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Wearable Healthcare Device

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ABSTRACT: Lots of research have focused on health care in recent years and developed a wearable non-invasive system that was not only fitted with BLE to detect critical signals but also combined with an intelligent terminal to develop IoT healthcare. The electrode potential is used in the ECG in most tests, while heart rates are determined by the volume of reflected LED light for the PPG. However, in this paper, author detect heart vibration signals from the wrist PVDF piezo film sensor based on radial artery vibration signals that the consumer wears to measure his / her heart rate. The system also has the ability to reduce power consumption. To encourage Signal to Noise Ratio (SNR), followed filter circuit design and peak detection algorithm to remove noise by using the smart terminal, then high accuracy is achieved in measurement of the heart rate. In addition, the smart terminal can upload the data to the cloud so that not only can the user track the self-vital information at any time, but even medical services can access the data in the event of an emergency.

KEYWORDS*:* BLE, Intelligent Terminal, Non-Invasive, PVDF, Wearable Device.

I. INTRODUCTION

Normally ECG and PPG are used to calculate heart rates. For that there is a need to put a lot of electrodes on the user's skin while applying ECG which is not easy and convenient for the patient. As for PPG, it uses LED for measuring heartbeat to track blood flow. And the capacity on the battery will soon be depleted. In this article, comparison of ECG, PPG, and PVDF, but will also adopt PVDF sensors to calculate heart rates and can vibrate slightly from wrist jumping by arterial wall and addition of op-amp (operational amplifier) circuit and Butterworth filter circuit to boost SNR to quickly get heart rate. In addition, when using an intelligent terminal system, this paper follows PAN TOMPKINs algorithm to peak scanning to reduce noise and improve accuracy in heart rate detection. Aside from providing Wi-Fi and BLE features, the smart terminal also equips a powerful CPU to automatically process raw data and share the cloud server's workload[1].

Remote identification and tracking of outbreaks of infectious diseases is now strongly required to contain the mealtime outbreak. These diseases cannot be easily managed using current health-care programs. Comparative study of CHV's published research, and remote healthcare systems related monitoring. The reported work was compared based on 11 essential criteria, i.e. major contributions, application area, IoT, cloud computing (CC), fog computing (FC), prediction model (PM), real time perspective (RTP), outbreak function index (ORI), warning generation (AG), protection mechanism (SM) and infectious disease comparison (CD). These programs have various drawbacks, such as unavailability of medical tests, lack of participation of people in providing critical information about their health and environmental conditions, and conventional strategies for diagnosing and tracking preventive diseases. Often it is not possible for the patient to visit the hospital for daily check-up or doctors cannot monitor and patient regularly. A remote control system is therefore very much required to provide healthcare support services[2].

II. LITERATURE REVIEW

This study discusses the computational approaches used for ECG research, concentrating on machine learning and 3D computer simulations, as well as their precision, clinical implications and scientific advancement contributions. The first section focuses on the detection of heartbeat and the techniques developed for separating and classifying irregular beats from ordinary ones. The second segment focuses on the treatment of patients from whole records, applied to different diseases. The third segment introduces Wearable Devices with real-time diagnostics and applications. The

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fourth segment highlights the recent area and its analysis of custom ECG computer simulations[3]. This work provides an algorithm for the classification of consistency of the ECG signals at five stages. A total of 13 signal quality measurements were obtained from ECG waveform segments, which experts classified as such. In order to perform the classification, a support vector machine (SVM) was trained and tested on a virtual dataset and validated using MIT-BIH arrhythmia database (MITDB). The simulated training and test datasets were generated by selecting clean ECG segments from the 2011 PhysioNet / Computing in Cardiology Challenge database and inserting three forms of actual ECG noise from the MIT-BIH Noise Stress Test Database (NSTDB) at different signal-to-noise ratio (SNR) levels[4]. This study discusses the computational approaches used for ECG research, concentrating on machine learning and 3D computer simulations, as well as their precision, clinical implications and scientific advancement contributions. The first section focuses on the detection of heartbeat and the techniques developed for separating and classifying irregular beats from ordinary ones. The second segment focuses on the treatment of patients from whole records, applied to different diseases. The third segment introduces Wearable Devices with real- diagnostics and applications. The fourth segment discusses the recent field of and their understanding of personalized ECG computer simulations[5]. A possible risk factor for cardiovascular problems has been blood pressure (BP). Measurement of BP is one of the most important criteria for early diagnosis, prevention and cardiovascular disease treatment. BP calculation currently relies primarily on cuff-based techniques that cause users to feel annoyance and discomfort. While some of the present prototype cuff less BP measurement techniques can achieve reasonable accuracies overall, they involve an electrocardiogram and a photo plethysmograph that makes them unsuitable for true wearable applications. The development of a single PPG-based cuff less BP estimation algorithm with adequate accuracy will therefore be used both clinically and practically[6]. This research provides a method for simultaneous non-invasive blood glucose (BGL) and systolic (SBP) and diastolic (DBP) blood pressure measurement using PPG and machine learning techniques. The method is independent of the individual whose values are being calculated and the adjustment is not necessary over time or subjects. Methodology: The device architecture consists of a photo plethysmograph sensor, an activity detection module, a signal processing module which extracts features from the PPG waveform and a machine learning algorithm which estimates the values of SBP, DBP and BGL[7]. A photoplethysmogram (PPG) is a non-invasive circulatory signal connected to the pulsatile blood volume in the tissue and is usually obtained by pulse oximeters. PPG signals obtained from mobile devices are susceptible to artifacts that adversely affect the precision of the measurement, which can lead to a large number of incorrect diagnoses. Given the increasingly increasing use of mobile devices to capture PPG signals, it is important to establish an optimal signal quality index (SQI) to identify the quality of the signals from these devices. Eight SQIs were developed and tested on the basis of: perfusion, kurtosis, skewedness, relative strength, non-stationarity, zero crossing, entropy and systolic wave detector matching[8]. This paper proposes an HMI based on a polyvinylidenedifluoride (PVDF) sensor and laminates it to the skin surface for signal detection and mobile robot movement control. The PVDF sensor with ultra-thin stretchable substratum can make conformal contact with the skin surface to measure the electrophysiological signal more accurately and to provide more precise control of the actuators. Microelectro-mechanical system (MEMS) technologies and processes of transfer printing are implemented for the epidermal PVDF sensor manufacture. With the fist clenched and loosened, sensors mounted on two wrists will produce two distinct signals[9]. Photo plethysmography (PPG) signals have special identification properties for human recognition, and the new IoT sensors are making it easier to catch. Current research on biometric systems based on PPG relies on fiduciary methods which extract landmarks as features from the PPG signal. This paper explores non-fiducial approaches that work in landmarks in a systematic manner less sensitive to noise and used a neural network and support vector machine to compare PPG-based human verification of 42 subjects with fiducial and non-fiducial methods (specifically, discrete wavelet transformation) and classification[10].

III. METHOD

Photo plethysmography (PPG) signals have special identification properties for human recognition, and the new IoT sensors are making it easier to catch. Current research on biometric systems based on PPG relies on fiduciary methods which extract landmarks as features from the PPG signal. This paper explores non-fiducial approaches that work in landmarks in a systematic manner less sensitive to noise. And use a neural network and support vector machine to compare PPG-based human verification of 42 subjects with fiducial and non-fiducial methods (specifically, discrete wavelet transformation) and classification. The app will prioritize the process even when an emergency occurs, and

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alert both the cloud server and the user. Current, healthcare focuses on the application layer. The cloud storage service will evaluate the user's historical data and inform the user accordingly. Unit 1 is sensing device based on Healthcare IoT and system architecture is divided into four units; Unit 2 is BLE communication; Unit 3 is intelligent terminal; Unit4 is cloud processing unit.

Unit 1.Sensing function:

It primarily uses sensitive but stable PVDF piezo film coupled with a low-noise electronic preamplifier to provide vibration pick-up with buffered output to monitor the user's heart rate by PVDF sensor CM-01B. The wrist jumping of the arterial wall is converted into an acoustic wave to reach the film within CM-01B, it can produce a low voltage signal around 0.3mV (Max), then amplify it through an amplifier circuit (Gain= 600), since the heart rate signal is an analog signal which is very easy to get crosstalk by noise, author adopted 2 order Butterworth low pass filter circuit to increase the SNR value. To remove high-frequency noise, then convert BLE's MCU to digital signal, according to Shannon's sampling theory, its sampling rate is set at 480Hz, which must be twice over the frequency of the heartbeat, it will preserve the original vital signal that also has no distortion and clearly appears as a waveform of the heart rate. The Figure 1 shows the system architecture.

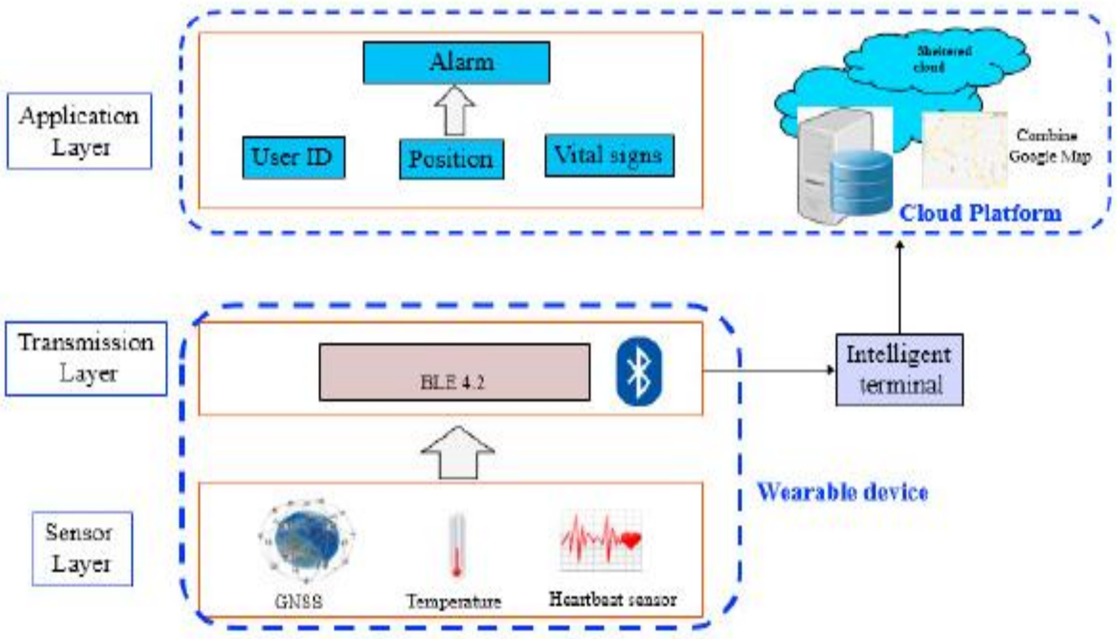

Fig.1: System Architecture

Unit 2. BLE communication:

For this model, Nordic BLE4.2 was used to transmit data, which is low power consumption, and to support the wireless solution for short range; it is very suitable for body sensor network applications; in the current BLE profile, it only supports ECG / PPG, so there is a need to develope a specific PVDF sensor profile, four items, raw heart rate data, EMG message, location and USR ID, the length of each object.

Unit3. Intelligent terminal:

This paper processed all of the sensor data in IoT applications and sent them to the cloud server. The cloud server will eventually do statistics and analysis to make a decision; but the emergency mechanism cannot handle the event immediately; to boost this problem, a smart terminal with edge computing is added to this healthcare system, the smart terminal accessed sensor information frequency from wearable devices, and processed raw data from PVDF sensors to measure it. Let the cloud server call the hospital or 911; not only does it process data in a timely manner for the smart terminal, it can also share cloud server loading.

Unit 4. Cloud computing:

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The cloud computing system collects all the information that comes from a smart terminal, it records the user's raw vital signal data, position information, user Identification and emergency information, it can also be based on location data combined with LBS (Location-Based Services), it is easier to know the location of the patient and share this data with the hospital and doctor, so it can save medical resources.

IV. RESULTS

Using this experiment, a PVDF sensor is installed to detect the needful with PCBA on the left wrist and use OMRON (HEM-6221) wrist blood pressure monitor on the right wrist to be a guide, it can also display heart rate and waveform in real time, there are 6 people who are 4 males and 2 females to enter this experiment, in addition to recording heart rate and also testing their SNR; the heart rate monitoring system will achieve accuracy of 98%.

V. CONCLUSION

This paper presented a new heart rate detection method that merged intelligent terminal and edge computing to create a healthcare IoT system; in this trial, based on these experiment results, once the SNR is below 8.9dB, the heart rate measurement error rate may be increased and the heart rate may be unreliable, as the heart rate signal is too low. And should incorporate more sensors for future work to introduce sensor fusion which can remove the same background noise and facilitate SNR, so the measurement of the heart rate can be more precise.

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