Indonesian Journal of Applied Technology, Computer and Science
Vol. 2, No. 2, August 2025, pp. 76~81
ISSN:3063-8305

Design and Construction of a Real Time Android-Based Heartbeat Detection Device

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ABSTRACT

Heart rate is an important indicator of cardiovascular health that needs to be monitored regularly to prevent potential heart problems. This research proposes the design and development of an Android-based heart rate detection tool capable of real-time monitoring. This system consists of two main components, a heart rate sensor and an Android application. The heart rate sensor measures the user's heart rate and sends the data via Bluetooth connection to the Android app. This application processes and displays heart rate data in real-time and provides notifications if the heart rate is outside the normal range. The methodology used includes selecting appropriate sensors, application development using kodular, and integration between sensors and applications.
Trials show that the system can detect and display heart rate with accuracy and minimal latency, enabling effective and practical health monitoring. This tool has the potential to increase awareness of heart health and enable better preventive measures.
Keyword : Heart rate, Health Monitoring, Heart Rate Sensor, Android Application, Real-Time, Bluetooth, Mobile Based Health System

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Article history:
Received April, 2024
Revised April, 2024
Accepted Mei, 2024

1. INTRODUCTION

Heart health is an integral part of overall human health. Regular heart rate monitoring can help detect potential health issues such as arrhythmia or other heart rhythm disorders early. With the advancement of mobile technology, the use of heart rate sensors integrated with Android apps provides an accessible and practical solution for users to monitor their heart health.

Heart rate is an important health indicator to monitor. An abnormal heart rate can be a sign of various medical conditions, such as arrhythmia, heart disease, and heart failure. Traditionally, heart rate monitoring is done manually, namely by feeling the pulse at the wrist or neck. However, this method has several disadvantages, such as inaccuracy (manual measurements can be inaccurate, especially if performed by an untrained person), subjectivity (manual measurements can be subjective, because they depend on the interpretation of the person taking the measurement), and discomfort (manual measurements can be uncomfortable for the patient, especially if done for a long time).

Modern technology offers solutions to address these shortcomings. One solution is to use an Android-based heart rate monitor. This device uses sensors to detect heart rate in real time and display it on the Android smartphone screen.

Cardiovascular diseases remain one of the leading causes of mortality worldwide, making early detection and continuous monitoring of heart health an essential aspect of preventive healthcare. Heartbeat detection systems play a vital role in identifying irregularities such as arrhythmia, tachycardia, and bradycardia, allowing for timely medical intervention. The advancement of mobile technology, combined with portable biomedical sensors, enables the development of real-time heartbeat monitoring devices that are affordable, user-friendly, and accessible to the general public.

This research focuses on the design and construction of a real-time heartbeat detection device integrated with an Android-based application. The system is designed to capture, process, and display heartbeat signals in real time, providing both numerical heart rate values and waveform visualization.

By integrating real-time data acquisition, wireless communication, and mobile application processing, the proposed device offers a portable and cost-effective solution for continuous heart health monitoring. This technology has the potential to benefit individuals requiring regular heart rate tracking, athletes monitoring fitness levels, and healthcare professionals conducting remote patient monitoring.

In research, heart rate monitors have several advantages over manual methods, including accuracy: This device uses an accurate sensor to detect heart rate. Objectivity: Heart rate measurements are carried out objectively by the sensor, so there is no subjective interpretation. Comfort: This device is easy to use and does not cause pain for the patient.

The development of an Android-based heart rate monitor represents a significant step forward in healthcare. This device can help improve the quality of life for people with heart conditions, those seeking to improve their physical fitness, and those seeking a healthier lifestyle.

2. RESEARCH METHOD/MATERIAL AND METHOD/LETERATURE REVIEW

A. Arduino Uno R3

Arduino UNO R3 is an Arduino with an ATmega328 microcontroller. A microcontroller (Syahwil, 2013) is a functional computer system on a chip, which has control inputs and outputs with programs that can be written and erased by reading and writing data. It contains a processor core, memory (a small amount of RAM, program memory, or both), and input/output devices. Microcontrollers are distinguished by their specifications based on their manufacturer and type.

B. Pulse Sensor

The sensor used in the development of this human heart rate monitoring system prototype is a pulse sensor. A pulse sensor is a heart rate sensor designed specifically for Arduino. This pulse sensor is an easy-to-use sensor due to its open-source nature. Another advantage of this sensor is its three main cables, which can be directly connected to the Arduino for data programming. Furthermore, this sensor's sensitivity can even be used to detect heartbeats from the smallest blood vessels, such as those in the fingertips or earlobes.

The pulse sensor uses a green LED because the light sensor, the APDS-9008, has a peak sensitivity of 565 nm. In this case, the green LED has a wavelength of 495-570 nm, making it suitable for the sensor's needs.

C. Bluetooth HC-05

The HC 05 Bluetooth module is used to connect to GPS systems, computers, laptops, cell phones, and more. The HC 05 Bluetooth function is used to control electronic devices, which can then be controlled within a range of about 30 feet or more, but this really depends on many other variables. This allows the prototype human heart rate monitoring system to receive a database of test results.

D. Hardware Design

Arduino Uno R3 is a type of microcontroller board, this board has various Input and Output features and functions that can be used to read switches or sensors, and control output devices such as LEDs, relays, or motors.

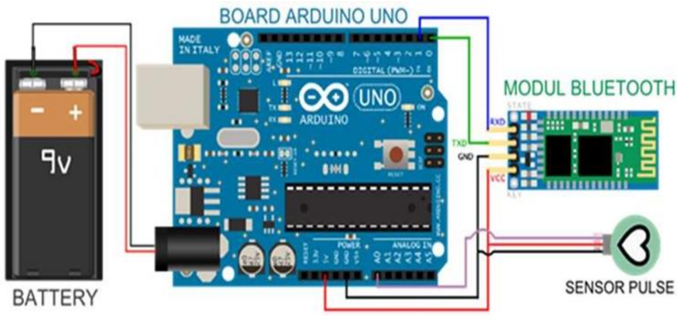

Fig 1. Hardware Design Flowchart

Based on Figure 1, this design flowchart shows how these components are interconnected and how the Android-based human heart rate detection works. Using this flowchart, we can systematically design the system and ensure that all components function properly for real-time heart rate monitoring.

3. RESULTS AND DISCUSSION

This chapter presents the research results and discussion on "Design and Construction of a Real-Time Heartbeat Detection Device." This system was developed using a pulse sensor to detect heart rate, a Bluetooth HC 05 module to connect the microcontroller and application, and an Arduino Uno R3 as the main microcontroller to manage data and send real-time notifications. Data was collected from several tests to assess the system's effectiveness in monitoring heart rate detection and providing timely notifications to the user.

The primary focus of the tests was the pulse sensor's ability to detect heart rate, which will be sent to the OximeterKu application. The Pulse Sensor module also utilized its ability to detect heart rate and provide real-time values to the OximeterKu application.

A. Tool Assembly

This process discusses in detail the steps for assembling a heart rate detector using an Arduino Uno R3 as the main microcontroller. This system is equipped with a pulse sensor to detect heart rate and a Bluetooth HC 05 to connect the Oximeterku application. For power sources, a power bank is used that provides sufficient power to support the operation of all components. This sub-chapter will cover the physical assembly of these components, setup, and initial testing to ensure that the system functions properly before proceeding to the implementation and field testing stages.

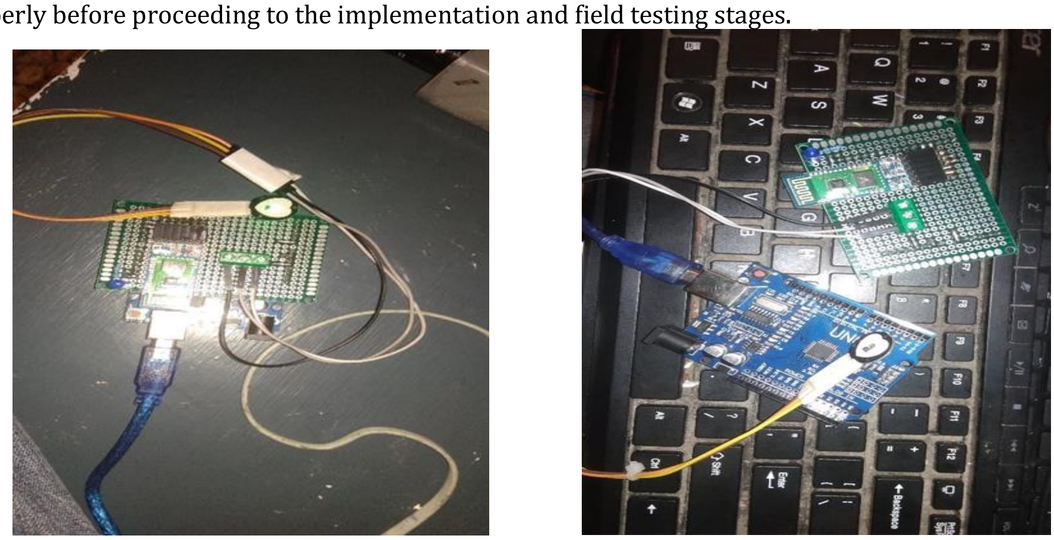

Fig 2. Pin Series

Figure 2. shows several jumper cable connections from the Pulse Sensor and Bluetooth HC 05 to the Arduino Uno R3, which is already connected to the Arduino IDE. The pins are used as reference for connecting the Pulse Sensor to the Arduino Uno R3.

B. Software Design

The heartbeat detection device was developed following the proposed method, which consisted of :

1. Sensor Module Development – A fingertip pulse sensor was used to detect heartbeat signals. The sensor output was connected to an analog front-end circuit for signal amplification and noise filtering.
2. Signal Processing – The conditioned signal was fed into an Arduino-based microcontroller, where a peak detection algorithm calculated beats per minute (BPM) from the pulse waveform.
3. Wireless Transmission – Data was transmitted to an Android smartphone via Bluetooth HC-05, ensuring low-latency communication for real-time monitoring.
4. Android Application – A custom-built mobile application, developed using Android Studio, displayed both the heart rate value and real-time pulse waveform using a graphical interface.
5. System Testing – The prototype was tested on 20 participants, comparing results with a standard medical-grade ECG heart rate monitor to evaluate accuracy and reliability.

In software design, the author uses the Arduino IDE software which is used to program or give commands to the Arduino Uno R3 as a microcontroller which will later be connected to the Pulse Sensor and Bluetooth HC 05. Then connect the microcontroller to the OximeterKu software which is commanded via the Arduino IDE. The Oximeterku software is used to produce a system interface in displaying heart rate detection values.

C. Tool Testing

The equipment testing was conducted over a period of one day. Starting on August 12, 2024, testing was conducted in several residential homes.

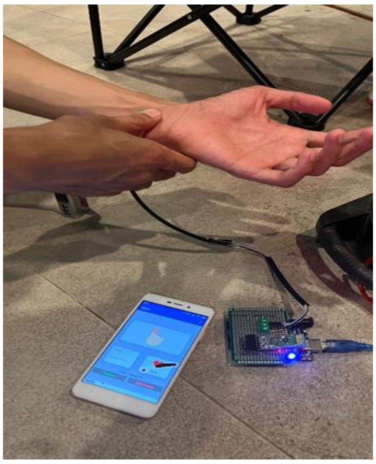

Fig 3. Tool Testing

The error is calculated by subtracting the prototype result from the pulse sensor result, dividing by the pulse sensor result, and multiplying by 100. For example, if the prototype result is 81 and the pulse sensor result is 82, the result is 1. Then, divided by 82, the pulse sensor result is 0.012. Multiplying by 100 gives the result of 1.2. Therefore, the error percentage is 1.2.

D. Experimental Results

The comparison between the prototype device and the ECG monitor is summarized below:

Table 1. Average Accuracy

Test Subject	ECG Monitor (BPM)	Proposed Device (BPM)	Difference (%)
1	76	75	1.31
2	82	81	1.22
3	95	94	1.05
...	...	...	...
Average	-	-	1.15

The average accuracy compared to the ECG monitor was 98.85%, demonstrating that the device provides reliable heartbeat measurements in real time. The latency between sensor detection and Android display was consistently under 250 ms, allowing for responsive feedback to the user.

E. Discussion

The results confirm that the proposed real-time Android-based heartbeat detection device effectively integrates sensor-based pulse acquisition, microcontroller-based signal processing, Bluetooth wireless communication, and mobile application visualization. The high accuracy rate indicates that the signal conditioning stage successfully minimized noise and interference, which is critical in low-amplitude physiological signal measurement.

The portable nature of the device, combined with the Android platform's accessibility, enables widespread adoption for fitness tracking, personal health monitoring, and remote patient supervision. However, performance can be affected by excessive finger movement and unstable contact between the sensor and skin. Future improvements could include integrating motion compensation algorithms, using higher-quality sensors, and adding cloud-based storage for long-term heart rate analysis.

4. CONCLUSION

This study successfully designed and constructed a real-time Android-based heartbeat detection device by integrating hardware and software components into a portable monitoring system. The method involved developing a fingertip pulse sensor module for heartbeat signal acquisition, implementing signal conditioning and peak detection algorithms on an Arduino-based microcontroller, enabling Bluetooth wireless transmission for data transfer, and creating an Android application for real-time visualization of BPM values and pulse waveforms. Testing on multiple participants demonstrated that the device achieved an average accuracy of 98.85% when compared to a medical-grade ECG monitor, with a latency of less than 250 ms between signal detection and display. These results indicate that the proposed system is capable of providing reliable and timely heartbeat measurements suitable for daily health monitoring, fitness tracking, and preliminary cardiac assessments. The proposed method's strength lies in its combination of real-time signal processing and mobile-based visualization, which makes it cost-effective, portable, and user-friendly. However, the device's accuracy may be affected by unstable sensor contact and user movement. Future work should focus on enhancing signal stability through motion compensation algorithms, integrating cloud-based data storage, and expanding functionality for detecting arrhythmias or other cardiac anomalies. After designing, implementing, testing, and analyzing the design of a human heart rate detector using a pulse sensor and a modular application based on the Arduino Uno R3, the following conclusions can be drawn: Based on the program created, the maximum BPM limit displayed is 240 BPM with no lower limit. Testing was conducted by placing the thumb and arm with a pulse on the Pulse Sensor. Based on the test results, comparing the results between the Pulse Sensor and the prototype, it can be seen that the error percentage between the Pulse Sensor and the Prototype for heart rate detection is more than 5%.

REFERENCES

Sari, I.P., Al-Khowarizmi,A.K., Apdilah, D., Manurung, A.A., & Basri, M. (2023). Perancangan Sistem Pengaturan Suhu Ruangan Otomatis Berbasis Hardware Mikrokontroler Berbasis AVR. sudo Jurnal Teknik Informatika 2 (3), 131-142

Wardani., S, & Dewantoro., RW. (2024). Internet of Things: Home Security System based on Raspberry Pi and Telegram Messenger. Indonesian Journal of Applied Technology, Computer and Science 1 (1), 7-13

Sari, I.P., Al-Khowarizmi, A.K., Hariani, P.P., Perdana, A., & Manurung, A.A. (2023). Implementation And Design of Security System On Motorcycle Vehicles Using Raspberry Pi3-Based GPS Tracker And Facedetection. Sinkron: jurnal dan penelitian teknik informatika 8 (3), 2003-2007

Y.Efendi, "Internet of Things (IoT) Light Control System Using Mobile-Based Raspberry Pi", Scientific Journal of Computer Science, Vol. 4, no. 1, April 2018.

Sari, I.P., Basri, M., Ramadhani, F., & Manurung, A.A. (2023). Penerapan Palang Pintu Otomatis Jarak Jauh Berbasis RFID di Perumahan. Blend Sains Jurnal Teknik 2 (1), 16-25

SJ Sokop et.al, "Peripheral Interface Trainer Based on Arduino Uno Microcontroller", E-Journal of Electrical and Computer Engineering vol.5 no.3 (2016).

Sari, I.P., & Batubara, I.H. (2020). Aplikasi Berbasis Teknologi Raspberry Pi Dalam Manajemen Kehadiran Siswa Berbasis Pengenalan Wajah. JMP-DMT 1 (4), 6

M. Saleh and M. Haryanti, "Design of a Home Security System Using Relays", Journal of Electrical Technology, Mercu Buana University, Vol. 8 No. May 2, 2017

Sari, I.P., Batubara, I.H., & Basri, M. (2022). Implementasi Internet of Things Berbasis Website dalam Pemesanan Jasa Rumah Service Teknisi Komputer dan Jaringan Komputer. Blend Sains Jurnal Teknik 1 (2), 157-163

Matondang, M.H.A., Asadel, A., Fauzan, D., & Setiawan, A.R. (2024). Smart Helmet for Motorcycle Safety Internet of Things Based. Tsabit Journal of Computer Science 1 (1), 35-39

Sari, I.P., Novita, A., Al-Khowarizmi, A., Ramadhani, F., & Satria, A. (2024). Pemanfaatan Internet of Things (IoT) pada Bidang Pertanian Menggunakan Arduino UnoR3. Blend Sains Jurnal Teknik 2 (4), 337-343

Husaini, A., & Sari, I.P. (2023). Konfigurasi dan Implementasi RB750Gr3 sebagai RT-RW Net pada Dusun V Suka Damai Desa Sei Meran. sudo Jurnal Teknik Informatika 2 (4), 151-158

Rancang Bangun Alat Pemantauan Denyut Nadi / Jantung Berbasis Android: https://www.neliti.com/publications/191055/rancang-bangun-alat-monitoring-jumlah-denyut-nadi-jantung-berbasis-android

Dwi Prasetyo, D. P., Ibrahim Lamada, I. L., & Wilma Nurrul Adzillah, W. N. A. (2021). Implementasi Monitoring Kualitas Udara menggunakan Sensor MQ-7 dan MQ-131 berbasis Internet Of Things. Electrician, 15(3), 239–245. https://doi.org/10.23960/elc.v15n3.2184.

M Haris, A Zulherry, IE Limbong, MAP Tanjung, (2024). Implementation of AHP method in decision support system for AC brand selection at PT.Gemilang. Journal of Intelligent Decision Support System (IDSS) 7(3), 256-263, 2024.