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Smart Health using IoMT

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ABSTRACT

This paper describes an approach to increase the safety of Patients using the concept of IoMT in which sensor is used to get data from the patient's body. The IoMT has grown out of the earlier efforts of mobile healthcare or mobile health, as it is known. Patients wear devices that monitor vitals, such as heart rate, body temperature, and blood pressure and transmit the results to hospitals or medical centers, rather than visiting doctors to provide the information.

Keywords – IoMT, Internet of medical things, mHealth, IoT.

I.INTRODUCTION

Health Band is an innovative solution for detecting a person whose health is in grave danger. So we are designing a bracelet that synced to the smartphone or to a web page. Our health monitoring bracelet capable of reading a human's vital signs (pulse rate, body temperature, sweat level and sleep monitor). The values are stored in the website's database so that other person who has the correct credentials would be able to view the patient’s health monitor.

Our band is connected to the web server which process all the data coming from the band and display it on the web page in the form of charts and pie. So that anyone can understand it in no time. We are planning to provide two interfaces, first is the web page and second is a mobile application. The application further divided into two parts, one is for doctors and another is for the patient. Currently, we successfully have done the web interface.

The project isn't only limited to tracking fellow individuals. Hospitals can use the Health Band project to monitor their outpatients. Patients who are at risk of unpredictable health conditions such as having Stroke, Cardiac Arrest, and Heart Attack. If an incident does occur, the bracelet can predict it before it even occurs, the Health Band system would be able to notify the nearest hospital by sending the exact GPS coordinates of the person in need. We have designed this project for the patient's so that we could monitor them remotely. If the bracelet detects life-threatening vital readings, the phone synced to the bracelet will automatically notify the doctors.

The database system maintains all information regarding the patient such as patients and doctor details, patient-doctor log record, maintain medicine record and maintain health update of the patient. There are certain health conditions that are completely unpredictable. People who are at risk of collapsing, cardiac arrest, heart attack and stroke are most likely to be found dead when it's too late. According to CDC, heart-failure ranks first in their list of the top leading causes of death while stroke ranks fourth.

The existing system provides more facilities related to mobile notifications rather than the health-related information. The system now a day's senses very few parameters of the body. It also has connectivity limitation as well as accuracy issues.

The motivation for this project is to incorporate multiple sensing parameters which help us to get maximum vital information about our body. To provide information for diagnostics. With our band, we are focusing only on medical purpose.

II.INTERNET OF MEDICAL THINGS DEFINITIONS AND APPLICATIONS

The Internet of Medical Things (IoMT) is the collection of medical devices and applications that connect to healthcare IT systems through online computer networks. Medical devices equipped with Wi-Fi allow the machine-to-machine communication that is the basis of IoMT. IoMT devices link to cloud platforms such as Amazon Web Services, on which captured data can be stored and analyzed. IoMT is also known as healthcare IoT. Examples of IoMT include remote patient monitoring of people with chronic or long-term conditions; tracking patient medication orders and the location of patients admitted to hospitals; and patients' wearable mHealth devices, which can send information to caregivers. Infusion pumps that connect to analytics, dashboards and hospital beds rigged with sensors that measure patients' vital signs are medical devices that can be converted to or deployed as IoMT technology.

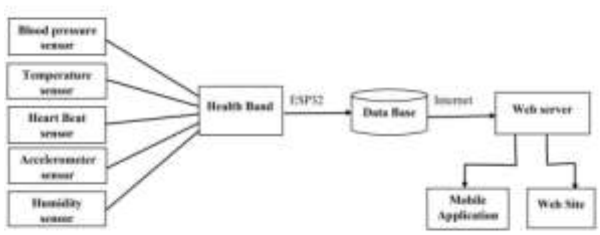
The Internet of Medical Things (IoMT) is a group of wearable medical devices used to collect patient physiological data. The wearable medical devices are interconnected with the assistance of wireless networks. Most of the medical devices are connected with the use of Wi-Fi to communicate each other. The data collected on wearable medical devices are stored in a cloud database. Nowadays, the number of wearable medical devices generates large amounts of healthcare data, including blood pressure, heart rate, body temperature, respiratory rate, blood circulation level, and body pain and blood glucose level. However, the main challenge in IoMT is how to manage with respect to critical applications, where a number of connected devices generate a large amount of medical data. This large volume of data, often called big data, cannot readily be processed by traditional data processing algorithms and applications. In general, many database clusters and additional resources are required to store big data. However, storage and retrieval are not the only problems. Obtaining meaningful patterns from big data, such as that pertaining to patient diagnostic information, is also an essential problem. Presently, a number of emerging applications are being developed for various environments. Sensors are most often used in critical applications for real-time or near future. In particular, the IoMT uses an accelerometer sensor, a visual sensor, temperature sensor, carbon dioxide sensor, ECG/EEG/EMG sensor, pressure sensor, gyroscope sensor, blood oxygen saturation sensor, humidity sensor, a respiration sensor and blood-pressure sensor to observe and monitor the patient's health in a continuous manner. By intelligently investigating and collecting large amounts of medical data (i.e., big data), IoMT can enhance the decision-making process and early disease diagnosis. Hence, there is a need for scalable machine learning and intelligent algorithms that lead to more interoperable solutions, and that can make effective decisions in emerging IoMT.

As is the case with the larger Internet of Things (IoT), there are now more possible applications of IoMT than before because many consumer mobile devices are built with Near Field Communication (NFC) radio frequency identification (RFID) tags that allow the devices to share information with IT systems. RFID tags can also be placed on medical equipment and supplies so that hospital staff can remain aware of the quantities they have in stock.

The practice of using IoMT devices to remotely monitor patients in their homes is also known as telemedicine. This kind of treatment spares patients from traveling to a hospital or physician's office whenever they have a medical question or change in their condition.

The security of sensitive data -- such as protected health information regulated under the Health Insurance Portability and Accountability Act -- that passes through the IoMT is a developing concern for healthcare providers.

III.FUNCTIONING



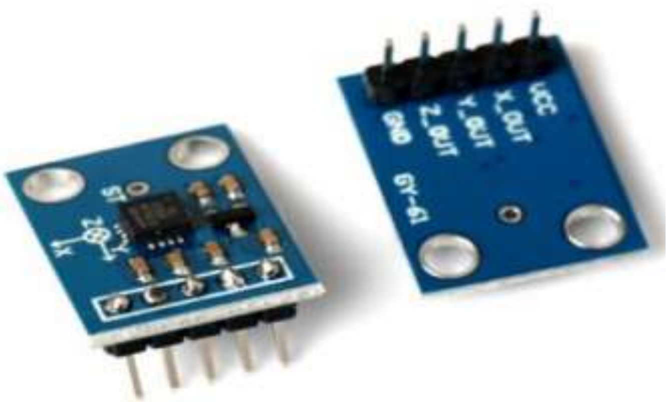
In above fig with the help of various sensors, the system gathers all the vital information about a patient like a body temperature, pulse rate, blood pressure, sweat level, steps count and sleep time. All data get transmitted and collected through the ESP32 chip which provides 802.11b/g/n connectivity. Database server sends that data to webpage and mobile application. The user can access that information with valid authentication credentials.

Sensors which is included in this system is as follows – 1. Pulse Sensor - It is a well-designed plug-and-play heart-rate sensor for Arduino. It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart-rate data into their projects. The sensor clips onto a fingertip or earlobe and plugs right into Arduino with some jumper cables. It also includes an open-source monitoring app that graphs your pulse in real time.

The front of the sensor is the pretty side with the Heart logo. This is the side that makes contact with the skin. On the front, you see a small round hole, which is where the LED shines through from the back, and there is also a little square just under the LED. The square is an ambient light sensor, exactly like the one used in cellphones, tablets, and laptops, to adjust the screen brightness in different light conditions. The LED shines light into the fingertip or earlobe, or other capillary tissue, and the sensor reads the light that bounces back. The back of the sensor is where the rest of the parts are mounted. We put them there so they would not get in the way of the of the sensor on the front.

2. DS18B20 - The DS18B20 has four main data components: 1) 64-bit lasered ROM, 2) temperature sensor, 3) nonvolatile temperature alarm triggers TH and TL, and 4) a configuration register. The device derives its power from the 1-Wire communication line by storing energy on an internal capacitor during periods of time when the signal line is high and continues to operate off this power source during the low times of the 1-Wire line until it returns high to replenish the parasite (capacitor) supply. As an alternative, the DS18B20 may also be powered from an external 3 volt - 5.5 volt supply.

3. GY-61 accelerometer - The ADXL335 is a small, thin, low power, the complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration.



IV.TECHNOLOGIES USED

MQTT Protocol –

All the above-mentioned sensors are used for sensing the vital signs of the body and the collected data is sent to the web interface through the help of ESP32 chip which acts as transmitter where it checks the abnormal values and if any abnormal value is found then it is get stored into the database.

The data is reached to the web interface through the protocol called mqtt. MQTT is a machine-to-machine (M2M)/"Internet of Things" connectivity protocol. It was designed as an extremely lightweight publish/subscribe messaging transport. It is useful for connections with remote locations where a small code footprint is required and/or network bandwidth is at a premium. For example, it has been used in sensors communicating to a broker via satellite link, over occasional dial-up connections with healthcare providers, and in a range of home automation and small device scenarios. It is also ideal for mobile applications because of its small size, low power usage, minimized data packets, and efficient distribution of information to one or many receivers. MQTT stands for MQ Telemetry Transport. It is a publish/subscribe, extremely simple and lightweight messaging protocol, designed for constrained devices and low-bandwidth, high-latency or unreliable networks.

The design principles are to minimize network bandwidth and device resource requirements whilst also attempting to ensure reliability and some degree of assurance of delivery. These principles also turn out to make the protocol ideal of the emerging "machine-to-machine" (M2M) or "Internet of Things" world of connected devices, and for mobile applications where bandwidth and battery power are at a premium. MQTT was invented by Dr. Andy Stanford-Clark of IBM, and Arlen Nipper of Arcom (now Eurotech), in 1999.

TCP/IP port 1883 is reserved with IANA for use with MQTT. TCP/IP port 8883 is also registered, for using MQTT over SSL. You can pass a username and password with an MQTT packet in V3.1 of the protocol. Encryption across the network can be handled with SSL, independently of the MQTT protocol itself (it is worth noting that SSL is not the lightest of protocols, and does add significant network overhead). Additional security can be added by an application encrypting data that it sends and receives, but this is not something built-in to the protocol, in order to keep it simple and lightweight.

Node-red –

The web interface which shows all the sensor data of the body is designed using the new IOT platform which is known as IBM node-red. Node-red provides all the functionality for designing advance and fast way to build a webpage and also provides the dashboard for ease of use.

Node-RED is a flow-based programming tool, originally developed by IBM’s Emerging Technology Services team and now a part of the JS Foundation. Invented by J. Paul Morrison in the 1970s, flow-based programming is a way of describing an application’s behaviour as a network of black-boxes, or “nodes” as they are called in Node-RED. Each node has a well-defined purpose; it is given some data, it does something with that data and then it passes that data on. The network is responsible for the flow of data between the nodes.

It is a model that lends itself very well to a visual representation and makes it more accessible to a wider range of users. If someone can break down a problem into discrete steps they can look at a flow and get a sense of what it is doing; without having to understand the individual lines of code within each node. Node-RED consists of a Node.js-based runtime that you point a web browser at to access the flow editor. Within the browser, you create your application by dragging nodes from your palette into a workspace and start to wire them together. With a single click, the application is deployed back to the runtime where it is run. The palette of nodes can be easily extended by installing new nodes created by the community and the flows you create can be easily shared as JSON files.

ESP32 chip –

ESP32 is a single 2.4 GHz Wi-Fi and Bluetooth combo chip designed with TSMC ultra-low-power 40 nm technology. It is designed to achieve the best power and RF performance, showing robustness, versatility, and reliability in a wide variety of applications and different power profiles.

ESP32 can perform as a complete standalone system or as a slave device to a host MCU, reducing communication stack overhead on the main application processor. ESP32 can interface with other systems to provide Wi-Fi and Bluetooth functionality through its SPI / SDIO or I2C / UART interfaces. ESP32 is highly-integrated with inbuilt antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power management modules. ESP32 adds priceless functionality and versatility to your applications with minimal Printed Circuit Board (PCB) requirements.

Engineered for mobile devices, wearable electronics, and IoT applications, ESP32 achieves ultra-low power consumption with a combination of several types of proprietary software. ESP32 also includes state-of-the-art features, such as fine-grained clock gating, various power modes, and dynamic power scaling. ESP32 is capable of functioning reliably in industrial environments, with an operating temperature ranging from -40°C to +125°C. Powered by advanced calibration circuitries, ESP32 can dynamically remove external circuit imperfections and adapt to changes in external conditions.

V.CONCLUSION

The proposed system will give all the information of our body and help to healthcare facilities to reduce a load of doctors as well as their staff too. The collected data from sensors can be accessible through anywhere so that anyone having authorized access can monitor the data and get updated all the time.

The objective of this project is to present the role of medical sensors in IoMT healthcare applications and state-of-the-art research and applications in utilizing IoMT enabled technology for healthcare systems.

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