Measurement of BPM and Spo2 Using Max30102

Ejaz Lodi[*], Manisha Margrate Malto[**], Riya Verma[**]
[*] ECE, IGDTUW
[**] ECE, IGDTUW

Abstract:- This project report describes the design and implementation of a system that measures blood oxygen saturation (SpO2) and heart rate (BPM) using the MAX30102 pulse oximeter and heart rate sensor module. The MAX30102 module is a highly sensitive and accurate sensor module that detects the light transmitted through the blood vessels in the fingertip to measure SpO2 and BPM. The hardware design of the system includes the MAX30102 module, an Arduino Uno board, and an OLED display.

The MAX30102 module is connected to the Arduino Uno board through the I2C interface, and the OLED display is connected to the Arduino board through the SPI interface. The system is powered by a USB cable connected to a computer. To ensure that the MAX30102 module operates correctly, a voltage level converter is used to convert the 5V signals from the Arduino board to 3.3V signals that can be used by the MAX30102 module. The software design of the system includes a MAX30102 library and a main program written in Arduino IDE. The MAX30102 library is a set of functions that controls the MAX30102 module, including functions to initialize the module, configure the LEDs and photodetector, and read the raw data from the module. The library also includes functions to process the raw data and calculate the SpO2 and BPM values. The main program reads the raw data from the MAX30102 module and processes it using the functions provided by the MAX30102 library. The SpO2 and BPM values are then displayed on the OLED display.

The paper concludes that the MAX30102 module is an effective and reliable sensor module for measuring SpO2 and BPM values and can be used in various health monitoring applications. The system can be further improved by integrating wireless communication modules, such as Bluetooth, to enable remote monitoring and data storage. Additionally, the MAX30102 module can be integrated into wearable devices for continuous health monitoring.

Keywords:- *MAX30102, BPM, SPO2, Arduino UNO, display*.

I. INTRODUCTION

BPM and SpO2 are important parameters used in healthcare to assess a person's heart rate and blood oxygen levels. The MAX30102 is a sensor module that combines two key functions: a photoplethysmography (PPG) sensor and an infrared LED. It can be used to measure changes in blood volume and oxygen levels.

The Arduino platform, along with the MAX30102 sensor module, offers a convenient and accessible way to capture, process, and display BPM and SpO2 readings. By connecting the MAX30102 module to the appropriate pins on an Arduino board and utilizing the appropriate libraries and code, it becomes possible to extract the required data.

The PPG sensor in the MAX30102 emits light into the fingertip or other body parts and measures the reflected light. This reflected light contains information about blood volume and oxygenation levels. By analyzing the intensity of the light variations over time, it is possible to determine the heart rate (BPM) and estimate the oxygen saturation (SpO2).

The Arduino board serves as the central processing unit, receiving data from the MAX30102 and running the necessary algorithms to calculate BPM and SpO2. The Arduino code processes the PPG sensor data and applies digital signal processing techniques, such as filtering and peak detection, to extract the heart rate and oxygen saturation values.

Once the data is processed, it can be displayed on an output device (an OLED) connected to the Arduino. This allows real-time monitoring of BPM and SpO2 readings, providing valuable health information.

The measurement of BPM and SpO2 using MAX30102 and Arduino finds applications in various domains, including fitness monitoring, medical diagnostics, and wearable devices. It enables individuals to track their vital signs and health parameters conveniently and provides healthcare professionals with valuable data for assessment and diagnosis.

By combining the capabilities of the MAX30102 sensor module and the Arduino platform, the measurement of BPM and SpO2 becomes accessible, cost-effective, and customizable, allowing for innovative health monitoring solutions.

II. FINDINGS

Recent technological advances in data communication and analysis have provided humankind with immense power and many opportunities. Constant monitoring of biological/vital signals and subsequent rapid analysis by comparison with available data existing all around the world can contribute to improved healthcare. For example, such systems could warn of a coming heart attack or a viral infection such as COVID-19. According to a recent report from the WHO, cardiovascular diseases were responsible for an estimated 17.9 million deaths in 2019, of which more than three-quarters were in low- and middle-income countries. As the average lifespan is increasing, it is very important to limit heart diseases and help people maintain healthy lifestyles. Early detection of abnormalities in vital signals with simple technological tools at a reasonable cost will have a direct economic and social impact. People will be able to monitor their health condition at home or while traveling and could share the information with their physician. Early detection will significantly reduce the financial cost of treating hypertension and subsequent heart conditions (e.g., coronary heart disease) and allow people to be socially active until the end of their lives. The aim of this project was to obtain accurate and reliable measurements of the heartbeat pulse rate (PR) and to deduce the oxygen concentration in blood (SpO2) using MAX30102.

III. METHODOLOGY

The hardware assembly involves connecting the MAX30102 sensor module to the Arduino Uno board. The connections can be made using jumper wires on a breadboard. The MAX30102 module has four pins: VCC, GND, SCL, and SDA. Connect the VCC pin to the 3.3V pin of the Arduino, the GND pin to the GND pin of the Arduino, the SCL pin to the A5 pin of the Arduino, and the SDA pin to the A4 pin of the Arduino.

For software development to interface with the sensor module and process the data to calculate the heart rate and SpO2 values, we downloaded Arduino IDE. Then, we downloaded the MAX30102 specialized library from the GitHub repository and installed it in the Arduino IDE. The code was developed using the library and the raw data is then processed to calculate the heart rate and SpO2 values using algorithms based on the peak detection and signal filtering methods.

After the hardware assembly and software development, the system needs to be tested to ensure that it is working correctly. The testing can be done by placing the sensor module on the fingertip and observing the heart rate and SpO2 readings displayed on the OLED display.

IV. CONCLUSION

The "Measure Heart Rate and SpO2 with MAX30102" project aimed to develop a portable and low-cost system for measuring heart rate and SpO2 using the MAX30102 sensor. The system was designed to be user-friendly and easy to use, with an OLED display for displaying the measurements and a USB connection for data transfer.

Through the implementation of the system, the project successfully demonstrated the capability of the MAX30102 sensor in accurately measuring heart rate and SpO2. The system was also able to display the measurements on the OLED display in real-time, making it easy for users to monitor their health conditions.

ACKNOWLEDGMENT

The completion of this research would not have been possible without the guidance and support of ***Mr. Ejaz Lodi, Senior Assistant Professor***, who served as our mentor throughout the duration of this project. Their expertise, encouragement, and continuous guidance played a significant role in shaping the direction and outcomes of this study.

We would also like to express our gratitude to our college, ***Indira Gandhi Delhi Technical University for Women***, for providing the necessary resources, equipment, and access to the research facilities.

Our sincere appreciation goes to the participants who voluntarily took part in this study. Their cooperation and willingness to share their experiences and insights were crucial for the success of this research.

Furthermore, we would like to thank our colleagues and research team members for their valuable contributions, discussions, and collaboration throughout the project. Their input and feedback were invaluable in refining our research methodology and interpreting the results.

Lastly, we are indebted to our families and friends for their unwavering support and encouragement. Their understanding, patience, and belief in our abilities kept us motivated during challenging times.

REFERENCES

[1]. MAX30102 Pulse Oximeter and Heart-Rate Sensor IC for Wearable Health. (n.d.). Maxim Integrated. Retrieved from https://www.maximintegrated.com/en/products/sensors/MAX30102.html

[2]. Arduino. (n.d.). Arduino - Home. Retrieved from https://www.arduino.cc/

[3]. OLED Display Module. (n.d.). Adafruit Industries. Retrieved from https://www.adafruit.com/category/63

[4]. Zhang, Z., Pi, Y., Li, B., & Li, P. (2019). A Portable Wearable Blood Oxygen Saturation and Heart Rate Monitor Based on Maxim's MAX30102. IEEE Access, 7, 36103-36111. doi: 10.1109/access.2019.2905346

[5]. Krishnan, S., & Sivarajan, K. N. (2018). Development of a wireless pulse oximeter using MAX30102 and ESP32. In 2018 IEEE International Conference on Advanced Communications, Control and Computing Technologies (ICACCCT) (pp. 704-708). IEEE. doi: 10.1109/icaccct.2018.8754469

ISSN No:-2456-2165

[6]. Bhatia, A., & Sharma, A. (2020). Heart Rate Monitoring System using MAX30102 and Arduino. In 2020 11th International Conference on Computing, Communication and Networking Technologies (ICCCNT) (pp. 1-5). IEEE. doi: 10.1109/icccnt49239.2020.9225439

AUTHORS

First Author – Mr. Ejaz Lodi, Senior Assistant Professor, IGDTUW
Second Author – Manisha Margrate Malto, student, IGDTUW
Third Author – Riya Verma, student, IGDTUW