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IOT BASED WEARABLE SMART HEALTH MONITORING SYSTEM

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ABSTRACT

An important part of our life, internet has enabled many machines and devices we use in everyday life to be monitored and controlled remotely through Internet of Things (IOT) technology. Thanks to IOT technology, smart health applications have become a rapidly growing sector. For individuals with heart disease, the Heart Rate (HR), Heart Rate Variability (HRV) and Body Temperature (BT) values are considered vital signs that must be measured regularly. In this study, an android-based application is developed that can monitor HR, HRV and CT parameters for cardiovascular patients who should be under constant observation. The measuring system, which consists of wearable sensors, constantly measures patient signs. Then send the measured signals to android interface via wireless connection. If the predetermined critical values for the patient are exceeded, the HR, HRV, CT values and also the real-time location of patient is sent both to family members and doctor as e-mail and twitter notification. The wearable measurement system allows patients to be mobile in their own social environment, allowing them to live their lives in confidence.

INTRODUCTION

IoT was first proposed by Kevin Ashton in 1999. It is a communication network in which physical objects are interconnected with each other or with larger systems. This network collects billions of data from the very different devices we use in everyday life and transforms them into usable information. Today, there are about 20 billion devices in the world that interact with each other, and by 2025 it is estimated to go up to 75 billion devices. This shows that in the coming years cities that we live with IOT will become smart cities that will

keep pace with the more paced and planned life. This transformation will offer us many opportunities to make our life easier. One of these important opportunities is the e-health services that are closely related to all of us. IOT applications in the health sector are increasing day by day. People living in rural areas cannot benefit from preventive health services due to lack of infrastructure. As a result, deaths occur very early in these regions.. In addition, with the rapid aging of the world population, the needs of the elderly for life support are increasing with the change of family structure. In addition to chronic heart disease, there is a high probability that the patient will lose his or her life as a result of excessive fatigue of the heart during sleep at night, especially in Chronic Obstructive Pulmonary Disease (COPD) and Obstructive Sleep Apnea Syndrome (OSAS). Devices that provide continuous monitoring of these patients are very expensive and sensitive and require trained personnel to use them. It is possible for such patients to be followed up continuously with wearable health devices while maintaining their daily lives in the social environment. These wearable devices continuously measure the patient's heart values and, when a symptom of a heart attack has occurred, may send information about the patient's health condition to the family members and the doctor. HR and HRV are used primarily as a diagnostic tool for heart and non-cardiac diseases such as heart failure, aging, Parkinson's disease, diabetes. IOT is a new reality that completely changes our daily life. It is also a way to revolutionize modern health care by providing more personalized and preventive care. Thanks to IOT technology, mutual information sharing among various smart devices has been facilitated anywhere in the world. In this environment, studies on smart health services, which can provide remote diagnosis of the disease, are also accelerated. Thanks to low cost, low power consumption and high performance, devices that can collect patient heart data can be sent to the patient's family or doctor by smart phone applications. Continuous monitoring of a person's health through wearable biomedical devices is now possible with many wearable health kits. However, real-time analyzes and estimates, warnings and alarms on health hazards are not adequately addressed in these devices. In this study, a wearable device is designed to measure vital values such as HR, HRV, and CT, which directly concern heart health. The pulse sensor on the device and the heart related data from the patient's fingertip are analyzed with the Arduino Pro Mini controller. The results of this analysis are transferred to the patient's mobile phone via Bluetooth connection. Thanks to the "Smart Health" interface created with the Blink application developer, the data transmitted to the mobile phone is displayed on the screen in real time. When the patient's vital parameters reach critical levels, an audible-visual alert is sent to the patient and family members with the Android-based application. Concurrently, this data and the patient's position information are sent to the patient's family members and the her/his doctor as e-mail and twitter notification. The main purpose of the device is to increase the chances of survival by providing medical assistance to the patient within the first few hours in case of a possible heart attack.

LITERATURE REVIEW

The patient monitoring system has become one of the major developing area in the medical industry because of its innovative technology and nowadays, healthcare sensors are playing an essential role in hospitals. Studies reveal that the wireless technology network and its application in health provision is gaining popularity. Governments, insurance agencies, hospitals as well as other healthcare providers are turning to wireless technology to limit medical errors and save costs of managing patients. The growing trend in introducing the technology will help in constant monitoring of the patients while reducing the cost and increasing the quality of healthcare. The six major actors in a typical scenario of healthcare are Children, Elderly and chronically ill, Caregivers, Healthcare professionals, Administrator and Developer. And the five subsystems with which these actors constantly interacts are Body Area Network (BAN), Personal Area Network(PAN), Gateway to the Wide Area Network, Wide Area Network(WAN) and End-user healthcare monitoring application. While developing devices based on new technologies like IOT one can encounter many challenges in each level. The main challenge the traditional health care systems in hospitals especially in post-operative wards are facing is the limitations to the patient's mobility. The patient's mobility in postoperative period is important in terms of standing or walking as it doesn't only reduce the risk of deep venous thrombosis but also helps the patient to return to his/her normal life. Many medical systems nowadays use IOT in order to reduce the limitations of traditional systems. The biological parameters gathered by the sensors can be forwarded directly to IOT cloud or can be shown in mobile applications like blink. The connection to internet can be either wired connection using an Ethernet cable or wireless using Wi-Fi. These devices can use Raspberry Pi or Arduino UNO as their main microcontroller. The microcontrollers for each device is chosen based on the requirement, sometimes it will need only a single microcontroller and other times it may need two or more different microcontrollers like using both Arduino UNO and Raspberry Pi in the sensors used in each device will also be different. The temperature sensor used for measuring body temperature can be Tsic506 [10], DS18B20 and MAX30205, but MAX30205 will give more precise value since it has an accuracy of 0.1°C and a resolution of 16 bit ($0.00390625^{\circ}\text{C}$). There are devices which could individually measure one vital parameter at a time and devices to measure more of them. A device which measures oxygen saturation, heart rate and ECG and uses wireless sensors to transmit the collected information to the data acquisition unit where the doctors can see the digitized image of the patient's parameters is shown in. The system in can be used to continuously measure the physiological parameters, such as Blood pressure (Systolic and Diastolic), Pulse rate, ECG monitoring, Temperature of a human subject using Zigbee to transfer collected data. But Wi-Fi is more preferred than Zigbee as it is faster. Some systems uses software's like Lab VIEW for applications like measurement and testing of real time data, where the data from the sensors are given to a nearby laptop having this software using Bluetooth or using USB connection. The authors of has proposed a flexible healthcare system for hospitals which monitors temperature, heart beat and ECG using embedded wearable low-power sensors whose data are gathered by Raspberry Pi and are then analyzed using Lab view software in nearby computer. But for remote monitoring the data should be

transferred to IOT based platforms like Thing Speak in order to analyze real time data in cloud any time anywhere. A GSM based system can also provide realtime health parameters from a source (patient) to destination (family members/doctors) constantly but only over some distance. All these devices can either directly display the data measured by the sensors and let the doctors analyze it manually and detect abnormalities, or it can compare the values given by the sensor with the real reading that are acquired by traditional methods and display the change in the web server for the doctor to see and respond quickly . This is possible by manipulating the software accordingly. A smart health monitoring system is proposed in where the patient data which includes heartbeat, body temperature and blood pressure are given to using Arduino and Raspberry Pi and is updated on GUI which is viewed by the doctor. If any of the parameter goes above or below of predefined levels, the status will be updated and doctor can trigger button of respective tablet so that the medication box will get opened and the patient have emergency tablets in real time. Even though the vital signs monitoring system available in market can measure a number of parameters, there is no device which can measure all of them together.

Conclusion

Today, many services can be reached with internet technology and the number of applications that use this technology is constantly increasing. IOT technology is expanding day by day to include different sectors and applications. One of them is the smart health sector and this sector offers incredible opportunities for us with new applications. The monitoring of the patients, who should be kept under constant surveillance, in the hospital environment is very difficult with the existing infrastructure and methods. Patients under surveillance in hospitals are dependent on bedding and this makes the patients uncomfortable. Many health problems that require early diagnosis may cause vital problems for the patient because they cannot be monitored on time. Early diagnosis is unbelievably important for patients with heart disease. In this study, a wireless patient monitoring system is developed that allows patients to be mobile in their social areas. The developed system continuously measures the heart rate and body temperature of the patient and provides monitoring and tracking through an android based interface. When the patient's vital data reaches a predetermined limit value, the mobile application alerts the patient and the people in the vicinity. This warning is made at a volume level that people near the patient can hear. If there is nobody in the vicinity of the patient who can help him, the patient's heart rate, body temperature, and coordination information are sent to family members and the doctor as e-mail and twitter notifications. The main purpose of the device is to make provide that they get medical aid as soon as possible, in case of a possible discomfort for heart diseases. So there will be an increased chance of survival of patients.

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