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ECG Display on Android Mobile Using IOT

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ABSTRACT

Health is wealth. Wealth and happiness are earned by having a healthy mind and body. However, people nowadays do not have much free time to keep track of their health status. Thus, a health monitoring system that automatically tracks and alarm the users about their health status is needed. Rapid improvement of the internet and technology, such as the Internet of Things allows the health monitoring system to be improved. The internet of things allows communication between machines and programmed actions to be triggered automatically, which makes the system to be more efficient. The traditional health monitoring system requires regular visitation of patients to doctors to check their health status. However, with the implementation of the internet of things in the health monitoring system, the health monitoring processes can be automated and helps the patient to save their precious time. Besides, the cloud that revolutionized data changing aids in the efforts of making a better and more reliable health monitoring system. The health data can be stored and visualized in real-time. In this project, a Node MCU is used as a gateway to collect the health data of the user, and a ESP 32 processor is used as the central processing unit that processes all the received data. The broker receives health data from the gateway process the data. The system is capable of tracking the location of the user by using the Google geolocation service.

Keywords: ECG (Electrocardiogram) , IOT, ESP 32 ,Android Mobile

Revolution and rapid improvement of the internet, technology such as the Internet of Things has emerged and is snowballing. Internet of Things with cloud computing and edge computing realizes a new and more efficient way of data sharing and transmitting. The Internet of things will remodel the healthcare sector and improves the health and wellbeing of humanity (Rahmani et al., 2018). The traditional healthcare system requires patients to visit the clinic or hospital for medical checkups which is time-consuming and inefficient. The Internet of Things is capable of realizing a real-time health monitoring system that involves sensors to measure heart rate and body temperature of patients and visualize the data in real-time. By such, people can have better control of their health condition. Instead of relying on infrequent visits to clinics or hospitals for various tests, people can access their health data through the internet and start to track their health conditions. The Internet of Things that realizes the connection between devices (Tao et al., 2014) allows activities such as sending an alert email and messages during an emergency to be possible by making use of open source services such as google assistance and IFTTT. Besides, the location of the user can be tracked by using geolocation.

LITERATURE REVIEW

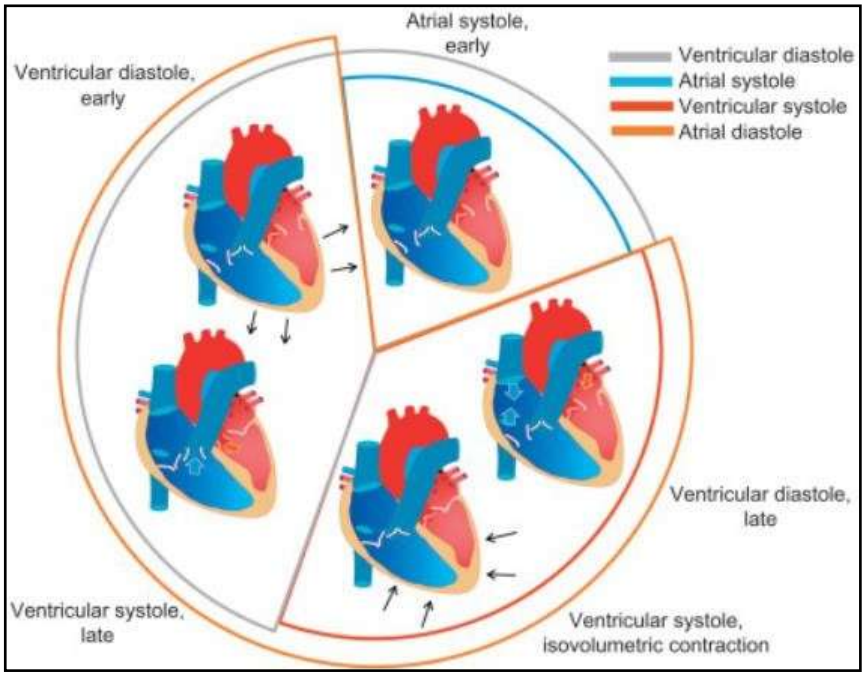
This chapter provides the reviews of different types of healthcare system related to this project. The reviews include the smart functions and methods used by researchers in their projects. Cloud computing delivers computing services such as servers, storage, analytics and, intelligence over the internet or cloud (Jo SEP et al., 2010) to provide a faster and flexible data exchange process, which helps to reduce the operating cost and increase the efficiency of the infrastructure. Cloud computing realizes a situation where the infrastructures, data or program that customarily installed in desktop PC and server rooms can now be installed in a cloud (Hayes, 2008). Users can perform different tasks by using services provided by the data centres of the cloud through the internet and access the virtualized resources (hardware and services) provided by the cloud anytime and anywhere as long as there is active internet connectivity. The data consumers are the end devices that send a request for data consuming to the cloud, and the cloud will respond by sending the raw data from data producer to the consumer. Cloud computing services are categorized as software as a service (SaaS), infrastructure as a service (IaaS), and Platform as a service (PaaS) based on the type of capability provided by the clouds.

Study Area

The cardiac cycle is a sequence of the human heart that counts from the beginning of one beat to the beginning of the next beat. The cardiac cycle consists of two periods which are the systole(filling) and diastole(pumping) that form a complete heartbeat(Athanasiou et al., 2017). During the diastole period, the superior and inferior vena cava receives

the returning blood from both the upper and lower human body, which then flows into the right atrium. As the blood filling up the right atrium, the pressure in the atrium increases. When the pressure of the right atrium surpasses the pressure of the right ventricle, the tricuspid valve that situated between the right atrium and right ventricle will open, which allows the blood to flow into the right ventricle. At the same time, the oxygenated blood will flow from the lung into the left atrium through the pulmonary veins, which increases the pressure in the left atrium as the blood flowing in.

When the pressure in the left atrium surpasses the left ventricle, the mitral valve will open and allows oxygenated blood to flow from the left atrium to the left ventricle. In the systole period, the blood in the left and right atrium will be forced to flow into the respective ventricle due to the depolarization of the atria as the result of the atrial muscle contraction while the pulmonary valves are closed. During the ventricular systole, the right and left ventricular muscle contracts. The tricuspid valve and mitral valve are closed while the pulmonary and aortic valve will be opened and the high-pressure blood will be pumped out from the heart to the body and lung through the aorta and the pulmonary artery. The heart muscle will then relax and starts the diastole phase again. The diastole and systole will repeat again and again which makes up the cardiac cycle. The figure below shows the complete cardiac cycle.



METHODOLOGY

Methodology for implementing an ECG display on Android mobile using IoT involves several key steps, spanning hardware setup, software development, integration, and testing. Below is a detailed methodology outlining each step:

1. Hardware Setup: Choose an ECG sensor or module compatible with your microcontroller platform Connect the ECG sensor to the microcontroller following the hardware specifications provided by the sensor manufacturer. Connect the microcontroller to an IoT device ESP32 with Wi Fi capabilities. Ensure proper power supply and physical connections between components.

2. Software Development for Microcontroller: The firmware for the microcontroller to initialize the ECG sensor and acquire ECG data . Implement signal conditioning algorithms if necessary to filter noise and enhance signal quality. Encode ECG data into a suitable format for transmission (e.g., JSON, CSV). Integrate IoT communication protocols (e.g., MQTT, HTTP) to establish connectivity with the IoT device. Implement error handling mechanisms and ensure data integrity during transmission.

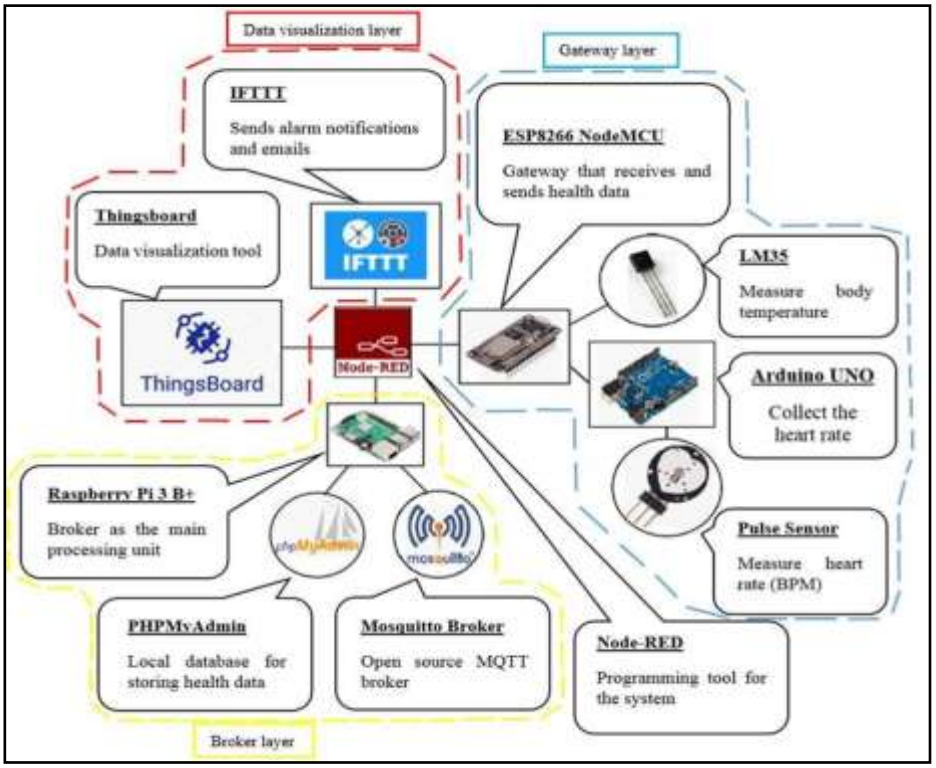
3. Setting Up IoT Communication: Set up an IoT server or utilize a cloud platform (e.g., AWS IoT, Google Cloud IoT Core) to receive ECG data from the microcontroller. Configure communication protocols, and data storage options on the IoT platform . Obtain necessary authentication credentials and configure them in the microcontroller firmware.

4. Android Application Development: Create an Android application capable of receiving ECG data from the IoT server . Implement UI components for real time ECG waveform visualization Integrate IoT communication protocols (e.g., MQTT client library) to establish connectivity with the IoT server. Develop logic to receive, parse, and display

ECG data on the Android device's screen. Implement features such as adjusting display settings, recording ECG data, and providing user alerts for abnormal heart rhythms.

System Architecture ECG Display On Android Mobile Using Iot

The health data of the user will be visualized in the Things board and updated in real-time. Only authorized users will have access to view the data. At the same time, the health data will be stored in the PHP My Admin local database for tracking purpose. This IoT based health monitoring system consists of three primary layers which are the gateway layer, the broker layer, and the data visualization and storing layer. The gateway layer consists of the pulse sensor, LCD JDH 162A, ESP32 processor .



System Communication Model

The communication model of the proposed system. Serial communication and Message Queuing Telemetry Transport (MQTT) communication protocol are used in this system. Heart rate is calculated in Beats per Minute (BPM), and body temperature is measured in degree celsius in this project. ESP 32 that receives the BPM from the pulse sensor, sends the data to ESP32 Node MCU via serial communication. The BPM and body temperature data will be "publish" to the broker via the MQTT communication protocol. Then, all data in this system (BPM, body temperature, coordinate, accuracy of the coordinate) will be "publish" to Node- RED for data processing.

The "publish" process is similar to any data transferring process. Details of the MQTT communication protocol is discussed in sectionGoogle Cloud SQL is a SQL based database that stores the users' health data in this project. Google SQL is one of the many services provided in the Google Cloud Platform. Google SQL database allows data to be stored in the cloud and reduces the risk of data loss. The database is automatically scaled up when the limit

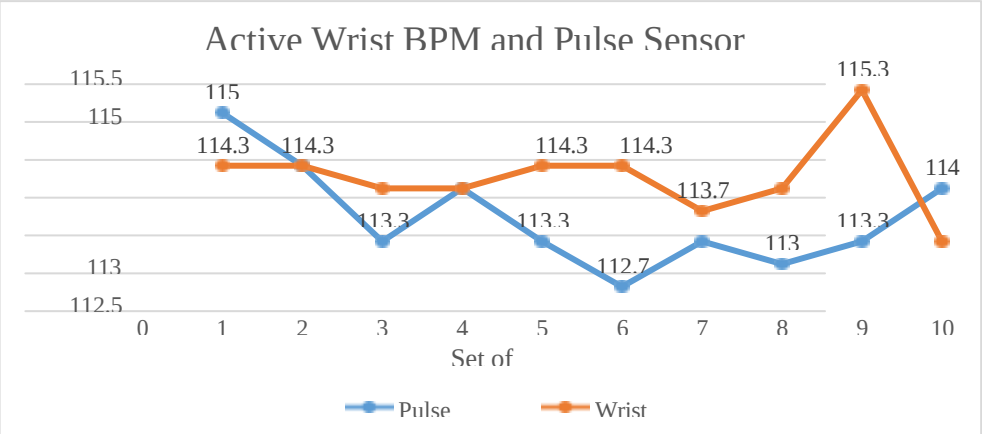
is near (Cloud SQL: Relational Database Service | Google Cloud, 2020). However, the service is not free of charge where the user will be charged monthly based on the usage of the database. In this design project, we fabricated a wireless ECG system.

This device is designed to serve both as a stand alone heart rate monitor and as a wireless adapter for the already existing bedside or diagnostic ECG monitors and biomonitors . The aim of the wireless adapter feature is for this ECG system to eliminate the need of lead wires and cables to transmit acquired ECG signals to biomonitors and other ECG (also EMG and EEG) monitors.

This system takes the input from the patient, convert it in digital form, filters it, convert it back to analog and the output of this converter is inputted in a class II Bluetooth® module which, then wirelessly transmits the data to a computer, biomonitors or other wireless capable bedside ECGmonitors. The designed Wireless ECG Monitoring System incorporates the following features:

RESULT OF PROJECT

There were ±2 beats fluctuation in the measured pulse sensor and wrist BPM, as shown in Any movement of the test subject will affect the BPM and led to the fluctuations the results of the experiment show that the SEN-11574 pulse sensor is capable of measuring the heart rate with high accuracy since the fluctuations obtained were small and insignificant.



CONCLUSION

The primary objective of this project is to develop an IoT based health monitoring system that able to provide real-time health data monitoring of the user. The proposed system r to track the user's location, send the health data to the visualization platform in real- time, and sends alarm notifications to phones and emails. The location of the user is tracked by using geolocation service while the real-time health data visualization is displayed on the Things board. The coordinate of the user location is very useful to track down the user during an emergency. User's relatives or authorized users are able to view the health data of the user through the Things board. The alarm notifications can be sent to any related personnel when there are sudden changes in heart rate and abnormal body temperature. The health data are stored in a local and cloud database, which allow the user to keep track of their health condition by tracking the health data. Experiments are conducted to prove the functionality of the sensors and the system.

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