GE-107
Health Monitoring System

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***Abstract*— This project aims to develop a health monitoring system to measure important vital signs: BPM (beats per minute),SPO2 (oxygen percentage in blood), and GSR (galvanic skin resistance). The system will consist of SPO2 sensor, heart beat sensor, and a GSR sensor connected to an NODEMCU ESP32 microcontroller. The readings from the sensors will be processed and displayed on a mobile app, providing real-time monitoring of the patient's health status.**

I. Introduction

Regular monitoring of vital signs is crucial for elderly and ill individuals to identify any changes in their health and provide timely medical treatments. Traditional methods of tracking vital signs can be uncomfortable and impractical, and may not offer constant monitoring, making it difficult to detect sudden changes. This delay in identifying changes can lead to postponed medical treatments, potentially harming patients. To address this issue, a portable gadget is needed that can constantly monitor and transmit real-time data on vital signs such as SpO2, GSR, and BPM to healthcare experts. This project aims to develop a health monitoring system that can continuously track vital signs and provide timely interventions, potentially improving patient outcomes and reducing the burden on medical staff. The development of such a system has the potential to make a significant impact on the healthcare sector, improving the quality of care provided to patients.

II. Core Functionalities

A. *BPM (Beats Per Minute)*

An SpO2 sensor has been used to measure the BPM or beats per minute of an individual's heart rate. The sensor is capable of detecting the electrical signals generated by the heart, which are then processed and used to calculate the BPM, providing real-time monitoring of the individual's heart rate. This heart rate sensor is a key component of the project and plays a crucial role in assessing cardiovascular health.

B. *SpO2 (Oxygen Percentage in Blood)*

Again, SpO2 sensor has been used to measure the oxygen saturation levels in an individual's blood. The sensor uses light to detect the amount of oxygen bound to hemoglobin in the blood, providing real-time monitoring of the SpO2 levels. This SpO2 sensor is a critical component of the project, providing vital information about the respiratory function of an individual.

C. *GSR (Galvanic Skin Resistance)*

A GSR (galvanic skin response) sensor has been used to measure the electrical conductivity of an individual's skin. The sensor measures the changes in skin conductance caused by emotional responses, stress, or anxiety, providing real-time monitoring of the individual's stress levels. This GSR sensor is a valuable component of the project, providing important information about an individual's emotional and physiological state.

III. SPECIFICATIONS

A. Software Specifications

1. Arduino IDE 1.8.19
2. Blynk Cloud System

B. Hardware Specifications

1. Node MCU ESP8266
2. SpO2 MAX30100 Sensor
3. GSR v 1.2 Sensor
4. Jumper Wires
5. USB Type-B Cable
6. 3.7 V Lithium Battery

IV. MODULES USED

A. Node MCU ESP32

The Node Mcu ESP32 is a microcontroller board that is used in this project to connect the sensors to the mobile application. It provides the necessary computing power and connectivity features required for the system to function effectively.

B. SpO2 MAX30100

The SPO2 MAX30100 is an integrated pulse oximeter and heart rate sensor module that is used in this project to measure the oxygen saturation levels in an individual's blood and their heart rate. It is a key component in the health monitoring system, providing accurate and reliable data for real-time monitoring of an individual's vital signs.

C. GSR Sensor v1.2

The GSR Sensor V1.2 is a galvanic skin response sensor module that measures the electrical conductivity of an individual's skin. It is used in this project to provide real-time monitoring of an individual's stress levels by measuring changes in skin conductance caused by emotional responses, stress, or anxiety.

V. DATA FLOW

A. SpO2 Sensor Circuit

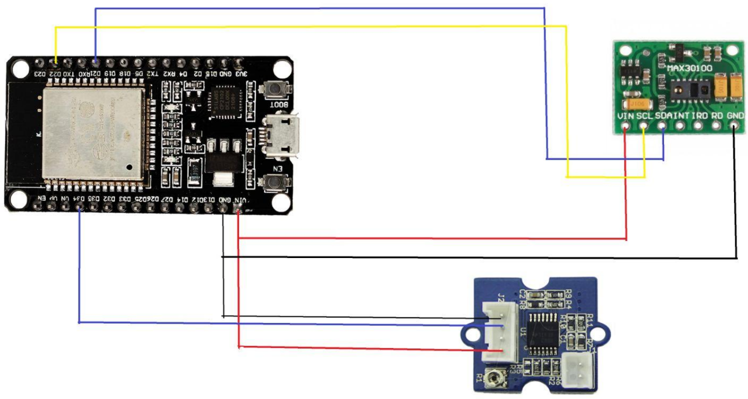
a. Heart rate/SpO2 sensor and Blynk setup is initialised.
b. Infrared light is passed it through the finger tip by pulse oximeter.
c. SpO2 value is calculated using a complex algorithm.
d. Data is transmitted from SDA pin of SpO2 sensor to D1 pin of Node MCU.
e. Data is transferred from Node MCU to PC via USB type-B cable and can be viewed via Serial Plotter or Serial Monitor of Arduino IDE.
f. Data is also sent via wifi from Node MCU to Blynk Cloud.
g. Heart rate and oxygen saturation in blood in displayed.

B. GSR Sensor Circuit

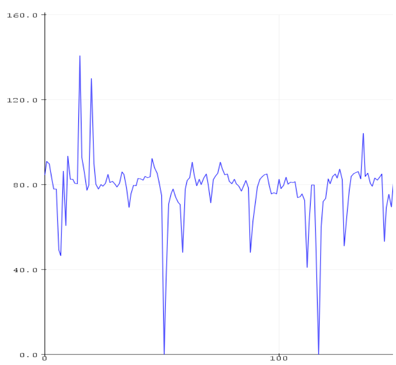
a. GSR sensor and Blynk setup is initialised.
b. Changes in electrical (ionic) activity resulting from changes in sweat gland activity is detected by GSR sensor.
c. GSR value is calculated using a complex algorithm.
d. Data is sent from SIG pin of GSR module to A0 pin of Node MCU ESP32.
e. Data is transferred from Node MCU to PC via USB type-B cable and can be viewed via Serial Plotter or Serial Monitor of Arduino IDE.

f. Data is also sent to Blynk Cloud from Node MCU via wifi.
g. GSR value is shown on the Blynk.

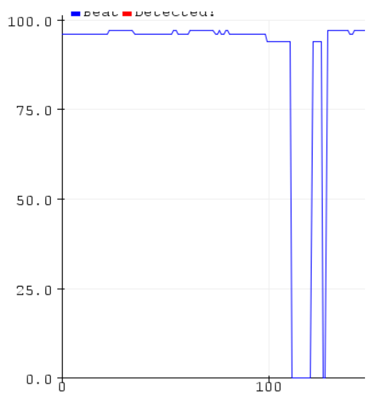
VI. Circuit Diagram



VII. Graphs



1. Heart Rate



2. SpO2

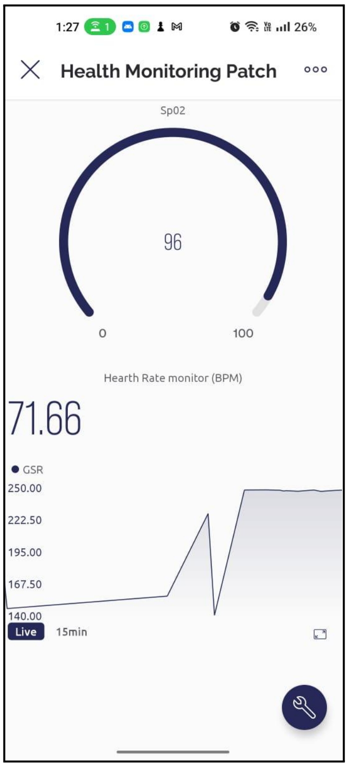
3. GSR

1. *Graph 1- Heart Rate* : We observed although the heart rate is fluctuating, the average value remains to be 80 beats per minute.

2. *Graph 2- SpO2 level* : As evident from the SpO2 readings, a healthy individual typically maintains SpO2 levels above 95. During the test, the subject held their breath, resulting in a rapid decrease in SpO2 levels, which quickly rose back to above 95+ once the subject resumed breathing normally.

3. *Graph 3- GSR Value* : This parameter serves as an indicator of stress levels. During the observation, the subjects remained still initially, but as the conversation in the group progressed and the mood became more positive, the GSR values decreased noticeably.

VIII. Testing Details



This user interface of Blynk app displays heart rate, oxygen saturation, and GSR values in real time, providing up-to-date information.

Conclusion

In conclusion, this project represents an innovative approach to healthcare, utilizing cutting edge technology to develop a health monitoring system capable of continuously measuring important vital signs. The proposed system has the potential keep a track of vital signs by escaping the traditional tedious methods, thereby reducing the burden on healthcare workers. By providing real time monitoring of vital signs- SpO2, GSR and BPM, this system can help identify changes in a patient’s health status and provide timely interventions, potentially improving the effectiveness of medical treatments especially for elderly people. This project underscores the importance of using technology to address healthcare challenges and demonstrates the potential for technological advancements to improve the quality of care provided to patients.

Further Improvements

This is a very basic model that has the potential to serve as the foundation for developing a comprehensive automated health monitoring system. By incorporating additional sensors and machine learning algorithms, a highly intelligent and automated healthcare device can be developed. This advanced system can analyze data, identify potential health risks, and intervene in a timely manner. This would greatly reduce the burden on healthcare providers and significantly improve patient care.