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Blood Oxygen & Heart Rate BPM Checker using Node MCU

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A B S T R A C T

Healthcare is a fundamental aspect of life that we all consider to be an entitlement - it is our right to have access to healthcare whenever we need it. The recent advancements in the healthcare system have made it apparent that regular medical check-ups are necessary for maintaining good health. Nowadays, a pulse oximeter is an essential and life-saving medical device, especially in light of the COVID-19 pandemic, and it is advisable to have one at home. In this article, we will demonstrate how to build an IoT Pulse Oximeter using Node MCU and MAX30100. Building it ourselves will help us understand how a pulse oximeter works and the components required for its construction. Let's proceed with the instructions.

Keywords: Healthcare, entitlement, access, medical check-ups, pulse oximeter, life-saving, COVID-19 pandemic, IoT, Node MCU, MAX30100,

1. Introduction

In our daily This project can detect the value of blood oxygen and Heart rate the same time, any value lower than the set value will light up in red.

The pandemic of the new coronavirus ailment (COVID-19) started in Wuhan, China in 2019. In the early part of 2020, the COVID-19 disease had been identified in almost every country in the world . The World Health Organization (WHO) issued several technical guidelines to combat the novel coronavirus and also declared it a pandemic. Out of several medical data, the oxygen saturation level is the most common to understand the patient's conditions. Oxygen saturation sometimes called the "fifth vital sign" along with the heart rate, and breathing or respiratory rate of the human body is a parameter that shows how much oxygen is being carried in the blood in comparison to its full capacity. That is, it is a ratio in the percentage of oxygen-carrying hemoglobin to the no-oxygen-carrying hemoglobin in the blood. A person with a good physical condition must have oxygen saturation or SpO2 level of more than 95% . The value of SpO2 level less than 95% indicates that the patient may have any respiratory diseases viz. pneumonia or asthma or may have other systemic inflammatory or infectious disease . To detect such types of diseases at an early stage, a pulse oximeter is a useful device, which can distinguish between severe pneumonia and simple cold or slight infections.In the absence of the doctors, the patient cannot consult the doctors due to which emergency situation may also be created. The personal health monitoring of each individual is considered very important because of the rise in health problems in today's world. The increasing stressful lifestyle is taking a maximum toll on public health. With the ever-increasing queues at hospitals and an increasing number of patients, the doctor fees have sky-rocketed which is affecting especially those patients who cannot afford the fee or who are not suffering from major ailments but get to know so only after paying a hefty fee to the doctor.

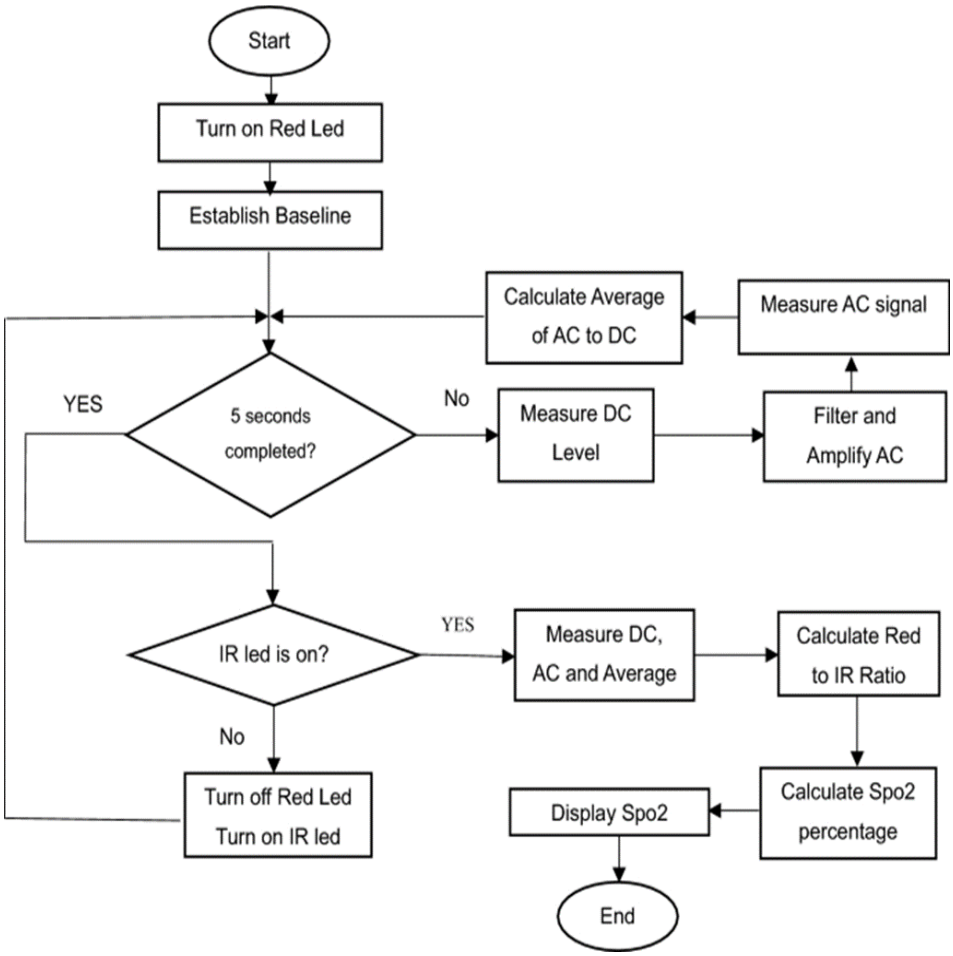
2. Motivation :

In today's fast-paced world, staying healthy and monitoring vital signs has become more important than ever. The ability to track our blood oxygen levels and heart rate with accuracy and convenience can provide invaluable insights into our overall well-being. By embarking on this project, you will not only enhance your technical skills but also contribute to the development of a device that can save lives and improve healthcare outcomes.Imagine the satisfaction of creating a portable and user-friendly Blood Oxygen & Heart Rate BPM Checker that can be easily used by individuals in the comfort of their own homes. With the ongoing COVID-19 pandemic and the challenges it has posed to accessing healthcare facilities, this project holds even greater significance. It empowers individuals to take charge of their health by regularly monitoring their blood oxygen levels and heart rate, providing early detection of potential issues and enabling timely intervention.By building this project, you will gain a deeper understanding of how pulse oximetry works, the intricate interplay between blood oxygen and heart rate, and the technology behind these vital measurements. Through the use of Node MCU and the MAX30100 sensor, you will explore the fascinating world of IoT and sensor technologies, learning how to integrate different components and retrieve data for analysis.Moreover, this project offers an opportunity to improve your problem-solving skills as you troubleshoot any challenges that may arise during the development process.

3. Design Methodology & Working :

1. Pulse Oximetry: Pulse oximetry is a non-invasive method used to measure the oxygen saturation level in the blood. It relies on the principle that oxygenated hemoglobin and deoxygenated hemoglobin absorb light differently. Several studies have investigated the accuracy and reliability of pulse oximeters, focusing on sensor design, signal processing techniques, and calibration methods.
2. Heart Rate Monitoring: Heart rate monitoring is crucial for assessing cardiovascular health and detecting abnormalities. Traditional methods include electrocardiography (ECG) and photoplethysmography (PPG). ECG measures the electrical activity of the heart, while PPG utilizes light absorption to detect blood volume changes in peripheral tissues. Various studies have explored different sensor technologies and algorithms for heart rate monitoring, aiming to improve accuracy and reduce measurement artifacts.
3. IoT and Sensor Technologies: The integration of IoT and sensor technologies in healthcare has revolutionized remote patient monitoring and personalized healthcare. Wireless connectivity and data transmission enable real-time monitoring and analysis, enhancing disease management and improving patient outcomes. Studies have explored the implementation of IoT-based systems for vital sign monitoring, including pulse oximetry and heart rate measurement, highlighting the benefits of remote monitoring and data-driven healthcare.
4. MAX30100 Sensor: The MAX30100 sensor is a commonly used sensor for pulse oximetry and heart rate monitoring projects. It combines red and infrared light sources with photodetectors to measure light absorption by blood. Many researchers have utilized the MAX30100 sensor for its compact size, low power consumption, and ease of integration with microcontrollers. Studies have investigated the accuracy, calibration methods, and signal processing techniques specific to the MAX30100 sensor.

4. Flow Chart:



5.Components Used :

1. MAX30100 Pulse Sensor Module
2. OLED Display

3. NodeMCU

6.Circuit Diagram :

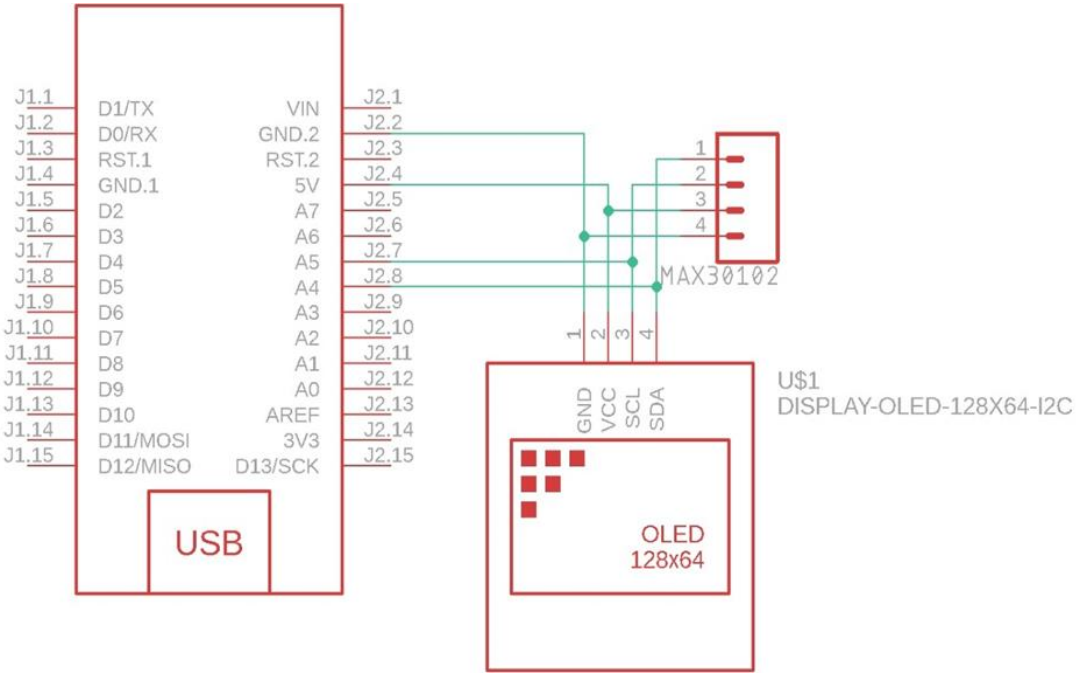


Fig.1 Circuit Diagram of Blood Oxygen & Heart rate BPM Checker

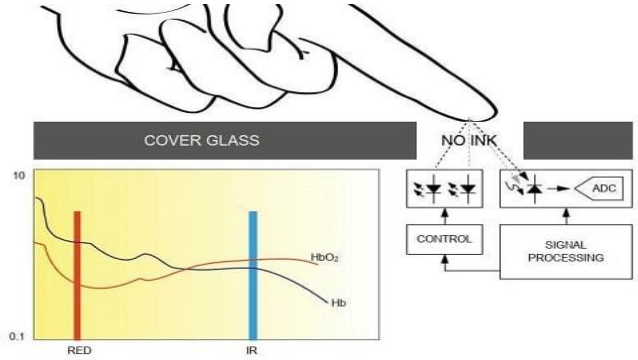


Fig.2 Pulse Oximetry working

7.Circuit Description:

The Blood Oxygen & Heart Rate BPM Checker Project utilizes a circuit design that incorporates the Node MCU microcontroller, the MAX30100 sensor, and other essential components to measure blood oxygen levels and heart rate accurately. Here is a detailed circuit description of the project:

- Node MCU (ESP8266) Microcontroller: The Node MCU serves as the central control unit for the project. It is based on the ESP8266 microcontroller and provides Wi-Fi connectivity, allowing for easy integration with IoT platforms. The Node MCU receives data from the MAX30100 sensor and processes it to calculate blood oxygen levels and heart rate.
- MAX30100 Sensor: The MAX30100 sensor is a key component in the project as it enables non-invasive measurement of blood oxygen levels and heart rate. It incorporates red and infrared LEDs and photodetectors to measure the absorption of light by blood. The sensor detects the changes in light absorption caused by pulsatile blood flow and converts them into electrical signals.
- LCD Display: An LCD display is utilized to provide real-time visual feedback of the measured blood oxygen levels and heart rate. The Node MCU communicates with the display to output the calculated values, allowing users to conveniently monitor their vital signs.

- Power Supply: The project requires a stable power supply to ensure proper functioning. A regulated power supply, typically 3.3V or 5V, is used to power the Node MCU, MAX30100 sensor, and LCD display. The power supply should be capable of providing sufficient current to all the components.
- Other Components: To ensure the smooth operation of the project, various additional components are incorporated, including resistors, capacitors, and connecting wires. These components are essential for signal conditioning, noise reduction, and proper interfacing between the microcontroller and sensor.

8.Circuit Operation:

The circuit operates as follows:

1. Power is supplied to the circuit, and the microcontroller (Node MCU) initializes.
2. The MAX30100 sensor is connected to the Node MCU via I2C communication protocol.
3. The Node MCU sends appropriate commands to the MAX30100 sensor to initiate blood oxygen and heart rate measurements.
4. The MAX30100 sensor emits red and infrared light, which passes through the fingertip or another suitable body part.
5. The photodetectors in the sensor detect the light absorbed by blood vessels, capturing the pulsatile changes in blood volume.
6. The MAX30100 sensor converts the detected light changes into electrical signals, which are transmitted to the Node MCU for further processing.
7. The Node MCU utilizes algorithms and signal processing techniques to calculate the blood oxygen levels and heart rate based on the received signals.
8. The calculated values are then displayed on the LCD screen in real-time, providing users with immediate feedback on their vital signs.
9. As soon as the switch is pressed the Lead Acid battery produces a 4v Direct Current (DC) Voltage. It is then passed to NPN transistor base is connected to the primary side of the transformer with a diode and resistor.
10. Here the NPN transistor acts as on/off switch which help to produce a pulsating ac voltage.
11. After which it passed through the Step-Up Transformer which steps-up the voltage from 4 volt to 15Kv.
12. If ever our user fails to aim at the correct target point, the switch of the stun gun pressed sends a signal to the GSM which is used to send emergency alert message and call to the preferred emergency numbers.

9.Hardware Implementation :

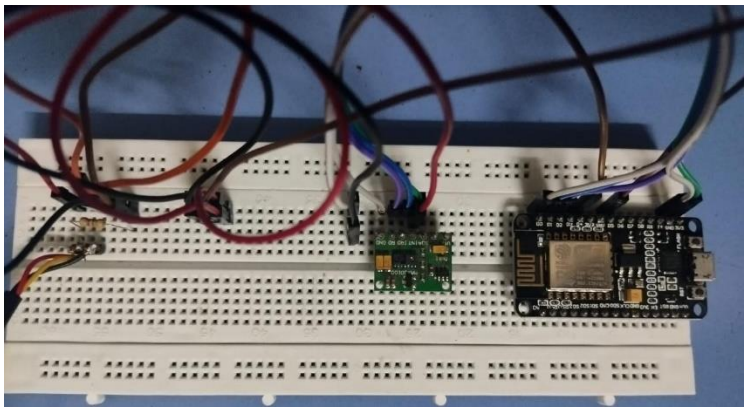


Fig.2 Structure of Blood Oxygen & Heart rate BPM Checker using NodeMCU}

10. Discussion :

The Blood Oxygen & Heart Rate BPM Checker Project is a significant undertaking that combines the fields of healthcare, technology, and IoT. In this discussion, we will explore the implications and potential impact of the project, as well as address some key considerations and challenges. The Blood Oxygen & Heart Rate BPM Checker Project represents a significant advancement in healthcare technology by combining the measurement of blood

oxygen levels and heart rate into a single portable device. This discussion will delve into the potential impact and implications of the project while addressing various considerations and challenges associated with its implementation.

One of the primary strengths of the Blood Oxygen & Heart Rate BPM Checker Project is its potential to enhance accessibility to vital sign monitoring. With a portable and user-friendly device, individuals can conveniently monitor their blood oxygen levels and heart rate in the comfort of their own homes. This accessibility promotes proactive and personalized healthcare, enabling early detection of potential health issues and facilitating timely medical intervention.

In the context of the ongoing COVID-19 pandemic, the project's ability to enable remote monitoring of vital signs takes on even greater significance. By reducing the need for frequent visits to healthcare facilities, individuals can minimize their exposure to infectious diseases and help alleviate the burden on healthcare systems. This aligns with the evolving landscape of healthcare, where remote monitoring and telemedicine are becoming increasingly prevalent.

The integration of IoT and sensor technologies in the Blood Oxygen & Heart Rate BPM Checker Project allows for real-time data collection and analysis. Continuous monitoring offers the potential for data-driven healthcare decisions and personalized interventions based on individual health trends. As technology continues to advance, future iterations of the project may incorporate features such as data storage, wireless connectivity, and integration with mobile applications, further enhancing its utility and effectiveness.

Ensuring the accuracy and reliability of measurements is paramount for meaningful health monitoring. While the MAX30100 sensor used in the project has shown effectiveness in various studies, calibration and proper signal processing techniques are essential for accurate readings. Addressing potential sources of error, such as motion artifacts and ambient light interference, is crucial to maintain measurement integrity and reliability.

User-friendliness and a positive user experience are crucial for widespread adoption of the Blood Oxygen & Heart Rate BPM Checker. Clear instructions and intuitive design are essential to ensure individuals can use the device effectively. Incorporating features such as user profiles, historical data tracking, and alarms can enhance usability and user engagement, making the monitoring experience seamless and empowering individuals to take charge of their health.

Ethical and privacy considerations must be carefully addressed in the development and deployment of healthcare technologies. Protecting the security and privacy of user data, especially when dealing with sensitive health information, is of utmost importance. Implementing robust data encryption, secure storage, and adherence to relevant privacy regulations are essential aspects that need to be prioritized throughout the project's lifecycle.

- **Accessibility and Personalized Healthcare**: One of the primary benefits of the Blood Oxygen & Heart Rate BPM Checker Project is its potential to enhance accessibility to vital sign monitoring. By providing individuals with a portable and user-friendly device, it empowers them to monitor their blood oxygen levels and heart rate conveniently in the comfort of their own homes. This accessibility promotes proactive and personalized healthcare, enabling early detection of potential health issues and facilitating timely medical intervention.
- **COVID-19 and Remote Healthcare**: The ongoing COVID-19 pandemic has highlighted the importance of remote healthcare and self-monitoring. With the Blood Oxygen & Heart Rate BPM Checker Project, individuals can monitor their vital signs without the need for frequent visits to healthcare facilities, reducing the risk of exposure to infectious diseases. This project aligns with the changing landscape of healthcare, where remote monitoring and telemedicine are becoming increasingly prevalent.
- **Technological Advancements**: The project utilizes IoT and sensor technologies to enable real-time data collection and analysis. This integration allows for continuous monitoring and the potential for data-driven healthcare decisions. As technology continues to advance, future iterations of the Blood Oxygen & Heart Rate BPM Checker may incorporate additional features such as data storage, wireless connectivity, and integration with mobile applications, further enhancing its utility and effectiveness.
- **Accuracy and Reliability**: Accurate and reliable measurement of blood oxygen levels and heart rate is critical for meaningful health monitoring. While the MAX30100 sensor used in the project has been proven effective in various studies, ensuring calibration and proper signal processing techniques are essential for accurate readings. Addressing potential sources of error, such as motion artifacts and ambient light interference, is crucial to maintain measurement integrity.
- **User-Friendliness and User Experience**: For the Blood Oxygen & Heart Rate BPM Checker Project to be widely adopted, user-friendliness and a positive user experience are key considerations. The device should be intuitive to use, with clear instructions and feedback provided through the LCD display. Additionally, the project may explore incorporating features such as user profiles, historical data tracking, and alarms to enhance usability and engagement.
- **Ethical and Privacy Considerations**: As with any healthcare-related technology, ethical and privacy concerns must be addressed. Ensuring the security and privacy of user data is paramount, especially when dealing with sensitive health information. Implementing robust data encryption, secure storage, and adherence to relevant privacy regulations are essential aspects of the project's development and deployment.

11.Conclusion :

The Blood Oxygen & Heart Rate BPM Checker Project utilizes a well-designed circuit that integrates the Node MCU microcontroller, MAX30100 sensor, and other essential components. This circuit enables the accurate measurement of blood oxygen levels and heart rate in a non-invasive manner. By

processing the sensor data and displaying the results on an LCD screen, users can conveniently monitor their vital signs and make informed decisions about their health. The Blood Oxygen & Heart Rate BPM Checker Project holds great promise in revolutionizing personal healthcare monitoring. By leveraging IoT, sensor technologies, and user-friendly design, this project empowers individuals to take control of their health, improve access to vital sign monitoring, and facilitate early detection of potential health issues. However, careful attention must be given to accuracy, user experience, and ethical considerations to maximize the project's impact and ensure its safe and effective use in diverse healthcare settings.

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