International Journal of Scientific Engineering and Science
Volume 4, Issue 7, pp. 43-46, 2020. ISSN (Online): 2456-7361

The Wearable Smart Device for Early Detection of Vital Signs Related to Heart

Yeshaswini. V, Tejaswi. S. P, Shaik Thahaseen, Varun Kumar, Murigendrayya M. Hiremath
Department of Medical Electronics, Dayananda Sagar College of Engineering, Bangalore, India
Email address: yeshuvenkt14 @ gmail.com, tejaswip864 @ gmail.com

***Abstract*—** *Death due to heart diseases is very common and diagnosing them in early stages is important to improve the health condition of an individual. A wearable sensor device is developed for early detection of vital signs related to the heart. The system developed consists of an AD8232 sensor to acquire the ECG signal and it is sent to the ESP32 microcontroller for further processing, then it is stored and displayed on Ubidots. MAX30100 sensor is used to acquire the heart rate and Spo2. The Dallas temperature sensor DS18B20 is used to measure the body temperature. The outputs are transferred to the HTML web page via TINY-GO-T CALL WIFI module for viewing it on PC or mobile phone. From all these parameters the variation in a person's body can be known, so that if any abnormalities are there in values they can consult the doctor.*

***Keywords*—** *Biosensor, wearable systems, real time, health monitoring, Wireless Communication, Wi-Fi.*

I. INTRODUCTION

In India real time health monitoring becomes an acute problem due to the number of doctors across our country being limited when compared to the population. In this case, monitoring the patient's health conditions and storing them becomes very important for the doctor, it helps the doctor to know about his patient's health conditions and proceed to take further steps accordingly [1]. Some diseases such as heart diseases, systolic/diastolic blood pressure problems, diabetes, etc, can be monitored regularly using smart wearable devices. Such devices are aimed at being a solution to overcome the limitations of current diseases. Particularly the advancement in the development of smart sensors and using them in analysis enables the production of non-invasive wearable devices which can be integrated onto the body surface [5][6].

The sensors are smart devices or a subsystem, that are used to detect the variations in the surrounding environment or in particular electrical, optical signals and respond accordingly. The physical parameters such as humidity, temperature, heart rate, step count etc, can be converted into measurable electrical signals using sensors. There are different criteria in choosing a sensor based on their features; accuracy, environmental conditions, measurement limits according to the user's demand, calibration, cost, repeatability, and also very importantly the resolution. Such devices help in monitoring different parameters such as step count, ECG, sleep monitoring, heartbeat, body temperature, body mass, etc.

The Sensors are two types of wired sensor and wireless sensor. In case of wearable devices the wired sensors are used to collect and transfer the data over a wire based communication technology. Non-contact techniques are non-interrupting and sufficient for long term monitoring. It is used in recording and organizing collected data at a central location. it can be monitored by people who have some knowledge about using the module and interpreting the output [2].

An innovations in mobile phones, getting connected to electronic health care which is reforming the hands of both doctor and patient in improvising the systems, by increasing the capabilities and supporting people in using physiological monitoring devices. Along with which it has become a key role in today's society by providing new medians for Communications, making jobs faster and increasing the quality of life with medical devices[2][7].

II. PROPOSED SYSTEM

The prototype developed is a wearable sensor device for early detection of vital signs that are related to heart. The system design is aimed to produce a compact monitoring system for real-time acquisition and measuring multiple physiological health parameters [3]. An AD8232 sensor is used to acquire an ECG signal by connecting an electrode to the user. An output signal is then transferred to ESP32 micro-controller for further processing and storage of acquired raw data which can be displayed on ubidots [4]. The MAX30100 sensor is used to measure Heart rate and SpO2 [3]. The Dallas temperature sensor is used to measure an absolute body temperature [8]. A TINY-GO-T CALL Wi-Fi module is used to upload on the HTML web page, while the output can be displayed on to the user's PC, or mobile phone at any instant.

III. APPLICATIONS

1. Medical Information - Provides information about events that have not occurred yet, which helps in predicting and preventing further problems.
2. Detection of Anomaly - Identification of deviations in the parameters from the expected behaviour.
3. Diagnosis Support - The most important part of continuous monitoring and storing is that it would help to give further precautions by doctor according to the retrieved knowledge.
4. Fitness/Wellness sector - Where non-medical applications, self monitoring procedures are involved.
5. Sports Sector - To self monitor an electrical activity of heart, pulse range and to estimate an oxygen saturation in an individual.

International Journal of Scientific Engineering and Science
Volume 4, Issue 7, pp. 43-46, 2020. ISSN (Online): 2456-7361

IV. Materials and Methods

A. ECG Signal Acquisition

An AD8232 is an non-invasive, integrated block with single-lead used for signal conditioning, used to measure an electrocardiogram (ECG).

Electrocardiography (ECG) is a process where the electrical activity of the heart rate is recorded placing electrodes on the skin over a period of time. In wearable sensor devices the biomedical sensor pads are usually placed on the chest underneath the pectoral muscles for better measurement or on forearms and legs based on Einthoven's triangle.

B. Measuring Heart Rate and Spo2

The MAX30100 sensor is used for measurement of pulse, it gives both heart rate and Spo2. Heart rate is also known as the speed of the heart beating which is measured based on the number of contractions per minute of the heart. Normal pulse ranges from 60-100 beats per minute (BPM). Spo2 is peripheral capillary oxygen saturation, it is the estimation to know the arterial oxygen amount in the blood. Normal Spo2 varies between 90% and 100%.

The finger is placed on the sensor where the LED and photo detector are placed. For every heartbeat there is an increase in blood volume at the tip of finger and this results in light reflection reaction. The Oxygenation or deoxygenation depends upon the ratio of red light absorbed over infrared light.

C. Temperature Measurement

The DS18B20 is a direct-to-digital thermometer used to measure the temperature in Celsius and provides 9 to 12 bits of temperature readings ranging from -55°C to +125°C, with ±0.5°C accuracy. The DS18B20 requires a single data line to communicate with a central microprocessor and the other one is grounded. Therefore it implements the communication over 1-wire bus.

The user should hold the sensor to acquire the body temperature. The measurement and A to D conversion is initiated, once the convert command is passed by RAM command and function command, and after the conversion the resulting thermal data will be stored inside the sensor in a register.

D. Processing and Transmitting the Signal

An output of AD8232 is sent to ESP32 for processing the raw signal, the ESP32 incorporates an inherent processor which has two cores named Protocol CPU (PRO_CPU) and Application CPU (APP_CPU). ESP32 is the most integrated solution for all Wi-Fi + Bluetooth applications in the industry with less than 10 external components. It integrates the filters, power amplifier, antenna switch, low noise receive amplifier, RF balun and power management modules. As such, the entire solution occupies the nominal Printed Circuit Board (PCB) area. This makes ESP32 perform multitasks and avoid the usage of an extra micro-controller.

An output from MAX30100 and Dallas temperature is transferred to TTGO T-Call which is a new ESP32 development board that combines both SIM800L and GSM/GPRS modules. ESP32 is a microcontroller, that is single chip 2.4 GHz frequency of Wi-Fi and Bluetooth combo chip, which is designed with the TSMC ultra low power 40 nm technologies. It is designed and enhanced for the best reliability, robustness, power performance, RF performance, versatility, and features, for a wide variety of applications, and different power profiles. ESP32 module is designed for mobile phones, wearable electronics devices, and Internet of Things (IOT) applications.

E. Ubidots

Ubidots helps the users to style themselves IoT and Cloud applications. Ubidots is proficient in countless internet connected projects across healthcare, transportation, energy / utilities, manufacturing, and retail-learning the various small characteristics of IoT and Cloud that enables digital transformation. Ubidots has become known within embedded engineering, hardware, software, and maker circles because it is a reliable, affordable, and most usable platform within the IoT application enablement ecosystem. Each Organization can have their own specific users, devices, dashboards, etc. The users are allowed to use it by entering the designated credentials such as username, e-mail, and the password.

F. Hypertext Markup Language (HTML) Page

It is the standard markup language for documentation that is designed to be displayed in a web browser. It can cooperate with technologies such as Cascading Style Sheets (CSS) and scripting languages such as JavaScript. HTML elements are used to build the blocks of HTML pages. With HTML constructs, images and other objects such as interactive forms may be embedded into the accomplished page.

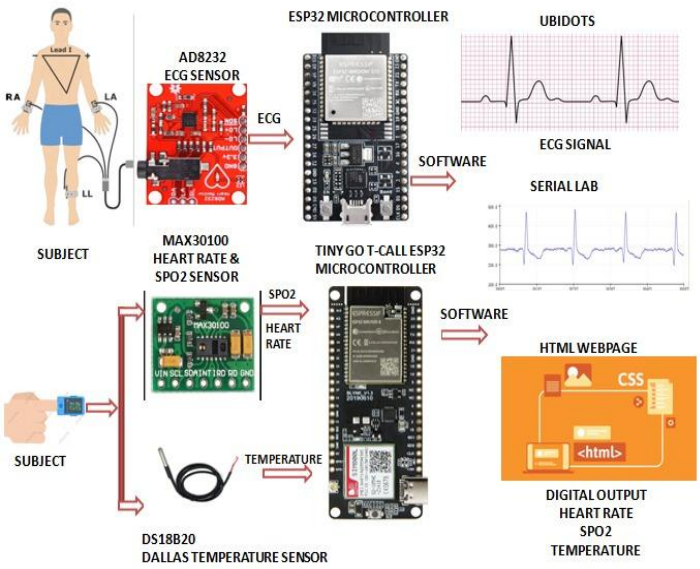

Fig. 1. Block Diagram

V. Experimental Result

The processed ECG signal from the microprocessor can be visualized on Ubidots. By entering the user name, e-mail, and password an end user can see the output signal on this

platform and follow up the health condition anywhere, at any instant.

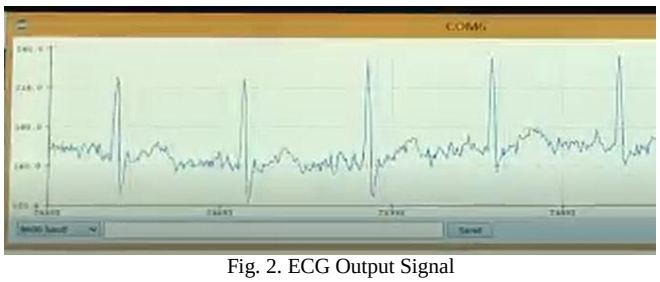

Fig. 2. ECG Output Signal

The server sends the values of heart rate (BPM), SpO2 (%), and temperature (°C) to the web page using the html documentation tags, such as document type, heading, title and links.

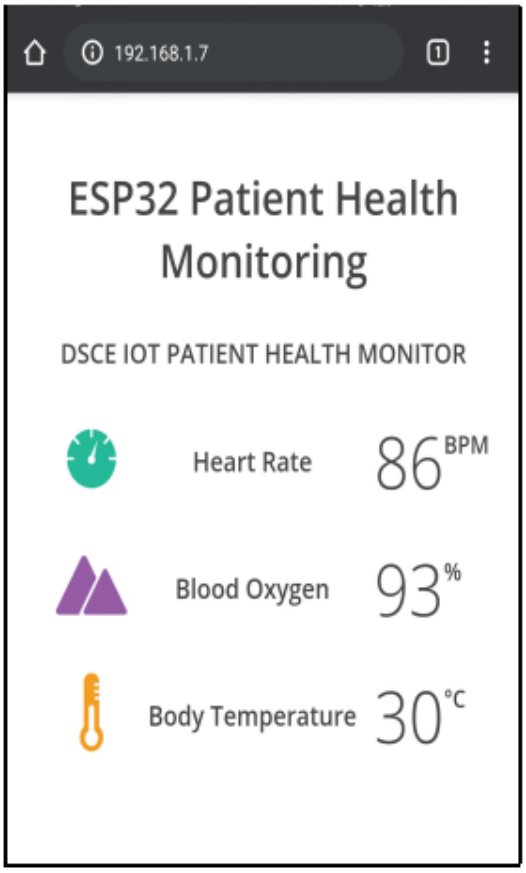

Fig 3. HTML Web page

TABLE 1. Subject vital signs measured

Subjects	Heart rate (BPM)	Sp02 (%)	Temperature (°C)
Subject A	98	96	34
Subject B	88	96	36
Subject C	70	95	38
Subject D	90	98	37

VI. CONCLUSION

There are many smart sensor devices that are available in the market yet it is not that well known or often used. All of such gadgets give different features that are useful for people to measure vital parameters. Some may be very costlier, some may be available with moderate cost.

This paper presents a real time monitoring, sensor device that detects heart related diseases at an early stage and provides effective results to users. The system design consists of wired and wireless network systems, data processing, and visualization. The proposed system is compact in size, cost effective and it can provide health service even in rural areas. It uses Wi-Fi to establish wireless communication as it provides more range when it is compared with Bluetooth and NFC. It is useful for those people who are suffering from many incurable heart related diseases and require continuous monitoring, people who are fitness conscious, sports, etc. The current scenario is that the priorities of people to visit the medical consultants may change regularly in their busy schedules due to the increase in the number of patients and scarcity of specialists. Therefore increase in population and the medical costs have made it possible to invent such wearable smart devices that result in non-invasive, user-friendly methods to use, with low cost which also saves the user's time and energy too.

VII. DISCUSSION

For people of any age group suffering from cardiac diseases, such online data monitoring devices would assist them in the need to consult a doctor for further diagnosis. A TINY-GO-T CALL module which consists of GSM can be programmed such that it can alter doctors or nearby hospitals via SMS if the data collected does not fall within the normal range.

Today the most challenging and threatening disease faced is the growing pandemic of COVID-19, the coronavirus. Fever, dry cough, and tiredness are the primary symptoms developed in an infected person. It is necessary to have a regular track on an individual's health condition. The smart device can provide the medical information such as breathing rate, oxygen saturation, most importantly the body temperature. DS18B20 is a temperature sensor which has to be integrated with a subject, further infrared based non-contact MLX90614 temperature sensor device can be used to follow up the same without the physical contact.

ACKNOWLEDGEMENT

We thank the staff, students, and authorities of Dayananda Sagar College of Engineering for their immense support.

REFERENCES

[1] Ayaskanta Mishra, Biswarup Chakraborty. "AD8232 based Smart Healthcare System using Internet of Things (IoT)". International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 7 Issue 04, pp. 13-16, April-2018.

[2] Rashi Kansara, Pritee Bhojani, Prof. Jigar Chauhan. "Designing Smart Wearable to measure Health Parameters". International conference on Smart City and Emerging Technology (ICSCET), 2018, pp. 1-5.

[3] Qunoot N. Alsahi, Ali F. Marhoon. "Design Health care system using Raspberry Pi and ESP32". International Journal of Computer Applications (0975 – 8887), Volume 177 – No. 36, pp. 33-38, February 2020.
[4] Tae Wuk Bae, Kee Koo Kwon. "Efficient Real-Time R and QRS Detection Method Using a Pair of Derivative Filters and Max Filter for Portable ECG Device". Appl. Sci. 9, 4128, pp. 1-22, 2019.
[5] Fatma Patlar Akbulut, Ozcan Ozg ur, Ipek C ınar. "e-Vital: A Wrist-Worn Wearable Sensor Device for Measuring Vital Parameters".978-1-7281-2420-9,19, 2019 IEEE.
[6] Hemanth Kapu, Kavisha Saraswat, Yusuf Ozturk, A. Enis Cetin. "Resting heart rate estimation using PIR sensors". Infrared Physics and Technology, vol. 85, pp. 56-61, 15 May 2017.
[7] Geoff Appelboom, Elvis Camacho, Mickey E Abraham, Samuel S Bruce, Emmanuel LP Dumont, Brad E Zacharia, Randy D'Amico, Justin Slomian, JeanYves Reginster, Olivier Bruyere, and E Sander Connolly Jr. "Smart WearableBody Sensors for Patient Self-Assessment and Monitoring". 2018.
[8] R.K.Parate, S.J.Sharma. "Design of a Portable Health Monitoring System Based on Node MCU". International Journal of Engineering and Advanced Technology (IJEAT). ISSN: 2249 – 8958, Volume-9 Issue-2, pp. 957-960, December, 2019.
[9] Kalpana M. Dewarshi, J. R. Panchal. "Heart Attack Warning System Using ECG Processing". International Journal of Advances in Electronics and Computer Science, ISSN: 2393-2835, Volume-2, Issue-6, pp. 63-66, June-2015.
[10] Adam Szczepański, Khalid Saeed. "A Mobile Device System for Early Warning of ECG Anomalies". Sensors, ISSN 1424-8220, pp. 11031-11044, 2014.
[11] Shree Raksha M P, Nandini B M. "Remote Monitoring of the Patients using the IoT Widget through Hrut Gati Android Application". International Research Journal of Engineering and Technology (IRJET). Volume: 07 Issue:05, pp. 865-869, May 2020.
[12] Ervin Domazet, Student, Marjan Gusev, Senior Member, IEEE, Ljupco Antovski. "Design Specifification of an ECG Mobile Application". 25th Telecommunications forum TELFOR. 978-1-5386-3073-0,17, 2017 IEEE.
[13] Meina Li 1, Youn Tae Kim. "Design of a Wireless Sensor System with the Algorithms of Heart Rate and Agility Index for Athlete Evaluation". Sensors 17, 2373, pp. 1-17, 2017.
[14] Dhanashri H Gawali, Vijay M. Wadhai. "Implementation of ECG Sensor for Real Time Signal Processing Applications". International Conference on Advances in Electronics, Computers and Communications (ICAECC), 978-1-4799-5496-4,14, 2014 IEEE.
[15] Sudip Deb, Sheikh Md. Rabiul Islam, Jannatul RobaiatMou,Md. Tariqul Islam. "Design and Implementation of Low Cost ECG Monitoring System for the Patient using Smart Device". International Conference on Electrical, Computer and Communication Engineering (ECCE), pp. 774-778, 978-1-5090-5627-9,17, February 2017 IEEE.