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Varicose Veins Disease Detection and Automated Treatment Using BAN (Body Area Network)

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ABSTRACT: Varicose vein is wealth. Wealth and happiness are earned by having a varicose veiny mind and body. However, people nowadays do not have much free time to keep track of their varicose vein status. Thus, a varicose vein monitoring system that automatically tracks and alarm the users about their varicose vein status is needed. Rapid improvement of the internet and technology, such as the Internet of Things allows the varicose vein 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 varicose vein monitoring system requires regular visitation of patients to doctors to check their varicose vein status. However, with the implementation of the internet of things in the varicose vein monitoring system, the varicose vein 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 varicose vein monitoring system. The varicose vein data can be stored and visualized in real-time. In this project, a Node MCU is used as a gateway to collect the varicose vein data of the user, and a MQTT broker is used as the central processing unit that processes all the received data. The broker receives varicose vein data from the gateway and process the data. The system is capable of tracking the location of the user by using the Google geolocation service. The varicose vein data and location of the user are visualized in the Things board visualization platform in real-time. Several experiments and tests, such as accuracy test and error analysis were conducted on the proposed system, and encouraging results were obtained.

KEYWORDS: Research Paper, Arduino Uno, Bluetooth module, Force Sensor, Vibration Motor, Temperature Sensor.

I. INTRODUCTION

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 varicose vein care sector and improves the varicose vein and wellbeing of humanity (Rahmani et al., 2018). The traditional varicose vein care 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 varicose vein 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 varicose vein condition. Instead of relying on infrequent visits to clinics or hospitals for various tests, people can access their varicose vein data through the internet and start to track their varicose vein 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.

Besides, the security of the varicose vein system is vital to safeguard the privacy of the user. People may avoid varicose vein care in sensitive areas due to varicose vein information privacy concerns (Bansal and Gefen, 2010). Smart wearable gadgets such as Apple Watch and Samsung Galaxy Watch are storing the collected varicose vein data in the cloud. Cloud storage allows users to enjoy high-quality services without any burden of storage maintenance (Wang et al., 2011). However, cloud users are more vulnerable to issues such as theft, confidentiality, and information leaked to the third party compared to local storage users (Romero, 2012). Storing confidential varicose vein information in the varicose vein system itself will help reduce the chance of information leakage, as the varicose vein information will only be accessible by authorized users which improves the security and privacy of the system.

The location tracking function plays a vital role in the varicose vein monitoring system as it allows people to track the whereabouts of the user. Besides, the coordinate of the user should be recorded as it allows people to trace the whereabouts of the user. The function will come in handy when there is a need to track down a person, such as the COVID-19 outbreak. The whereabouts of the patients are useful to trace the source of the disease. Besides, the information will aid in the prevention and evacuation works that will prevent or reduce the spreading of the disease.

II. LITERATURE REVIEW

Yapei Zhao analyses the algorithm based upon the vascular endothelial cell in animation images and multi-scale deep learning, called MSDCNN. Rinong zhu¹, Huipingniu they obtained the images of vascular endothelial cells in patients with varicose veins of the lower extremities and normal subjects & convolutional layers extract multi-scale features of vascular endothelial cell images. The MFM activation function is used to introduce a competitive mechanism that extracts more features that are compact and reduces network layer parameters. The network uses a 3×3 convolution kernel to improve the network feature extraction capability and use the 1×1 convolution kernel for dimensionality reduction to further streamline network parameters[6].

Ultrasound (US) is the main modality for examination of venous disease. Color Doppler and occasionally spectral Doppler US (SDUS) are used for evaluation of the venous flow. Thor Bechard proposed this system, the main base is chronic venous, which creates the varicose veins, by using ultrasound the chronic venous are eliminated

III. METHODOLOGY

This BAN based varicose vein 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 LM35 temperature sensor, SEN-11574 pulse sensor, Arduino IDE and ESP8266 Node MCU gateway, as shown in Fig.3.2. The pulse sensor is connected to the Arduino IDE that sends the heart rate data to ESP8266 via serial communication, and the LM35 temperature sensor that collects the body temperature of the user is connected to the ESP8266 directly. The sensors will collect the body temperature and heart rate of the user and send those data to the ESP8266 gateway. Then, the ESP8266 gateway will send the varicose vein data to the broker via Message Queuing Telemetry Transport (MQTT) communication protocol.

Node-RED, which is a programming tool, is used to program the varicose vein monitoring system and communicate with various services such as IFTTT, Thingsboard, and PHPMyAdmin database. The varicose vein data collected by the broker will be visualized on the Node-RED and Thingsboard dashboard in real-time. At the same time, the varicose vein data will be stored in the PHPMyAdmin local database that allows the authorized user to keep track of the user's varicose vein data. The MQTT broker will process all the data and direct every action programmed in the Node-Red. Alarm notifications and emails will be sent to assigned users during an emergency (Sudden changes in heart rate or abnormal body temperature) using If This Then That (IFTTT) services. The notification sent will direct the assigned users to the Thingsboard dashboard interface when clicked, and the users can track the varicose vein system's user location and varicose vein data from the Thingsboard dashboard.

IV. RESULTS AND DISCUSSION

The entire system consists of 4 modules namely, hardware implementation module, Hardware interface module, decision tree implementation module and output module.



a) Hardware Implementation Module This module consists of all the hardware's such as force sensor, accelerometer, spO2 sensor, Arduino-uno, Peltier crystal, batteries, relay, accelerometer and wires for connection. These are connected through wires and soldered. The entire unit acts as hardware system.

b) Hardware Interface Module The above mentioned hardware unit is interfaced to Arduino-Uno which acts as a brain for the entire hardware unit. The coding is done using embedded C program and output of every sensor is displayed in LCD display board placed in the system. The output from each sensor is collected as data set to the algorithm used.

c) Decision Tree The dataset collected from sensors has been fetched and fed into PC for machine learning purpose. The algorithm used is decision tree algorithm. This algorithm classifies the train and test the entire data set. Thus providing the exact output. Based on the criteria set on algorithm, output is provided.

V. CONCLUSION

The primary objective of this project is to develop an IoT based varicose vein monitoring system that able to provide real-time varicose vein data monitoring of the user. The proposed system is able to track the user's location, send the varicose vein 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 varicose vein data visualization is displayed on the Thingsboard. 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 varicose vein data of the user through the Thingsboard. The alarm notifications can be sent to any related personnel when there are sudden changes in heart rate and abnormal body temperature. The varicose vein data are stored in a local and cloud database, which allow the user to keep track of their varicose vein condition by tracking the varicose vein data. Experiments are conducted to prove the functionality of the sensors and the system.

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