as in fig 5 so that data will be in scurely stored and retrived only through the authenticated persons approved

5. Retrieving Data from the Database

Receiver Android application in which we receive the heart rate and display.

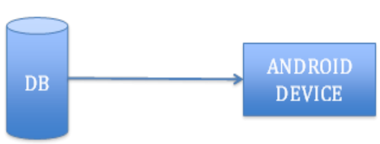

Fig 5. Cloud storage

4. RESULT AND DISCUSSIONS

The Healthcare monitoring system captures the Heart rate from the user through PPG sensor and transfer the pulse rate to android phone through Bluetooth low energy signals. Heart rate monitor app receives lower and upper range values and draw continuous graph in app as in Fig 6 & 7.

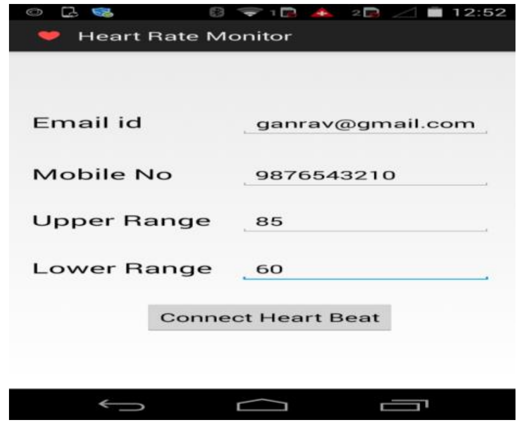

Fig 6. Machine to Machine Send

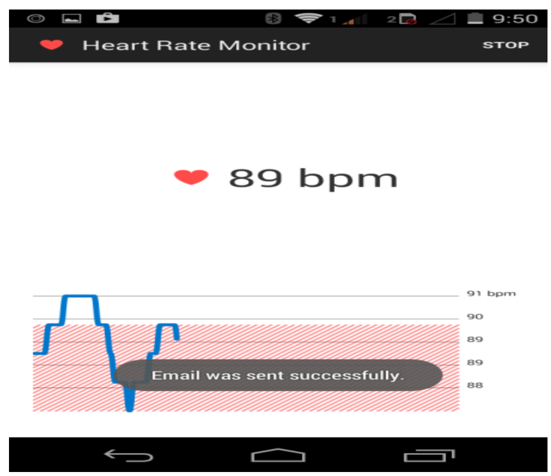

Fig 7. Machine to Machine Receive

5. CONCLUSION

Monitors and alert the patients 24/7 Patient can get high quality treatment. It increases the patient privacy and confidentiality over their medical records. Immediate remedy will be given to the patient. Three different levels of security and privacy requirement in the distributed m-healthcare cloud computing system are proposed, followed by the formal security proof and efficiency evaluations which illustrate our monitoring system. In addition, an Android mobile healthcare application can be deployed on mobile devices, such as smart phones, tablet PCs, and laptops to monitor biomedical signals in real time for healthcare services with an exponentially increasing number of sensors and opportunities in the marketplace, this field of research has the potential to significantly change and improve the efficiency of the healthcare system. Based on our results, we conclude that, with the evolution of network integration and the management of embedded devices operating multimodal tasks a more precise and universal healthcare service scheme can be realized. A wireless M2M healthcare solution using the Android mobile devices is successfully implemented in a global network with the help of the IPv6 technique. The M2M devices are designed and used for the measurement of BEETS BLU signals and their transmission to a server PC through the IP-enabled internet, while the Android mobile device is used to provide a mobile healthcare service by means of an Android application running on a Samsung Galaxy S device with wireless internet access.

By combining the 6LoWPAN and mobile communication techniques, significant network extension and the higher accessibility of M2M devices has been achieved. We have proposed the key ideas of establishing the 6LoWPAN and the efficient support of IPv6 with the IEEE 802.15.4 protocol in health care applications. With the use of comfortable wearable sensors in global areas, the proposed M2M healthcare system promises to improve the flexibility and scalability of healthcare applications.

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