Fitness Tracker for Heart Rate, SpO_2 and Body Temperature Measurement

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Abstract

Advances in communication and technology have facilitated the creation of the Internet of Things (IoT). Today, IoT plays an important role in monitoring, recording, storage, imaging, and communication in medicine, smart cities, engineering, and other fields. Using IoT-based monitoring, important aspects of health can be monitored and information can be sent over the Internet. Information will be entered according to the patient's current condition. This research article only focuses on remote monitoring of body temperature (DS18B20), heart rate, and SPO2 (MAX30100). The proposed system uses the latest versions of IoT microcontrollers and devices, which significantly affects the accuracy and speed of the entire system. We create Graphical User Interface(GUI) cross-platform mobile applications to provide instant information to doctors and patients. The system facilitates real-time monitoring of the patient's health, allowing doctors to make urgent treatment decisions at the right time.

Keywords—Internet of Things, Healthcare, Remote Monitoring, SPO2, Raspberry Pi, GUI, Instant Search, DS18B20, MAX30100

I. INTRODUCTION

The rapid growth of the Internet is fuelled by its widespread use of it and is driving the growth of the Internet of Things (IoT). The Internet of Things has revolutionized many industries, including healthcare, by delivering energy management solutions that increase efficiency, productivity, and security. The Internet of Things, which uses smart devices and sensors to communicate over the Internet, has the potential to improve people's lives.

With the rapid advancement of technology, the Internet of Things is used in smart cities, medicine, engineering, etc. started to be used in areas. IoT in healthcare is revolutionizing remote patient care, particularly through the use of wearable devices and smartphones.

In healthcare, IoT helps prevent diseases, accurately measure health, and provide continuous health care regardless of where the doctor is located. Telehealthcare allows patients to be cared for outside of a traditional hospital, thus reducing costs while improving access to healthcare. Healthcare providers can monitor patients' health status using various critical health parameters, including heart rate, blood pressure, body temperature, SpO2 (blood oxygen saturation), respiratory rate, ECG (electrocardiogram), and blood sugar. Advancements in medical technology have enabled the development of electronic devices with precise sensors to track these parameters. To facilitate remote monitoring, healthcare providers can utilize a variety of microcontrollers, including the ESP32, commonly used in IoT applications.

The ESP32 provides connectivity to the internet, enabling the automation system to be linked to a remote-controlling device. Various sensors are employed to receive signals from the external environment, such as heart rate sensors, pulse oximeter sensors, and body temperature sensors. These sensors collect real-time data. The proposed IoT system focuses on remote monitoring of three vital health parameters: heart rate, SpO2, and body temperature. By leveraging IoT technology, the system provides real-time patient monitoring capabilities, empowering healthcare professionals to make timely and informed treatment decisions.

Key Features of the Proposed System:

1]Real-time Patient Monitoring: The system continuously tracks three critical health parameters: heart rate, SpO2, and body temperature, enabling healthcare providers to stay abreast of any potential changes in a patient's condition.

2]Improved Efficiency: The system's streamlined design and utilization of advanced IoT technology contribute to enhanced operational efficiency, ensuring seamless data collection, transmission, and analysis.

3]Timely Treatment Decisions: The real-time monitoring and data accessibility facilitated by the system empowers healthcare providers to make timely treatment decisions, potentially improving patient outcomes.

The rest of this paper is organized as follows. Section 2 provides a methodology of the proposed system, Section 3 is the result and discussion, and the conclusion.

II. PROPOSED METHODOLOGY

The fitness Tracker is depicted in a block diagram format in Figure 1. The system comprises three distinct sections: input, processing, and output.

The input section consists of three primary components:

Pulse Oximeter (MAX30100): This module measures blood oxygen saturation (SpO2) and heart rate.

Body Temperature Sensor (DS18B20): This sensor measures body temperature.
The processing section utilizes the Arduino IDE software to determine the specific ESP32 Arduino microcontroller that will be connected to the system.

The output section comprises an ESP32 webserver that aggregates data from the input sensors, including blood oxygen saturation, body temperature, and pulse rate. This compiled data is then transmitted to a smartphone or PC for real-time monitoring.

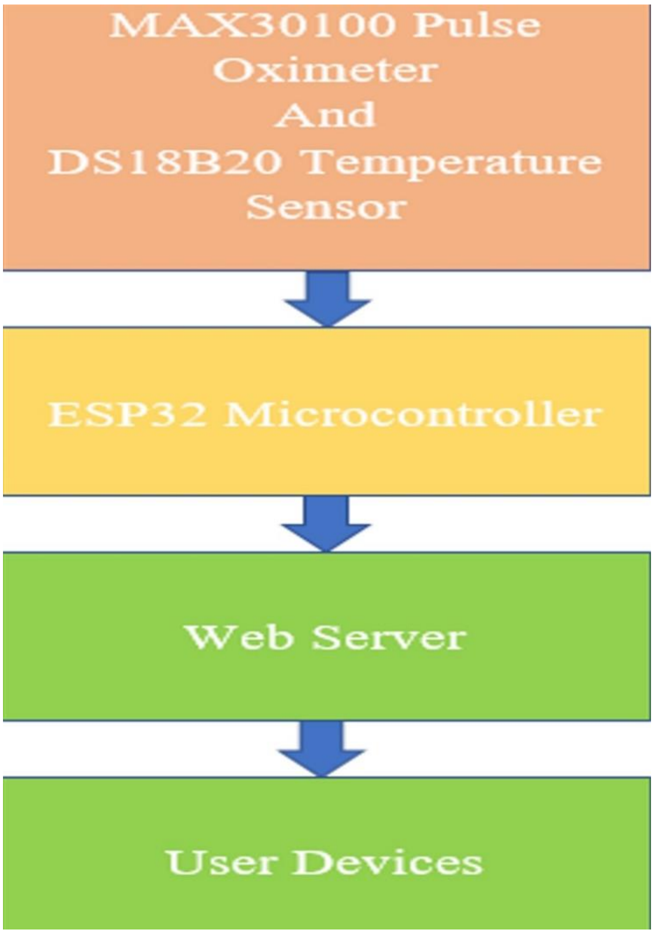

Fig. 1: Block diagram of fitness tracker

Upon activation of the input sensors, as illustrated in Figure 2, the ESP32 Arduino microcontroller receives signals from the respective sensors. The ESP32 processes this input data and converts it into a format suitable for execution.

Once the data is processed, the Hypertext Transfer Protocol (HTTP) is employed to establish communication between the client (smartphone or PC) and the server (ESP32 webserver). Upon successful client request (Wi-Fi connection), the processed data becomes accessible through the webserver. Users can access this data using the designated IP address from any smartphone or PC.

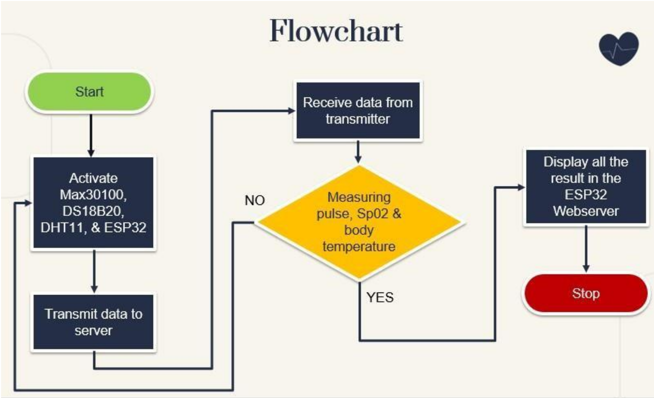

Fig. 2: Flowchart of Data Transmission Process of Fitness Tracker

A. Pulse Oximeter (MAX30100)

MAX30100 is an optical device that combines two LEDs, a photodetector, optimized optics and low-noise analog signal processing to measure pulse oximetry and heart rate signals. It works with 1.8V and 3.3V power supplies and can be controlled by software, standby current does not cause problems, allowing the power supply to be connected at all times.

The MAX30100 is a powerful, high-powered device ideal for many applications requiring accurate measurement of blood saturation and heart rate.

B. Body temperature Sensor

This system uses the DS18B20 sensor for body temperature measurement. This digital thermometer uses a 1-Wire interface, requiring only one digital input for bi-directional communication with the Arduino microcontroller. It has a temperature range (-55°C to +125°C) and an accuracy of 0.5°C. Users can set the sensor resolution to 9, 10, 11, or 12 bits. However, the default is 12-bit resolution (0.0625°C accuracy). During the temperature change process, the sensor draws a minimum of 1mA current and can be used from a supply between 3V and 5.5V. To collect body temperature data, a probe is touched to the body and the collected data is instantly sent to Arduino for temperature measurement.

C. ESP32 Arduino

ESP32 is a low-power Wi-Fi and Bluetooth microcontroller with a 2.4 GHz radio. It integrates power amplifiers, noise amplifiers, filters, antenna switches and control power modules. In this system, ESP32 Arduino acts as the central controller and is responsible for collecting health data from biosensor modules, temperature and humidity sensors. The processor then processes this information and creates the necessary products, including displaying the results and storing the information in the cloud.

Key features:

* Low-power Wi-Fi and Bluetooth connectivity
* Single 2.4GHz radio
* Integrated power amplifier, noise reduction amplifier, filter, Antenna switch and control power modules
* Multifunctional processor for data collection, processing and output generation

Role in the system:
* Collection of health assessment data biosensor modules, temperature sensors and humidity sensors
* Data storage and production of necessary products
* Viewing results of connected devices
* Store data in the cloud for long-term monitoring and analysis

ESP32 Arduino in the full functioning of the whole body, health It plays an important role in allocating time to services and data analysis.

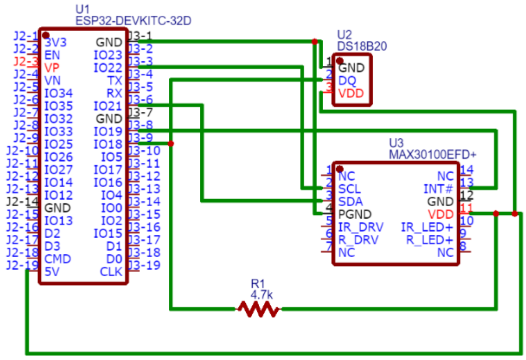

Fig. 3: Schematic diagram of the Fitness Tracker

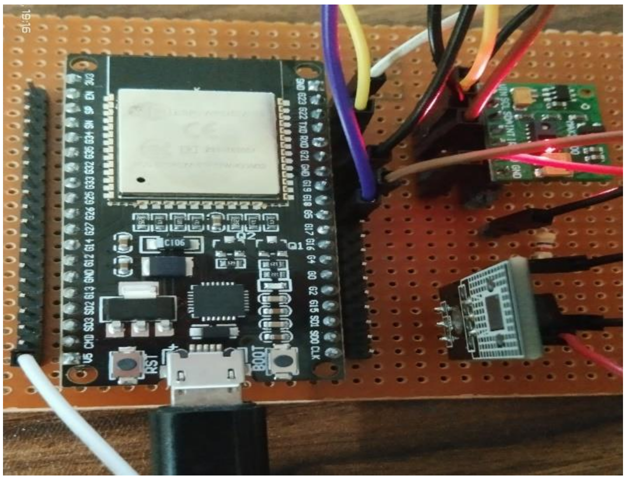

Fig. 4: Hardware diagram of the Fitness Tracker

III. RESULT AND DISCUSSION

The system has been carefully tested using the Arduino IDE software and ESP32 web server. The equipment used to collect the required data includes the MAX30100 Pulse Oximeter, and DS18B20 body temperature sensor.

Figure 5 shows that the connection between Arduino and the system is completed. The Queue Monitor can be accessed from the toolbar in the top bar or by clicking the magnifying glass icon in the upper right corner of the screen.

Figure 6(a) shows information such as Wi-Fi connection status, IP address, and connection process displayed on the monitor. After the system starts, body temperature, heart rate, and blood saturation will be displayed every second as shown in Figure 6(b).

Figure 7 shows the sensor data collected by the ESP32 web server during system testing. Users simply copy and paste the IP address displayed on the monitor into a web browser such as Google, Yahoo, Bing, or Safari.

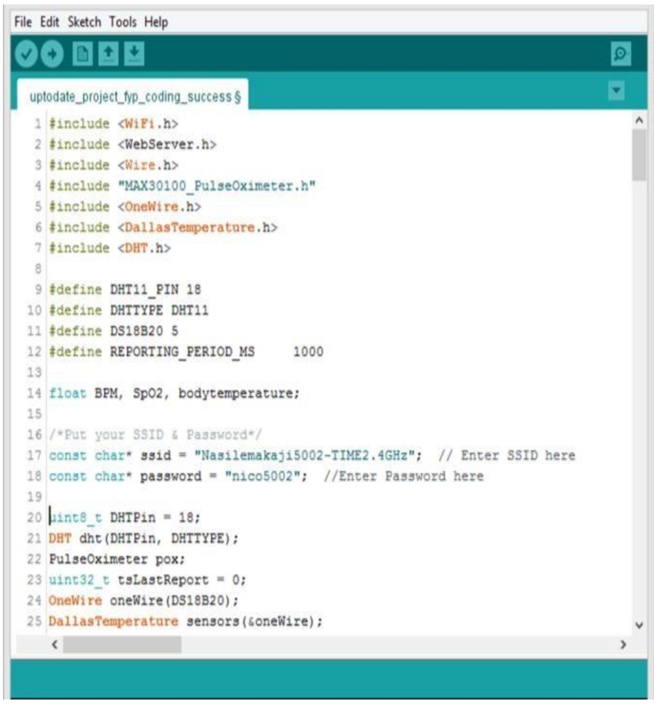

Fig. 5: System testing using Arduino

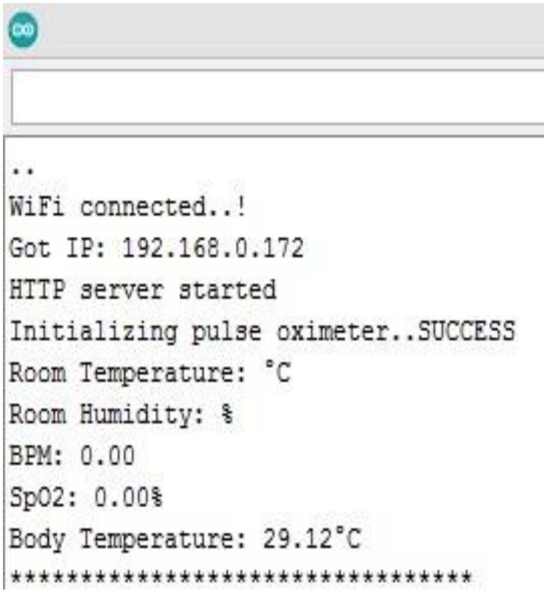

Fig. 6 (a): Initial information of connection status

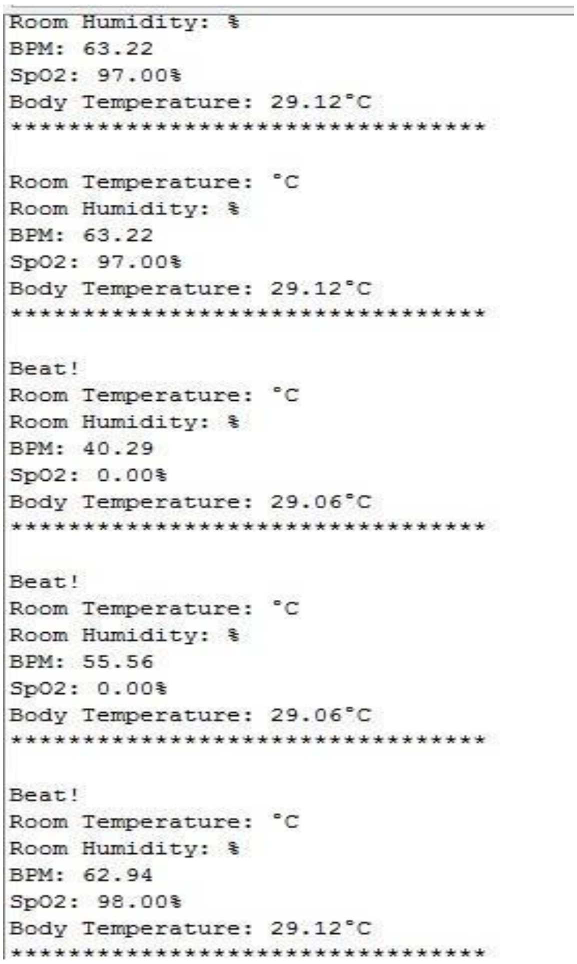

Fig. 6 (b) : Result of the health assessment in serial monitor

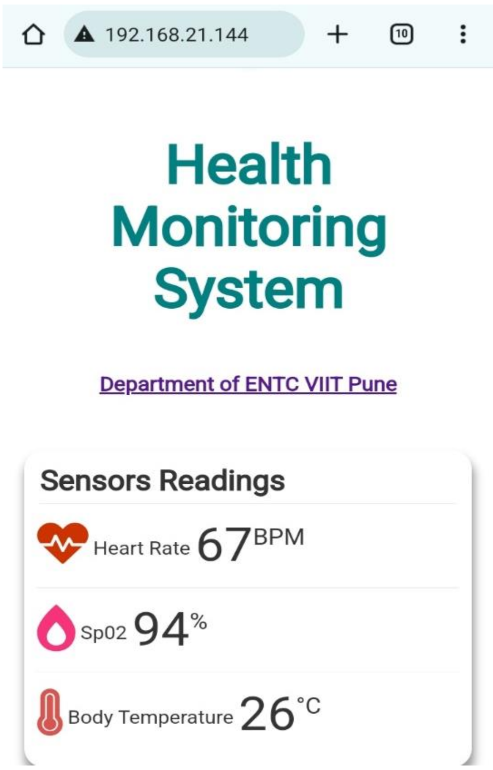

Fig. 7: Result in the Webserver

The implementation of this IoT health monitoring system revolutionizes patient care by offering a multitude of benefits for both patients and healthcare providers.
Enhanced Patient Monitoring and Care:
1]Real-time Data Access: Healthcare professionals can access real-time vital signs data, including body temperature, heart rate, blood saturation, and room temperature, from an authorized smartphone or PC. This continuous monitoring enables timely detection of any potential health complications and facilitates prompt intervention.
2]Remote Patient Monitoring: Patients can be monitored remotely, even from the comfort of their homes, reducing the need for frequent hospital visits and minimizing the risk of cross-contamination. This is particularly beneficial for patients with chronic conditions or those recovering from surgery
3]Improved Patient Outcomes: By providing real-time insights into a patient's health status, healthcare providers can make informed decisions regarding treatment plans, leading to improved patient outcomes and reduced hospitalization duration.
Easing the Burden on Healthcare Providers:
1]Reduces Physical Strain: The system reduces the physical strain on nurses and doctors by eliminating the need for frequent manual patient monitoring, allowing them to focus on more critical care tasks.
2]Optimizes Resource Allocation: By streamlining patient monitoring processes, the system optimizes the allocation of healthcare resources, ensuring that providers can prioritize patients with the most urgent needs.
3]Enhances Patient-Provider Communication: Real-time data access and remote monitoring capabilities foster improved patient-provider communication, enabling patients to proactively address any concerns and healthcare providers to provide timely guidance.
Overall, the IoT health monitoring system revolutionizes patient care by promoting proactive monitoring, enhancing treatment decisions, and easing the burden on healthcare providers.

IV. CONCLUSION

In short, The process proposed in this study is promising for remote patient care and makes healthcare workers more efficient. They can understand vital signs and health status without patients and physical contact. This remote monitoring capability not only reduces the risk of infection for healthcare workers but also reduces the growing demand for PPE (self-blocking protective equipment) equipment and other essential equipment.
The system's ability to provide real-time information about patients' body temperature, heart rate, and blood oxygen saturation allows doctors to make informed treatment decisions and plan treatment. This optimal approach to patient care can improve patient outcomes and reduce hospital length of stay. Additionally, the system's remote monitoring capabilities could extend beyond any type of patient, making it an important tool in population control for chronic pain or
Recovering from surgery. By enabling remote care, patient can receive regular care from the comfort of their homes,
reducing the need for multiple hospital visits and reducing
the risk of infection.

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