

# Design of a Heart Rate Monitoring Application Based on Internet of Things (IoT) Technology with WhatsApp Blast

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## ARTICLE HISTORY

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## ABSTRACT

The highest death rate based on data from WHO (World Health Organization) is due to heart-related diseases. In 2015, more than 17 million people in the world died from heart disease and blood vessel disorders. About 75% of deaths from heart disease occur in developing countries with low to moderate income. Based on SRS (sample registration system) data in 2014, heart disease was the highest cause in Indonesia, namely 12.9%. With IoT (Internet of Things) technology, it can make it easier to provide information to survivors, namely carrying out early heart detection if there are several anomalies that occur in the human body, especially heartbeats that do not comply with the provisions. Utilizing the Max30102 sensor in collaboration with several other IoT devices can be integrated with a web-based system which is used for monitoring based on incoming data from IoT devices. This system is capable of recording heart data in humans in real time by providing notifications to heart survivors via WhatsApp blasting technology.

## 1. Introduction

The heart is a vital organ in humans whose function is to pump blood to all parts of the body through the blood vessels. Because this is a vital tool possessed by humans, there are many cases of decline in health and even death due to disruption of the human heart system. The rate of cardiac death has reached 75% in developing countries based on data that affects people from low to middle classes [1]. Meanwhile, 85% of deaths in the world are caused by strokes and heart attacks, affecting men over 45 years of age and women over 50 years of age. [2].

Internet of Things (IoT) technology can certainly be collaborated with several other technologies such as artificial intelligence technology [3], because IoT is a non-human device but the device can be built based on real life whose task can replace humans. AI sensors allow the use of IoT to be controlled with commands or controlling tools, for example for commands using human body movements. Internet of Things or also known as the abbreviation IoT, is a concept that aims to expand the benefits of continuously connected internet connectivity which allows us to connect machines[4], equipment and other physical objects with network sensors and actuators to obtain data and manage their own performance, thus enabling machines to collaborate and even act on new information obtained independently[5]. When Covid19

occurred in 2020, we became more innovative and more productive in carrying out projects using IoT technology to create smart home products, namely by creating fire detectors in homes when the occupants were isolated and quarantined because they were Covid19 survivors [6]. Apart from that, IoT is often used by governments in both cities and districts for monitoring, because IoT support for smart cities plays a very big role in supporting the city. [7].

The existence of the internet of things (IoT) in the industrial revolution 4.0 era needs to be developed to simplify health services, so that they become more efficient in monitoring patients' health conditions remotely. IoT is a system of interconnected computing devices, between mechanical and digital machines, objects, animals/people that are given unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. In implementing IoT-based applications, the data collected is a person's health data which is included in the realm of privacy, for this reason it is necessary to pay close attention to the IoT security system as well as the protection and legal remedies that patients can take in seeking justice if the data recorded in the IoT system is leaked and misuse occurs [8].

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continuously connected internet connectivity which allows us to connect machines, equipment and other physical objects with network sensors and actuators to obtain data and manage their own performance, thus enabling machines to collaborate and even act on new information obtained independently[5]. When Covid19 occurred in 2020, we became more innovative and more productive in carrying out projects using IoT technology to create smart home products, namely by creating fire detectors in homes when the occupants were isolated and quarantined because they were Covid19 survivors [6]. Apart from that, IoT is often used by governments in both cities and districts for monitoring, because IoT support for smart cities has a very large role in supporting the city. [7].

Technological collaboration between IoT and the web is closely related, in this case controlling devices used remotely by utilizing website technology which uses a web server with HTML, PHP and JavaScript languages. The web server on web hosting allows it to be accessed on computers or smartphones [9] where the data obtained from the MAX30102 sensor will be sent via a website page designed in the form of heart data by detecting wavelengths. MAX30102 consists of a pair of LEDs and a photodetector, each of which has a wavelength of 660 nm for red and 880 nm for infrared. The MAX30102 works by shining an LED on a finger and measuring the amount of light reflected using a photodetector [10]. The photodetector on the MAX30102 sensor connected to an amplifier is used to detect blood vessel pulses that occur during a heartbeat. The photodetector captures the light emitted by the blood vessels exposed to the sensor and then converts it into an electrical signal. This method of detecting pulses through light is often called a photoplethysmogram. In the context of personal health, heart rate monitoring is becoming increasingly relevant. The main focus of this research is to utilize Internet of Things (IoT) technology to monitor heart rate automatically using a microcontroller. Thus, this research makes a positive contribution to real-time personal health monitoring by using WhatsApp Blast because later several users will receive data from WhatsApp. [11].

## 2. Method

The method used in this research is to use the prototyping method which starts from gathering requirements, involving system developers and users to determine the goals, functions and operational needs of the system[12].

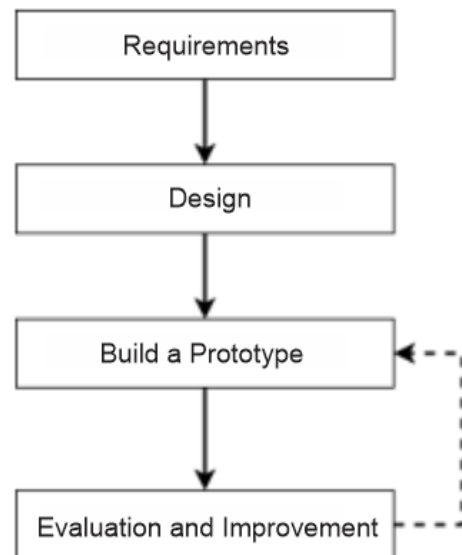


Figure 1. Steps Prototyping Method

### 2.1 Requirements

The first step is to gather user and system requirements. This includes identification of key issues in heart rate monitoring, technical specifications such as heart rate sensors and microcontrollers, as well as integration of the WA Blast notification service. These needs form the basis for prototype design and development [13].

### 2.2 Design

Design focuses on representing aspects of the software from the user's perspective, including input, process and output format. Rapid design leads to the development of a prototype, the prototype is evaluated by users and design analysts and used to adapt the needs of the software to be developed. At this stage, thinking and designing systems and tools for implementing the Internet of Things system using the web with the Nodemcu microcontroller are carried out. Using system modeling tools with unified modeling language (UML), namely Use Case Diagrams and Flowcharts. At this stage, the design of the physical form of the circuit and the design of the web are also carried out.

### 2.3 Build a Prototype

The prototype is then built based on the design that has been created. It involves hardware implementation and software development to read, process, and send heartbeat data to an IoT platform. WA Blast integration is carried out for sending automatic and manual notifications via WhatsApp, as well as creating a web-based monitoring dashboard.

### 2.4 Evaluation and Improvement

After the four data prototyping steps have been carried out, the next step is the actual creation or design of the product. This stage is the implementation of a

system that is ready to operate and then there is a process of mentoring and learning regarding the new or developed system and can also be compared with the old system, evaluations are still made in terms of technical and operational systems as well as interactions between system users.

In general, the prototyping method in developing an IoT-based heart rate health monitoring system with WA Blast has proven to be effective. The requirements gathering stage identifies technical specifications such as heart rate sensors and WA Blast notification services. Rapid system design enables coordinated hardware and software integration, with an intuitive user interface for monitoring dashboards. Building the prototype involved hardware implementation, software development, and WA Blast service integration. Prototype evaluation ensures the system is tested and refined according to user feedback, maintaining system functionality and responsiveness in effective heart rate health monitoring.

### 3. Result and Discussion

#### 3.1 Analysis

The process of analyzing and designing a heart rate health monitoring system based on Internet of Things (IoT) technology with WA Blast integration as a method for sending notifications. Considering the importance of real-time health monitoring in providing a quick response to critical conditions, this system is designed to monitor the user's heart rate and send alerts automatically via WhatsApp.

This research uses a prototype because this method allows system development through repeated iterations, where each iteration refers to user needs and feedback obtained during the development process. The stages in the prototype method include identifying needs, system design, prototype development, evaluation and improvement to produce a system that meets user needs.

The prototype of a heart rate monitoring device using Arduino or NodeMCU is an innovation that utilizes microcontroller technology to monitor and record a person's heart rate in real-time. This prototype is designed to measure heart rate using special sensors such as the Pulse Sensor or MAX30102, which detects blood pulses through the pulse. The data obtained from the sensor is then processed by a microcontroller (Arduino or NodeMCU) to produce information in the form of BPM (beats per minute) [14].

The normal resting heart rate for babies is 100 to 180 BPM, for toddlers 100 to 130 BPM, for children 80 to 100 BPM, and for teenagers it is 60 to 100 BPM. BPM is a unit for measuring heart rate in one minute. Other research shows that heart rate tends to decrease with age [15].

Table 1. Heart Rate per minute by Age

Age	Min (bpm)	Max (bpm)	Average
New Born	100	180	140
1 month until 1 year	80	160	120
1 year until 3 year	80	130	105
3 year until 6 year	80	120	100
6 year until 12 year	65	100	83
12 year until 19 year	60	90	85
More than 19 year	60	100	80

#### 3.2 Requirements

System requirements analysis is carried out to determine the specifications of the application requirements to be built. At this stage we will discuss the hardware and software used in implementing Heart Rate Health Monitoring Based on Internet of Things (IoT) Technology with WhatsApp Blast.

Table 2. Software Requirements

No	Software	Information
1.	Arduino IDE	Code Building for mikrokontroller NodeMCU 8266
2.	Visual Studio Code	Code Develop for Heart Rate Control and health parameter
3.	Xampp	Software integration between Apache HTTP Server, MySQL database, PHP, and Perl.

#### 3.3 Design

The design process in this research uses use cases because the system used is web-based where there are several actors involved in the system including nurses, patients, and several devices connected to the system such as the use of the WhatsApp API for blasting messages and also IoT devices that provide data.

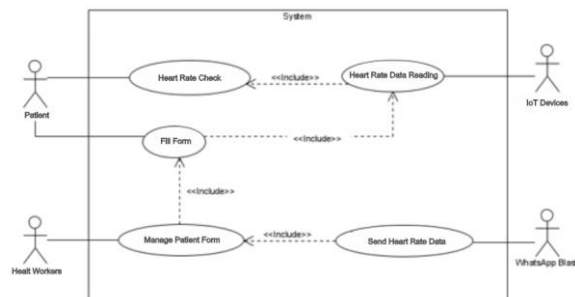


Figure 2. Use case Diagram Heart Rate Monitoring

#### 3.4 Build Prototype

The process of building a prototype is to describe the scheme of how the system works from start to finish as follows:

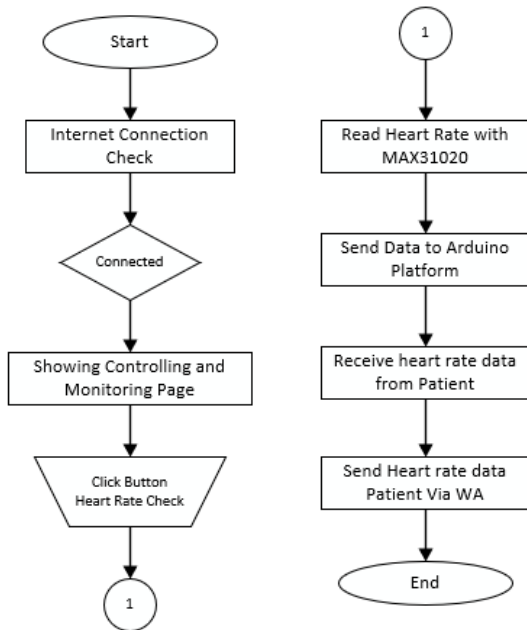


Figure 3. Flow Diagram Heart Rate Monitoring

Heart rate health monitoring system based on Internet of Things (IoT) technology with WA Blast integration. Starting with system initialization and opening the monitoring dashboard, the heart rate sensor reads data which is then processed by the microcontroller and sent to the IoT platform. IoT platforms analyze data to detect anomalies or critical conditions. If an anomaly is found, an automatic notification is sent via WA Blast. Users also have the option to send manual notifications via the dashboard. All data is displayed in real-time and logged for further analysis before the system is shut down.

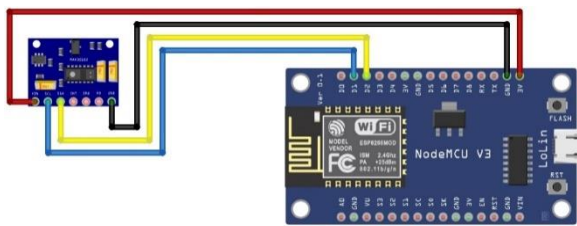


Figure 4. Device Setting for NodeMCU and MAX31020

The cable connection between NodeMCU 8266 and MAX31020/Oximeter sensor. The VCC cable from the sensor is connected to the 3.3V pin of the NodeMCU, the GND cable is connected to the GND pin of the NodeMCU, the SDA cable is connected to pin D2 of the NodeMCU, and the SCL cable is connected to pin D1 of the NodeMCU. This connection allows the NodeMCU 8266 to communicate with the MAX31020/Oximeter sensor and read heart rate and blood oxygen level data.

Table 2. Connection Configuration MAX31020 and NodeMCU

MAX31020 PIN	NodeMCU PIN	Cable Collor
VCC	3,3 V	Red
GND	GND	Black
SDA	D2	Yellow
SCL	D1	Blue

### 3.5 Software Design

Software design includes developing code and algorithms that will be uploaded to the microcontroller, as well as developing an IoT platform and application for sending WA Blast notifications.

#### 3.5.1 Login Page

Shows the login page interface for a heart rate health monitoring system based on IoT technology with WA Blast. This page has two main parts: on the left there is a placeholder for an image or logo, and on the right there is a login form with input fields for username and password, as well as a "Login" button.

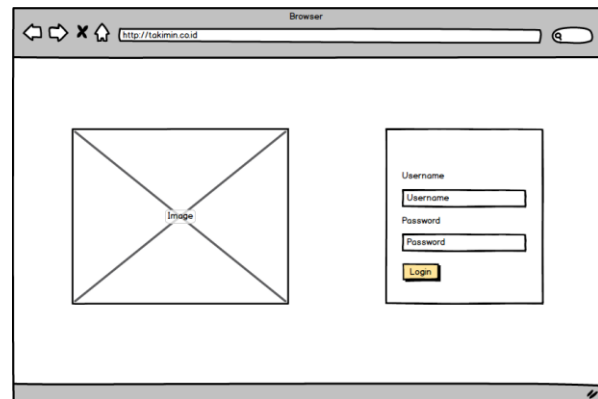


Figure 5. Login Page

#### 3.5.2 Dashboard

On the IoT-based heart rate health monitoring dashboard page which is integrated with WA Blast. This dashboard shows real-time computer usage information and user heart rate. The computer usage graph shows usage time, while the heart rate information displays the current heart rate, monitoring status, and healthy heart rate range.

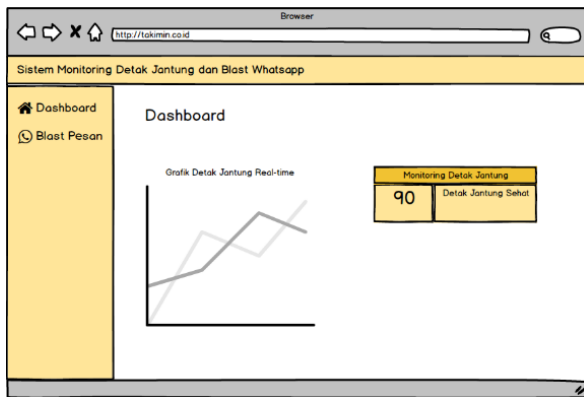


Figure 6. Dashboard Page for Heart Rate Monitoring

### 3.5.3 WhatsApp Blast

On this page is a system that allows users to monitor their heart rate in real-time through a dashboard that displays graphs and heart rate information. The WA Blast feature allows sending mass messages regarding users' heart health conditions.

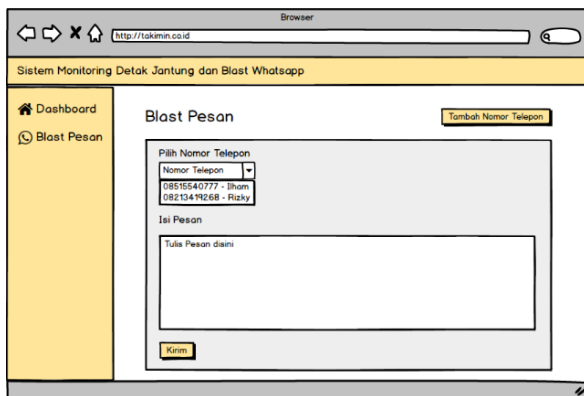


Figure 7. WhatsApp Blast Dashboard

### 3.5.4 Add Phone Number for WhatsApp Blast

The "Add Telephone Number" feature in the IoT-based heart health monitoring system with WA Blast allows users to enter the telephone number of another person who wants to receive heart health information. Users can add phone numbers one by one. Once the

phone number is entered, users can write messages they want sent to them related to heart health conditions.

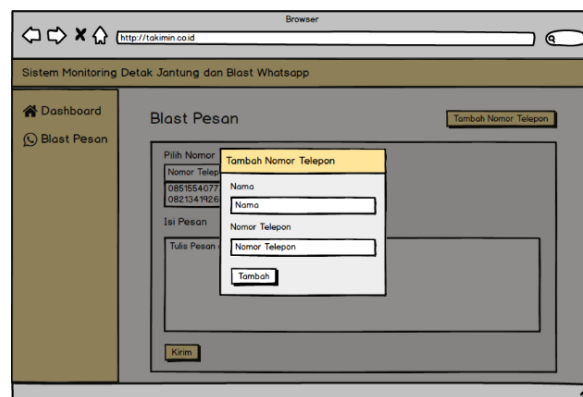


Figure 8. Add WhatsApp Blast Number

### 3.5.5 Patient Form Page

The patient form page displays the user interface of a web-based heart rate monitoring system equipped with the WhatsApp Blast feature. In this display, there is a form that patients must fill in with their personal information, including name, address, date of birth, and telephone number. This form is designed to help patients get more information about their heart rate condition. After this form data is filled in and sent by pressing the "Submit" button, the information will be forwarded to employees in the health sector. Healthcare workers can then monitor and analyze patient heart rate data more effectively and provide necessary information or actions through this system.

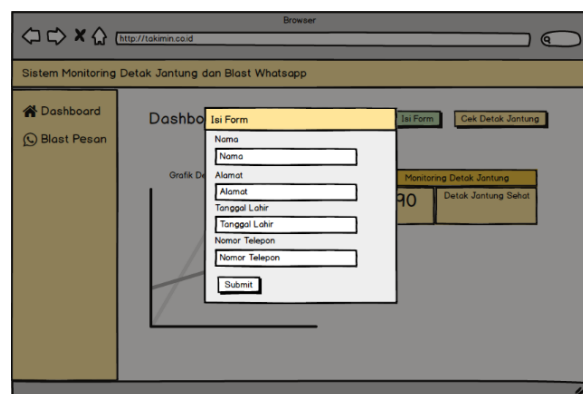


Figure 9. Patient Form Page

### 3.6 Evaluation and Improvement

The purpose of the test is to ensure that the heart rate health monitoring system based on Internet of Things (IoT) technology with WA Blast can function properly and in accordance with the planned specifications. Testing is carried out by providing variations in the input and observing the output in the circuit block being tested. Apart from that, this test will also measure the level of accuracy of each component in the system. The results of this test will be reference data in drawing conclusions regarding system performance and reliability. The system implementation stage is carried out after the system

design has been completed and of course the design is in accordance with the results of the analysis, then the system implementation is made by referring to the initial design so that the results are in accordance with needs.

#### 4. Conclusion

Heart rate health monitoring system based on Internet of Things (IoT) technology with WA Blast integration. Starting with system initialization and opening the monitoring dashboard, the heart rate sensor reads data which is then processed by the microcontroller and sent to the IoT platform based on data obtained via the MAX30102 sensor integrated via nodeMCU. IoT platforms analyze data to detect anomalies or critical conditions. If an anomaly is found, an automatic notification is sent via WA Blast which has previously been configured via the website created. Users also have the option to send manual notifications via the dashboard. All data is displayed in real-time and logged for further analysis before the system is shut down.

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