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Developing a wristband to monitor Heartbeat and Temperature Using Internet of Things (IoT)

Israa S. AL-Forati1, Bayadir A. Issa2, Hayder M. Amer3
Alla'a.I.Hussein 4

Computer Eng. Dep1. IT. Dep2, Computer Sys. Dep3.
University of Basrah1, Southern Technical University2, 3
Basrah, Iraq

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ABSTRACT: This paper develops a multi-sensory device by utilizing a smart Internet of Things device that can collect data from the region sensor body to provide an instant indication of imminent heart failure. The main goal of this work is to manufacture and implement an electronic medical bracelet by using simple and inexpensive electronic components. Therefore, it can measure the medical information such as temperature, blood pressure, the oxygen level in the blood of the individuals that are wearing it. The medical bracelet consists of two types of sensors: the first sensor (GY 906 where it is responsible for measuring the body temperature and room temperature. The second sensor is (MAX 3100) that is responsible for measuring and sensing the oxygen level in the blood and the heartbeat rate. All components are summarized in the shaped manufacture by using the 3D printer and it has been designed by using the AutoCAD application to be compatible with the system requirements. The ESP 32 cannot receive two types of sensors within the same electronic circuit at the same real-time. Two of the microcontrollers were connected in a serial, and each sensor is implemented individually on a microcontroller, and they were connected in serial. As for the parts connected to the Internet through the Blynk application. The sensors transmit their readings in real-time through the internet by using a Blynk program. This paper proposes a new approach to design and implement a smart medical bracelet that can obtain readings in real-time and send them through the application of BLNK.

KEYWORDS: Blynk; MAX 3100; blood pressure, temperature.

I. INTRODUCTION

Healthcare services will make significant advances. Computing and networking technologies have the potential to provide a wider range of services to patients. As a result of this development, the quality of life of the patient will be enhanced and leads to support a large portion of the smart community. Numerous kinds of Pulse Rate and Infection monitors exist, counting both wrist monitors and the more common arm monitors. Fig. 1. shows the smart healthcare watch. The armband monitors are rare because they are typically large and require a separate module attached to the armband. Armband monitors are less convenient than the wrist monitors. The wrist monitors are self-contained and have no separate module or any other attachments. Wireless Pulse Rate and Temperature monitors collect readings continuously to obtain more information from patients to analyze how their Pulse Rate and Temperature varies throughout the day [1]. It is well known that people's Pulse Rate and Temperature vary a lot during the day. However, this opinion is still questionable and needs more investigation. Fig.2. shows the Internet of Things (IoT) architectures of middle application where someone at the home Pulse Rate and Temperature is normal in the daytime but then reads high when collected later during the same day in a doctor office. What can be an important point in this case? A Wireless Pulse Rate and Temperature monitor provides many readings throughout the day and would give a better and true picture of patients' Pulse Rate and Temperature [2]. Such a device could also be a research tool to help better understand the effects of Pulse Rate and Temperature on the body.Many IoT systems have been developed for healthcare and assisted living applications. Fig.2. illustrates IoT that has developed a Multi-communication protocol compliant IoT program for medical devices [3].

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Fig. 1 Smart healthcare watch.

In Xu et al [4], authors have suggested a resource-based data access approach (UDA-IoT) that would be sufficient for health information-intensive applications. The authors in [5] have developed and introduced a patient assistance network for Peer-to-Peer (P2P) and IoT technology. They used a smart box to monitor the patients' condition. Multiple tests were conducted to examine the framework that is applied in a few specific scenarios. Due to the scarcity and development of portable IoT nodes, it helps people to monitor and control their health metrics. One of the benefits that are an individual may at any point be made conscious of the state of their illness with the aid of these devices. Data can be made available to the healthcare provider to include timely treatment for the disorder or to preserve the life of the patient in emergency situations [6]. Connected health is proving to be a major application for technology development.

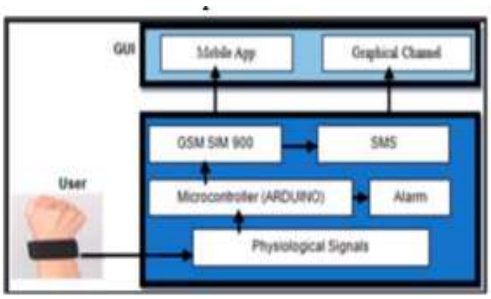

Fig. 2 IOT- wearable monitoring system

The concept of connected healthcare systems and smart built-in IoT devices offers potential benefits for both commercial and individual companies.

The aim is to use the research carried out on new technologies to enable the creation, enhancement and expansion of connected health systems. This helps to develop a system that can assist patients to become better aware of their health status. The timeframe for the system has become a very important health care issue and to provide early medical warnings [7]. IoT is formed of multiple words one is the Internet and second is The Things. Internet is a network of networks that are connected world widely through some proper procedures. By using IoT many devices can be connected together and share the information such as Radio Frequency Identification (RFID) tag, sensors, actuators and smartphone and cloud computing [8]. IoT helps to access any of the services and obtain useful information of any object from anywhere and at any time [9, 10]. The evolution of IoT applications requires further development in many areas, including communication and applications. A number of research and development entities are involved in development activities. Cisco describes the IoT as the integration of individuals, records, objects and processes in the network of connections [11]. IoT refers to as a network of ordinary artifacts that provide pervasive computing. The ubiquity of artifacts has improved by combining each entity into an integrated network for interaction [12]. It links people and devices across a massively distributed network. IoT is essentially a worldwide network of computers. IoT helps to connect every person and object through the Internet. A unique identifier is assigned to each object in IoT which helps to access each object via the internet [13]. The IoT device proposed in this paper is based on the UNO. The Arduino is one of the oldest and most famous prototyping boards. Using this basic and successful tool, the health condition of critically ill patients may be continuously tracked. It may be used to monitor the wellbeing of elderly people who also have trouble with their heart or blood pressure. Health-related data, i.e. pulse rate and temperature, are periodically updated and logged on the Thing Speak platform. These data can be further used to maintain the patient's medical history. Freeboard.io is used as a dashboard to represent the recorded data graphically. The Arduino Sketch running over the device implements various project features, such as reading sensor data, converting it into strings, passing it to the IoT platform, and displaying the measured pulse rate and temperature of the LCD character. The Sketch is drawn, assembled and posted by using the Arduino IDE. The employed IoT framework is Thing Speak and the Freeboard.

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Fig.3 smart healthcare framework.

iPhone and Android applications can be used in order to easily observe the patient's information. This machine is supposed to track the patient's Heart Rate and Temperature with the practitioner to control the patient's health in his own office without being actively present in the patient's room. The specialist would interpret more accessible and precise findings for the treatment of a patient's medical disorder that culminated in irregular Pulse Rate and temperature measurements. Medical Electronics is also moving forward with the use of the Internet of Things. The Internet of Things is the most rising invention in the world. A dedicated IEEE special standard is under development for the IoT architectural framework, i.e. IEEE P2413 [14]. Thai Industrial **Standards** (**TIS**) defines IoT as a platform for interconnected people and physical objects, along with Information and Communication Technology (ICT) to build, operate and monitor the physical world through smart networking, general data processing, predictive analysis, and optimization [15]. IoT architecture offers a conceptual guide, defines architectural building blocks and calls for the application of similar frameworks. As the Internet continues to evolve, one of the key enablers is the universal roll-out of IPv6 [7] that encourages a pervasive solution for every "smart things" communication. The IoT architecture offers a conceptual guide, defines architectural building blocks and calls for the application of similar frameworks. As the Internet continues to evolve, one of the key enablers is the universal roll-out of IPv6 [16] that encourages a pervasive solution for every "smart things" communication. Health-related outcomes, i.e. pulse rate and heat, are routinely tracked and recorded on the Item Talk website. Such records can often be used to preserve the patient's medical background. Freeboard.io is used as a dashboard to graphically reflect historical results.The Arduino Sketch that is running over the system performs different functions of the project, such as interpreting sensor input, translating it into strings and moving it to the IoT. The Arduino Sketch displays and views of determining heart rate and temperature on the LCD character. IoT security is one of the key challenges since there is a need to provide protection for a growing array of connected devices. Therefore, there is a need to ensure that IoT devices only send details to designated entities [18]. There are several research experiments that aim to describe the abnormality of the core of the user but several of them ignore the main components. Two different categories of related systems are examined. This paper proposes a program that is more relevant to connected mobile health applications. This is because we are designing smartphone applications that link to smart IoT devices as compared to other organizations that rely on robust health care networks which help consumers to communicate and profit from services. The medical bracelet consists of two types of sensors: the first sensor (GY 906 that it is responsible for measuring the body temperature and room temperature, and the second sensor is (MAX 3100) and it is responsible for measuring and sensing the oxygen level in the blood and the heartbeat rate.

Fig.4 the smart device with sensors through the cloud.

All the components are summarized in shaped manufacture using the 3D printer and it has been designed by using the AutoCAD program in order to be compatible with system requirements. The ESP 32 cannot receive two types of sensors within the same electronic circuit at the same real-time. Two of the microcontrollers were connected in a serial, and each sensor has been employed individually on the microcontroller and they were connected to each other in serial. As for the parts connected on the Internet through the Blnk application. The sensors sent their readings in real-time through the internet using a Blnk program. The aim of the research is to design and implement a smart medical bracelet that contains sensors that

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obtain readings in real-time and transmit them through the application of BLNK.

II. RELITED WORK

A monotonous waiting area with lengthy lines hoping to see the doctor as early as possible and on the other side, the sad expressions of the people there with their distressed cries. Well, this was the situation of the hospitals a couple of years ago. Things are changing now with the speed of technology. Modern hospital services, virtual healthcare apps and an all-new IoT paradigm are transforming the whole landscape of the healthcare industry. Since gaining hold over other sectors such as Companies, Retails, Business, Manufacturing, IoT is now booming the healthcare sector as well. Probably no other industry has gained more from the Web of Things, more than health services. If it's for doctors, clinicians, patients or insurers, IoT is truly a dynamic power in health care. Physicians are also in a role to track patients ' safety and development constantly, while patients, on the other side, may conveniently interact with their physicians. Specialists and researchers have been offered an opportunity to chat to each other across the globe about tough health problems While technology cannot rescue the planet from ageing or eradicating chronic ailments, it can at least make health care healthier in the mouth, the development of IoT systems is now gaining momentum in the healthcare sector Before moving any further, it would be prudent to test the IoT industry dynamics figures in order to verify how technology is transforming various realms. If that has been achieved, knowing how healthcare is driven by technology should not be a challenge. IoT Health Sector Figures from Becker's Hospital Study show that nearly three-fifths of health professionals utilize IoT apps in their organizations. 73 per cent of hospitals are tracking their patients with IoT devices. 89% of the institutions had experienced a loss of confidentiality in their structures. 87 per cent of companies expect to incorporate IoT in their buildings by 2019. Organizations believe IoT has saved up to 57 expenses. This was because of its facilities. In addition, the Internet of Things Healthcare industry was estimated at USD 28.42 billion in 2015 and is expected to hit USD 337.41 billion by 2025, rising at a CAGR of 28.2% over the forecast era. Many IoT technologies have recently been developed for IoT safety and assisted living applications. Wang et.al [3] has developed a Multi-communication system that complies with the IoT framework for medical equipment. Xu et al. [4] has proposed resource-based data access (UDA-IoT) solution that would be suitable for health information-intensive applications. Authors in [5] have created and developed a patient assistance network for Peer-to-Peer (P2P) and IoT technologies. They have used a smart box to track the health of the patients. Many experiments have been performed to evaluate the applied program in a variety of various scenarios. Sand Holm et al. has proposed a Real-Time Communication (WebRTC) and an on-demand IoT tunnelling facility for hospitals. The proposed system relies on the interception of key parts of the WebRTC JavaScript Session Establishment Protocol (JSEP) and the use of local network gateways that can effectively multiplex traffic from multiple concurrent streams without leaking any WebRTC traffic through the firewall except through a trusted port [6]. As per Link Labs By using the RFID tag, health care providers can track real-time locations, assigned physicians and treatment progress, etc. Medical devices and devices, such as defibrillators, ECG machines, spirometers and nebulizers, etc., may be tagged with sensors and it was simple to monitor with IoT [7]. Krishnan et al. has presented an automated real-time platform for the IoT Health Distributed Flow System. If the patient is out of reach to Wi-Fi or the device is unavailable, the patent data should be processed locally and transferred to the cloud until the patient returns to the communication range [8]. Azariadi et al. have also developed an electrocardiogram (ECG) signal analysis and arrhythmia prediction algorithm for an IoT-based embedded handheld monitoring system that is suitable for 24-hour continuous surveillance. The Galileo Management Board is expected to carry out the specification [9]. Mohan addressed a security program for IoT Personal Medical Devices (PMDs) to ensure better mobility. In the meantime, it makes for better monitoring of the health of the patient when travelling. This poses the security risks and vulnerabilities of PMD IoT that pose a challenge in overcoming such challenges. It also offers several initial approaches to counter these security threats [10]. Ah, Yeh et al. has presented a cloud-based, fine-grained health information access management system for lightweight IoT applications with automated evaluation and revocation of attributes. We discussed future vulnerability concerns and problems linked to cloud reciprocity. The findings suggest that the new system is successful for the cloud-based Personal Health Information (PHI) platform [11]. It's Porambage et al. has proposed a stable, lightweight authentication protocol and main end-to-end protocol for restricted devices in IoT-enabled ambient assisted living systems.We used a proxy-based method to allocate strong computational

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operations to more efficient machines in the vicinity of used medical sensors. The tests are good for implementations in the real world [12]. Yelamarthi and Laubhan [13] have created and launched handheld wireless travel assistance for the blind. Ultrasonic range finders are used based on Jayant Shekhar and International Journal of Advancements in Information Science and Technology, 7(11), November 2018, 75- 82 77 belts. The assistive device was able to detect the obstacles in front of the user and to provide the necessary instructions using the Bluetooth headset. Nevertheless, this method is constrained in the distance and the location of obstacles with reasonable accuracy. This paper addresses these constraints by introducing a cloud-based IoT device capable of remote control of pulse rate and temperature.

III. THE PROPOSED WRISTBAND TO MONITOR HEARTBEAT AND TEMPERATURE USING INTERNET OF THINGS (IOT)

Recently, many individuals have been increasingly worried about unexpected cardiac arrests. With the growing prevalence of smart connected applications, IoT approach has become more readily accessible. Unfortunately, hospital mortality levels for patients with unexpected heart arrests are small. The developed system in this paper aims to introduce a multi-sensory device utilizing a smart IoT framework that can gather data from the Body Area Sensor (BAS) to provide early notice of imminent cardiac arrest. The idea of the scheme is to implement of an electronic medical bracelet using simple and inexpensive electronic components that helps to measure the medical information of the person who wears it such as temperature, blood pressure, the oxygen level in the blood and other tasks. The medical bracelet consists of two types of sensors: the first sensor (GY 906 that is responsible for measuring the body temperature and room temperature, the second sensor is (MAX 3100) that is responsible for measuring and sensing the oxygen level in the blood and the heartbeat frequency.

1- Hardware component

The idea of the project is the manufacture and implementation of an electronic medical bracelet using simple and inexpensive electronic components so that it is able to measure the medical information of the person who wears it (temperature, blood pressure, oxygen level in the blood and many other tasks.) The medical bracelet consists of two types of sensors: the first sensor (GY 906 Where it is responsible for measuring the body temperature and room temperature, and the second sensor is (MAX 3100) and it is responsible for measuring and sensing the rate of oxygen in the blood and also the measurement of the heartbeat. All the component is summarized in a shaped manufactures using the 3D printer and design using the auto cade program in order to be compatible with our requirements. the ESP 32 cannot receive two types of sensors within the same electronic circuit at the same real time. Two of the microcontrollers were connected in a serial, and each sensor was on a microcontroller individually, and they were connected to each other in serial.

- **ESP MODULE**

ESP32 is a series of low-cost, low-power microcontroller chip systems with built-in Wi-Fi and dual-mode Bluetooth. The ESP32 series utilizes the Tensilica Xtensa LX6 microprocessor in dual-core and single-core configurations and it includes built-in antenna switches, RF Bayln, sensor amplifiers, low-noise transmit amplifiers, filters and power management modules. ESP32 has been designed and developed by Espresso if Systems, a Chinese firm headquartered in Shanghai, and is assembled by TSMC by utilizing its 40 nm technology. It is the descendant of the ESP8266 microcontroller. The characteristics will be seen in Fig.5,6. The role block diagram as seen in Figure 7.

Fig.5 ESP8266 microcontroller module.

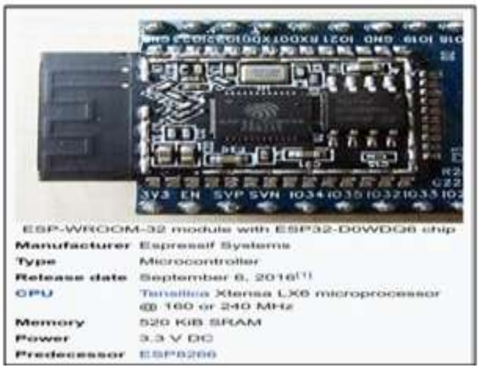

Fig.6. the ESP8266 features Prerequisites

1. Tool chain to build the Application for ESP32
2. ESP-IDF which contains API for ESP32 and scripts to operate the tool chain
3. Blynk installed in your PC
4. The ESP32 board

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5. USB CableGY906 and MAX3100 sensors

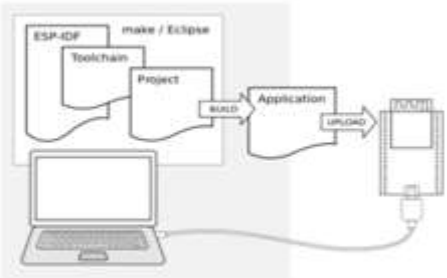

Fig.7 ESP32 function block diagram.

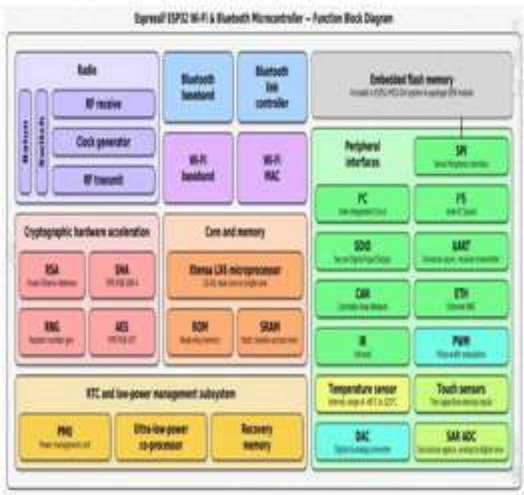

Fig9. GY906 sensor **Fig.10** MAX3100 sensor with ESP32

- **GY906 sensor**

The MELEXIS MLX90614ESF-BAA-000-TU-ND non-contact infrared thermometer for use with Arduino or any microcontroller capable of communicating with it through its I2C interface is on offer. The sensor comes with a breakout board with all the components required for operation and two styles of pins. They are not going to be rented. Two I2C solder jumpers can or may not need to be soldered based on application, but should not be soldered for other purposes.

- **MAX3100 sensor**

The MAX3100Serial library has been developed to allow serial communication using the MAX3100 integrated circuit over the SPI bus. The interface replicates the familiar Serial and Software Serial interface. Using multiple Chip Select pins, it is possible to have multiple additional external serial ports with speeds between 300 bps and 230400 bps, depending upon the crystal chosen in the hardware design.

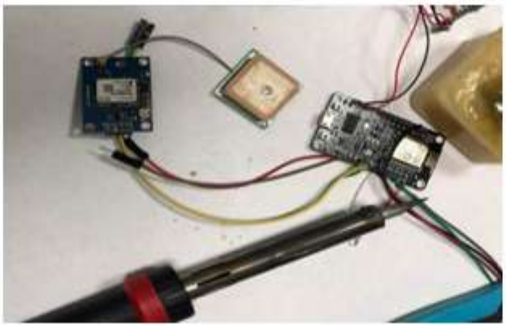

Fig.11 the electronic circuit of ESP32 and MAX 3100 with GPS

2- Software system

In this research, we design a system consisting of a practical part, The medical bracelet consists of two types of sensors: the first sensor (GY 906 that it is responsible for measuring the body temperature and room temperature, and the second sensor is (MAX 3100) that is responsible for measuring and sensing the oxygen level in the blood and the heartbeat rate. All the components are summarized in shaped manufacture by using the 3D printer and it has been designed by using the AutoCAD program to be compatible with system requirements. The ESP 32 cannot receive two types of sensors within the same electronic circuit at the same real-time. Two of the microcontrollers were connected in a serial, each sensor was implemented individually on a microcontroller, and they were connected in serial. As for the parts connected on the Internet through the Blynk application. The sensors sent its reading in real-time through the internet using a Blynk program.

Step 1: Pin Definition
Step 2: Material Preparation: we require these items:

1. ESP32 Development Board

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2. MAX3100 sensor Blynk App in Android or IOS apps
3. GY906 sensorThe material preparation is shown in Fig.12.

Step 3: Pin Connection: connect LED's anode to ESP32's p21 and LED's cathode to ESP32's GND. Fig.14 show the pin connection for the proposed circuit.

Step 4: Setting Up Blynk App

1. Download Blynk apps from Play Store or App Store.
2. After download is done, open the apps and create an account. If you already create an account, you may log in.
3. When you have already successfully developed an account, continue with the launch of a new project.
4. Create a name for the project and choose a device from the ESP32 Dev Board and choose an IR connection type.
5. After pressing the "Create" button, the "Auto token has been sent to ..." window will pop up. You will open an email to search the authentication key.
6. Then press the canvas where you want to access the widget box. All available widgets are located right here. Pick a tab now.
7. Tap the widget to change the settings. Select the LED pin to Digital-gp21 and select the mode to switch.
8. When you're done with the setup, click the PLAY button. This will move you from EDIT mode to PLAY mode where you can communicate with your hardware.

Step 5: Sample Source Code: you need to download and install the Blynk Library. This library enables ESP32 to connect to Blynk. You would need to import this package and add it to your Arduino package files to be able to connect the ESP32 with Blynk. Then import this example source code and change the auto token by testing your email and copying it to the encoding.

-Programming ESP32 for Developing a wristband to monitor Heartbeat and Temperature Using Internet of Things (IoT): The medical bracelet consists of two types of sensors: the first sensor (GY 906 Where it is responsible for measuring the body temperature and room temperature, and the second sensor is (MAX 3100) and it is responsible for measuring and sensing the rate of oxygen in the blood and also the measurement of the heartbeat. All the component is summarized in shaped manufacture using the 3D printer and design using the AutoCAD program to be compatible with our requirements. the ESP 32 cannot receive two types of sensors within the same electronic circuit at the same real-time. Two of the microcontrollers were connected in a serial, and each sensor was on a microcontroller individually, and they were connected in serial. As for the parts connected on the Internet through the Blynk application. The sensors sent its reading in real-time through the internet using a Blynk program. For programming the ESP8266 Node MCU module, it has been controlled through a special application (Blynk), that has been programmed by the system designer according to the available work requirements. The program code is written through the C language inside the software for the Arduino program. A special code has been sent via email from the mentioned application. Then the obtained code from the application via email is added to the code of the program in Arduino software to link the software application with the physical components of the electronic circuit and control them properly.

Fig.12. Material Preparation

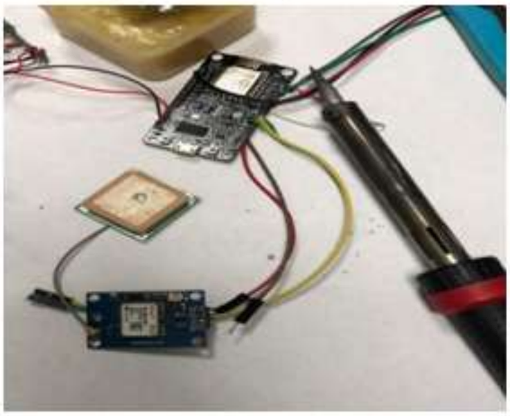

Fig.13 Pin Connection

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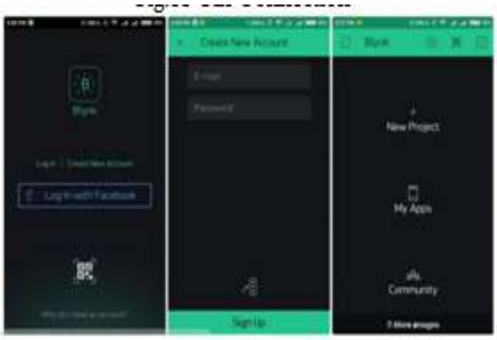

Fig.14 Setting Up Blynk App

Step 6: the result: Based on the result, the LED will turn on or off when you switch the button on the Blynk app. Once the Blynk application is open, at the first position when there is no movement achieved as shown in Fig16, it will show that the amount of heartbeats and the SPO with respect to the body temperature is changed when there is a movement is done as shown in Fig.16 below.

Fig. 15 The result

- **Circuit Diagram:** Circuit diagram for this Fig.17. show the connection circuit with GY906 sensor IoT Smart system.
- **Automatic IOT System:** The proposed system in our research is summarized as shown in Fig.18

IV. RESULTS AND DISCUSSION

In this paper, a system consisting of practical parts and simple electronic circuits has been designed. This program is controlled by the C language within the Arduino program and a special application that programming according to the available work requirements, where the program code is written via a special code that is sent via email. The application is added to the program icon to execute the program application by linking it correctly to the physical components of the electronic circuit. This system has been practically applied and designed and has proven successful in performing the required tasks. The objective of this research is to present a multisensory system using a smart IoT system that can collect Body Area Sensor (BAS) data to provide early warning of an impending cardiac arrest. The idea of the project is the manufacture and implementation of an electronic medical bracelet using simple and inexpensive electronic components so that it is able to measure the medical information of the person who wears it (temperature, blood pressure, the oxygen level in the blood and many other tasks.) The medical bracelet consists of two types of sensors: the first sensor (GY 906 Where it is responsible for measuring the body temperature and room temperature, and the second sensor is (MAX 3100) and it is responsible for measuring and sensing the rate of oxygen in the blood and also the measurement of the heartbeat. All the component is summarized in shaped manufacture using the 3D printer and design using the AutoCAD program in order to be compatible with our requirements. the ESP 32 cannot receive two types of sensors within the same electronic circuit at the same real-time. Two of the microcontrollers were connected in a serial, and each sensor was on a microcontroller individually, and they were connected to each other in serial. As for the parts connected on the Internet through the Blynk application. The sensors sent its reading in real-time through the internet using a Blynk program. The aim of the research is to design and implement a smart medical bracelet that contains sensors that take readings in real-time and send them through the application of BLNK.

V. CONCLUSION

In this paper, a system consisting of a practical part has been designed, which is a simple electronic circuit consists of two sensors with an electronic circuit with a wired connection and a simple electronic circuit that is controlled through a special application (Blynk). Blynk has been programmed according to the available work requirements where the program code is written through the C language inside the software for the Arduino program and through a special code sent via email from the mentioned application, and the obtained code from the application is added to the code of the program in Arduino software to link the

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software application with the physical components of the electronic circuit and control them properly. This system has been applied and designed in practice, and it has proven outstanding success in performing the required mission. The objective of this research is to present a multisensory system using a smart IoT system that can collect Body Area Sensor (BAS) data to provide early warning of an impending cardiac arrest. The idea of the project is the manufacture and implementation of an electronic medical bracelet using simple and inexpensive electronic components so that it is able to measure the medical information of the person who wears it (temperature, blood pressure, the oxygen level in the blood and many other tasks.) The medical bracelet consists of two types of sensors: the first sensor (GY 906 Where it is responsible for measuring the body temperature and room temperature, and the second sensor is (MAX 3100) and it is responsible for measuring and sensing the rate of oxygen in the blood and also the measurement of the heartbeat. All the component is summarized in shaped manufacture using the 3D printer and design using the AutoCAD program in order to be compatible with our requirements. the ESP 32 cannot receive two types of sensors within the same electronic circuit at the same real-time. Two of the microcontrollers were connected in a serial, each sensor was on a microcontroller individually, and they were connected to each other in serial. As for the parts connected on the Internet through the Blynk application. The sensors sent its reading in real-time through the internet using a Blynk program. The aim of the research is to design and implement a smart medical bracelet that contains sensors that take readings in real-time and send them through the application of BLNK.

Fig.16 Circuit diagram with GY906 sensor

Fig.17. The proposed wristband

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