POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

BLOOD PRESSURE IOT MONITORING

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(08DEU22F1006)

ELECTRICAL ENGINEERING DEPARTMENT

SESI I 2024/2025

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This final report is submitted to the Electrical Engineering Department in fulfilment of the requirements for the award of the Diploma in Electronic Engineering (Medical)

ELECTRICAL ENGINEERING DEPARTMENT

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DECLARATION OF PROJECT REPORT AND COPYRIGHT

BLOOD PRESSURE IOT MONITORING

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Before me,)

NOR KHARUL AINA BINTI MAT DIN)

(As a project supervisor at (date): …25.11.2024….)

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NOR KHARUL AINA BINTI MAT DIN

ACKNOWLEDGEMENT

In preparing this project I have encountered and learnt so many new experiences. I would like to thank my supervisor, NOR KHARUL AINA BINTI MAT DIN for his excellent advice, guidance and motivation. I am also very thankful to my classmate, friends and other people that contributed to my project. Without their contribution, I won't be able to finish my project on time.

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ABSTRAK

Projek ini memberi tumpuan kepada pembangunan sistem pemantauan tekanan darah berasaskan IoT. Matlamat utama adalah untuk membolehkan pengumpulan data kesihatan masa nyata dan pengurusan penjagaan kesihatan jauh. Sistem ini direka bentuk untuk mudah alih dan mesra pengguna, membolehkan individu memantau tekanan darah mereka dengan kerap di rumah. Dengan menggunakan teknologi komunikasi tanpa wayar seperti Wi-Fi atau Bluetooth, peranti memindahkan data ke platform berasaskan awan dengan lancar. Infrastruktur awan ini memudahkan analisis data, pengenalpastian trend dan campur tangan tepat pada masanya oleh penyedia penjagaan kesihatan. Pendekatan inovatif ini bukan sahaja memberi kuasa kepada individu untuk mengawal kesihatan mereka tetapi juga menyumbang kepada kemajuan teleperubatan, membolehkan pemantauan pesakit jauh dan meningkatkan hasil penjagaan kesihatan secara keseluruhan.

ABSTRACT

This project focuses on the development of an IoT-based blood pressure monitoring system. The primary goal is to enable real-time health data collection and remote healthcare management. The system is designed to be portable and user-friendly, allowing individuals to monitor their blood pressure regularly at home. By utilizing wireless communication technologies like Wi-Fi or Bluetooth, the device seamlessly transfers data to a cloud-based platform. This cloud infrastructure facilitates data analysis, trend identification, and timely intervention by healthcare providers. This innovative approach not only empowers individuals to take control of their health but also contributes to the advancement of telemedicine, enabling remote patient monitoring and improving overall healthcare outcomes.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

The Blood Pressure IoT Monitoring system revolutionizes healthcare by seamlessly integrating cutting-edge IoT technology with advanced blood pressure monitoring capabilities. This innovative solution provides real-time tracking and comprehensive analysis of blood pressure levels, delivering invaluable insights into cardiovascular health for both users and healthcare professionals. By harnessing the power of connected devices and sophisticated cloud-based platforms, individuals can effortlessly monitor their blood pressure anytime and anywhere, enabling proactive management and early intervention for hypertension-related complications.

Key features include personalized alerts for abnormal readings, which ensure timely responses to potential health issues, and data-driven recommendations that guide users toward healthier lifestyle choices. The system's user-friendly interface and continuous monitoring capabilities empower individuals to take control of their health, fostering a proactive approach to cardiovascular wellness. Furthermore, the seamless sharing of health data with healthcare providers facilitates collaborative care, enhancing patient outcomes through informed decision-making and personalized treatment plans.

The Blood Pressure IoT Monitoring system not only enhances personal health management but also contributes significantly to the broader healthcare ecosystem by promoting preventive care and reducing the burden on healthcare facilities. By integrating technology and healthcare, this system exemplifies the future of medical monitoring and patient care, driving forward a new era of digital health management.

1.2 Project Background

The Blood Pressure IoT Monitoring project builds on recent advancements in healthcare technology that aim to improve the accuracy, accessibility, and convenience of blood pressure monitoring. Traditional methods, which rely on occasional readings during medical visits, often fail to provide a comprehensive view of a patient's cardiovascular health. This project leverages the Internet of Things (IoT) to enable continuous, real-time monitoring of blood pressure, facilitating early detection and proactive management of hypertension. By integrating a blood pressure sensor with a microcontroller like Arduino UNO and employing wireless communication modules such as ESP8266 or NodeMCU, the system can transmit data to cloud platforms for storage and analysis. This approach not only enhances patient engagement and compliance but also provides healthcare professionals with valuable insights through remote access to historical data, ultimately improving patient outcomes and reducing the burden on healthcare facilities.

1.3 Problem Statement

Intermittent Monitoring in Traditional Methods: Traditional blood pressure monitoring methods depend heavily on periodic measurements taken during medical appointments. This approach results in significant gaps in continuous monitoring, making it challenging to capture and manage fluctuations in blood pressure that occur throughout the day. Consequently, these intermittent readings may not provide an accurate picture of an individual's cardiovascular health, potentially overlooking critical trends and variations that are essential for effective diagnosis and treatment.

Inconvenience and Non-Compliance: Regular visits to healthcare facilities for blood pressure checks can be burdensome, especially for elderly individuals or those with mobility issues. The inconvenience associated with frequent trips to clinics or hospitals often leads to non-compliance with recommended monitoring schedules. As a result, many individuals fail to track their blood pressure consistently, increasing the risk of undetected hypertension and related complications.
Limited Accessibility to Historical Data: Both patients and healthcare providers face challenges in accessing comprehensive historical blood pressure data. Typically, such

data is stored within healthcare centers, making it difficult to maintain and retrieve systematically. This limited accessibility hinders the ability to monitor long-term health trends and make informed decisions based on an individual's complete medical history. Without easy access to historical data, managing and adjusting treatment plans becomes less efficient and effective.

1.4 Project Objective

The main objective of Blood Pressure IoT Monitoring This project is to design a project that can help in medical technology and help in learning about medical technology that can be improved to help the community and medical officers in dealing with patients.

More specifically the principle objective of this research are:

1. To study blood pressure in healthcare monitoring

    - This involves a comprehensive analysis of how blood pressure is monitored within the healthcare sector, including the importance of regular monitoring for diagnosing and managing conditions such as hypertension. The study will cover current methodologies, challenges, and the benefits of continuous monitoring for improving patient outcomes.

2. To design a blood pressure monitoring system attached to IoT

    - This objective focuses on developing an innovative system that integrates blood pressure sensors with IoT technology. The system will include wearable devices that measure blood pressure, transmit data wirelessly to a cloud-based platform, and enable real-time monitoring. The design will prioritize accuracy, reliability, and ease of use, ensuring that the devices can be worn comfortably for extended periods.

3. To record data for self-monitoring and trace the record of previous BP data

    - This objective aims to create a robust data management system that allows patients and healthcare providers to access historical blood pressure readings easily. The system will facilitate self-monitoring by providing users with immediate feedback on their blood pressure trends, enabling proactive management of their health. It will also support long-term tracking of blood.

1.5 Project Scope

This project is expected to be used for pre-hypertensive patients to record data & present to Doctors. Through this project, recorded data can be stored more securely and easily accessed when needed for retreatment. The scope of the Blood Pressure IoT Monitoring project encompasses the design and implementation of a comprehensive system for continuous, remote monitoring of patients' blood pressure levels. This system integrates wearable blood pressure sensors with IoT technology to facilitate real-time data collection, transmission, and analysis. Key constraints include ensuring the accuracy and reliability of the sensors, maintaining patient data privacy and security, achieving seamless connectivity in diverse environments, and designing a user-friendly interface for both patients and healthcare providers. Additionally, the system must comply with relevant medical regulations and standards, and it should be scalable to support a large number of users efficiently.

1.6 Problem Significance

The Blood Pressure IoT Monitoring project holds significant importance in modern healthcare by enabling continuous, real-time monitoring of blood pressure outside traditional clinical settings. This technology addresses the limitations of intermittent measurements during medical visits, providing a comprehensive view of an individual's cardiovascular health. It empowers patients, especially those who are elderly or have mobility issues, to easily monitor their blood pressure at home,

enhancing compliance and convenience. The system's ability to send data directly to healthcare providers facilitates timely interventions and personalized care, ultimately improving health outcomes and reducing the risk of complications related to hypertension. Additionally, by leveraging IoT technology, the project contributes to the advancement of telemedicine and remote healthcare solutions, making healthcare more accessible and efficient.

1.7 Definition of Term or Operation

Operational definitions are essential in research to ensure consistency and reliability in data collection. In the context of blood pressure IoT monitoring, these definitions clarify the specific meaning and measurement techniques used for key terms.

For instance, "blood pressure" is defined as the force exerted by the blood against the walls of the arteries. It is typically measured in millimeters of mercury (mmHg) and consists of two components: systolic blood pressure (the pressure when the heart contracts) and diastolic blood pressure (the pressure when the heart relaxes). The operational definition would specify the type of blood pressure monitor used, the positioning of the patient, and the number of readings taken to obtain an average measurement.

Similarly, "IoT" (Internet of Things) refers to the network of interconnected devices that collect and exchange data. In this project, the IoT component involves the use of sensors, microcontrollers, and wireless communication technologies to transmit blood pressure data to a remote server or mobile app. The operational definition would outline the specific devices used, the protocols for data transmission, and the security measures implemented to protect patient privacy.

By clearly defining these terms and the methods used to collect and analyze data, researchers can ensure the validity and reproducibility of their findings.

1.8 Summary

In this chapter, we explored the comprehensive framework and necessary resources for developing an IoT-based blood pressure monitoring system. The project leverages advanced technologies to enable continuous and remote health monitoring, addressing the limitations of traditional sporadic measurement methods. Key components include the Arduino UNO microcontroller, BP sensor, LCD display, ESP8266/NodeMCU for connectivity, and additional elements like buzzers and adapters. We also discussed the importance of a PCB making facility, essential hand tools, and circuit simulation software to ensure accurate and reliable circuit design and assembly. The integration of these resources facilitates the creation of a user-friendly and efficient system that allows real-time blood pressure tracking and proactive healthcare management. This chapter sets the foundation for understanding the technical and practical aspects involved in realizing an effective IoT-enabled blood pressure monitoring solution.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The literature review delves into the realm of IoT-based blood pressure monitoring systems, showcasing the advancements and innovations in remote health monitoring technologies. Norlezah Hashim et al. present the development of an IoT blood pressure monitoring system (IBPMS) utilizing Raspberry Pi as a gateway, allowing remote monitoring of blood pressure readings. M.S. Norsuriati et al. propose a cuffless blood pressure measurement system based on pulse transit time (PTT), offering a non-invasive and comfortable alternative to traditional cuff-based methods. Guruh Eko Saputro et al. contribute by designing an IoT-based blood pressure and body temperature monitoring device, achieving high accuracy rates and enabling comprehensive health tracking. Bharat Singh et al. introduce a wireless blood pressure monitoring system, facilitating easy integration of heterogeneous sensors and offering online monitoring for enhanced diagnosis and efficiency. Lastly, Kusvihawan Muhammad Shihab et al. discuss the design and implementation of IoT-based blood pressure monitoring tools, highlighting the potential for ubiquitous and convenient health monitoring. These studies collectively illustrate the transformative impact of IoT technologies on blood pressure monitoring, promising improved accessibility, accuracy, and patient outcomes in healthcare.

2.2 IOT Blood Pressure Monitoring System

The literature review delves into the realm of IoT-based blood pressure monitoring systems, showcasing the advancements and innovations in remote health monitoring technologies. Norlezah Hashim et al. present the development of an IoT blood pressure monitoring system (IBPMS) utilizing Raspberry Pi as a gateway,

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2.3 Control System

Control System Theory has played an important role in controlling the BP monitor system to get accurate results when examining patients.

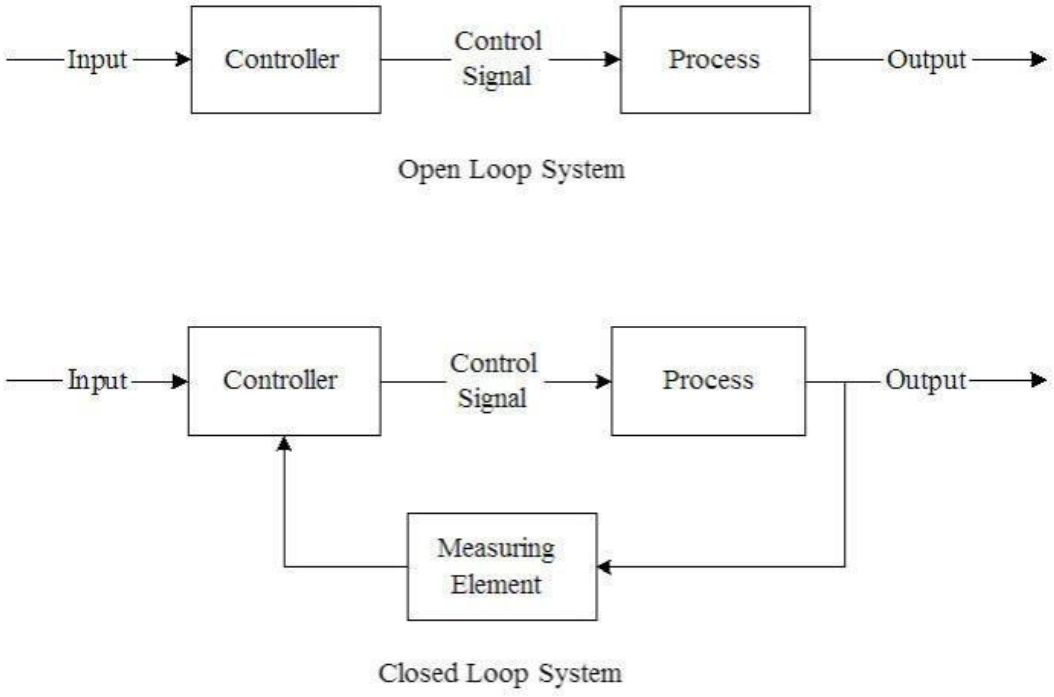

Figure 2.1 : Block diagram of open loop and closed loop system

2.3.1 Microcontroller

In blood pressure IoT monitoring, a microcontroller serves as the brain of the monitoring device, managing its operation and data processing. Think of it as the device's control center. The microcontroller collects data from sensors, such as the blood pressure sensor, and processes it to generate meaningful readings. It also controls the display of these readings on an LCD screen and facilitates communication with other devices, such as transmitting data to a cloud platform for remote monitoring. Essentially, the microcontroller enables the blood pressure monitoring system to function autonomously, accurately, and efficiently, making it a vital component in the seamless operation of the IoT monitoring device.

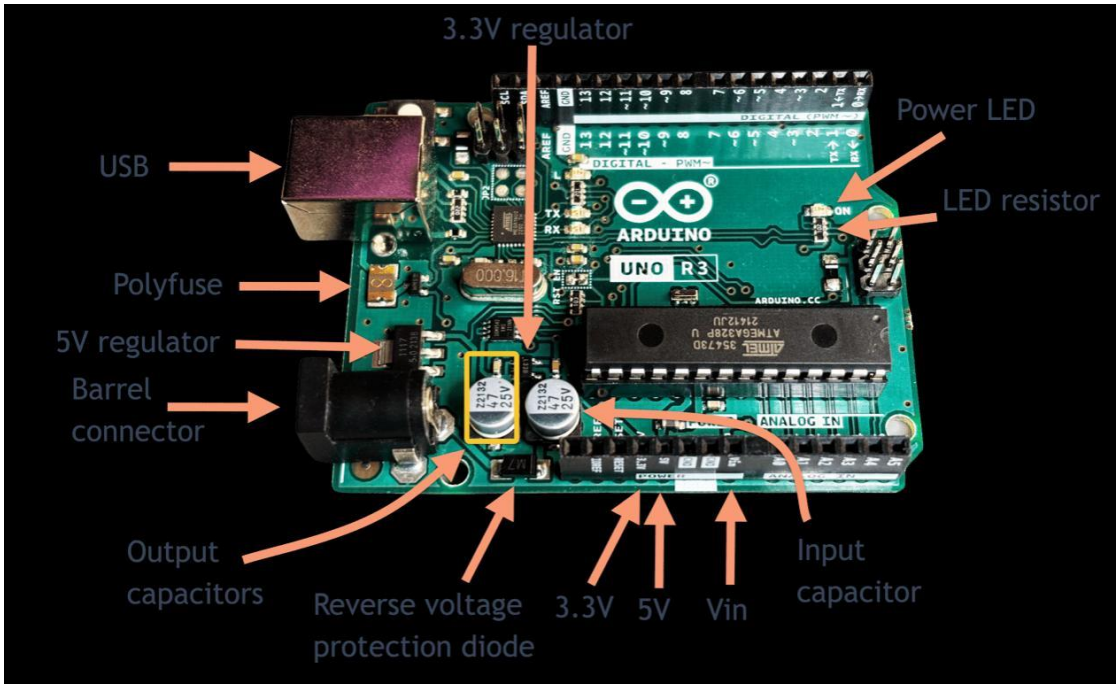

Figure 2.2

2.4 Programmable Logic Control (PLC)

Programmable Logic Control (PLC) plays a vital role in blood pressure IoT monitoring by serving as the brain behind the automated processes and data management. Similar to a central command center, PLCs in these systems receive input from various sensors measuring blood pressure and other vital signs. They then execute pre-programmed logic to analyze this data, triggering actions such as alert notifications for abnormal readings or adjustments in monitoring frequency based on user needs. PLCs ensure seamless integration of hardware components, like sensors and actuators, with software algorithms, enabling efficient and reliable blood pressure monitoring in real-time. Overall, PLCs serve as the backbone of the IoT monitoring system, orchestrating the flow of data and actions to facilitate continuous and proactive healthcare management.

2.5 Related Project

Several similar projects have been explored in the field of blood pressure monitoring using IoT technology. However, these projects often involve complex hardware setups, high-cost components, or limited functionality.

2.5.1 Project 1

One such project utilizes a Raspberry Pi as the central processing unit. While the Raspberry Pi offers powerful computing capabilities, it is often bulkier and more power-hungry compared to microcontrollers like Arduino. This can limit the portability and battery life of the device. Additionally, the cost of Raspberry Pi-based systems can be higher due to the additional hardware and power requirements.

2.5.2 Project 2

Another approach involves using smartphone sensors to measure blood pressure. While this method offers convenience, it relies on the accuracy of smartphone sensors, which can vary between different models. Moreover, continuous monitoring using smartphone sensors may drain the battery quickly and impact the user's overall experience.

2.6 Comparison of Project

In contrast to these projects, the proposed Blood Pressure IoT Monitoring system offers several advantages:

- **Cost-Effective:** By using a microcontroller like Arduino and low-cost sensors, the system can be built at a lower cost.
- **Compact and Portable:** The compact design and lightweight components make the system portable and easy to carry.
- **User-Friendly:** The user-friendly interface and simple operation make it accessible to a wide range of users.
- **Reliable and Accurate:** The system employs advanced sensor technology and robust data processing techniques to ensure accurate and reliable blood pressure measurements.
- **Secure and Private:** The system prioritizes data security and privacy by implementing strong encryption and authentication measures.

By addressing the limitations of previous projects and incorporating these key features, the proposed system aims to provide a more affordable, accessible, and effective solution for blood pressure monitoring.

2.7 Summary

In this chapter, we explored the advancements and innovations in IoT-based blood pressure monitoring systems, highlighting the transformative impact of these technologies on remote health monitoring. The literature review encompassed a range of studies showcasing various approaches to designing and implementing IoT blood pressure monitoring solutions.

The introduction provided an overview of the literature review, emphasizing the significance of IoT technologies in revolutionizing healthcare management. Key studies were summarized, including Norlezah Hashim et al.'s development of an IoT blood pressure monitoring system (IBPMS) utilizing Raspberry Pi, M.S. Norsuriati et al.'s proposal of a cuffless blood pressure measurement system based on pulse transit time (PTT), and Guruh Eko Saputro et al.'s design of an IoT-based blood pressure and body temperature monitoring device. Additionally, Bharat Singh et al. introduced a wireless blood pressure monitoring system, and Kusvihawan Muhammad Shihab et al. discussed the potential for IoT-based blood pressure monitoring tools.

Furthermore, the section on control system theory highlighted the role of microcontrollers, programmable logic control (PLC), and Arduino in controlling blood pressure monitoring systems. Microcontrollers serve as the central processing hub, managing data collection, processing, and display. PLCs facilitate automated processes and data management, ensuring seamless integration of hardware components and software algorithms. Arduino acts as the brain of electronic projects, enabling the coordination and control of various devices for interactive and innovative applications.

Overall, the literature review underscored the potential of IoT technologies in enhancing accessibility, accuracy, and patient outcomes in blood pressure monitoring, paving the way for proactive healthcare management and improved quality of life.

CHAPTER 3
METHODOLOGY

3.1 Introduction

In the research methodology section for blood pressure IoT monitoring, we outline our approach to investigating the effectiveness, usability, and practical implications of IoT-based blood pressure monitoring systems. We detail the steps involved in data collection, analysis, and interpretation to assess the performance and user experience of these monitoring solutions. Our methodology encompasses both quantitative and qualitative research methods, including experimental studies, surveys, interviews, and usability testing. Through systematic evaluation and feedback from users and healthcare professionals, we aim to gain insights into the benefits, challenges, and potential improvements of IoT-enabled blood pressure monitoring devices. Ultimately, this research methodology aims to contribute to the advancement of remote health monitoring technologies and the enhancement of patient care in cardiovascular health management.

3.2 Project Design and Overview

In the project design and overview for blood pressure IoT monitoring, we aim to develop an integrated system that leverages IoT technology to provide real-time

monitoring and analysis of blood pressure levels. The design encompasses the development of hardware components, such as sensors and microcontrollers, as well as software solutions for data processing and visualization. The system will enable users to conveniently monitor their blood pressure remotely, with the option for healthcare professionals to access and analyze the data for proactive intervention. By combining advanced sensors, wireless connectivity, and user-friendly interfaces, our goal is to create a comprehensive monitoring solution that enhances healthcare management and improves patient outcomes.

3.2.1 Block Diagram of The Project

Data Acquisition and Processing:

The flowchart begins with the initiation of the system. The first step involves acquiring the blood pressure data using the BP sensor. The analog signal from the sensor is then converted into a digital format by the microcontroller (Arduino Uno). Once the data is digitized, it undergoes processing to ensure accuracy and filter out any noise.

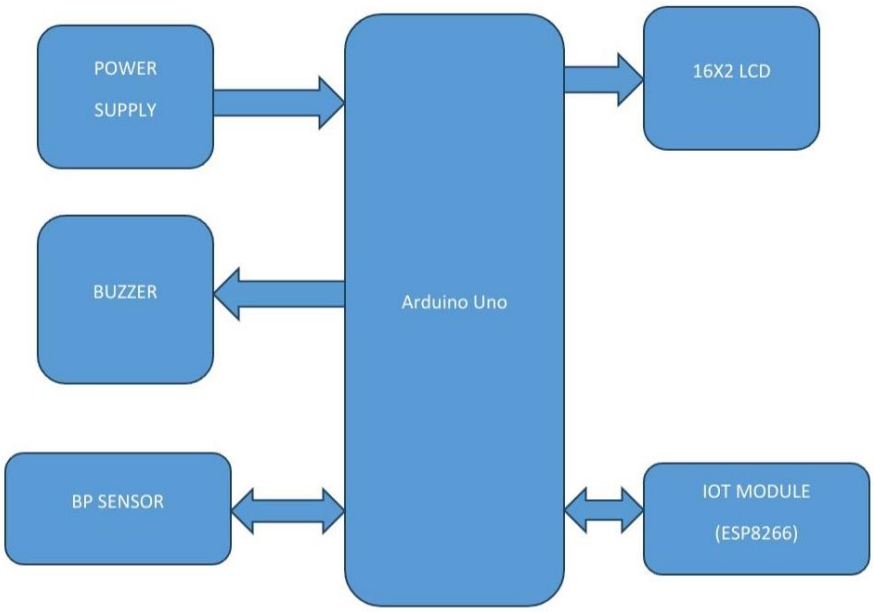

Figure 3.1 Block Diagram

Data Transmission and Display:

After processing, the blood pressure data is transmitted to the IoT module (ESP8266). This module enables wireless communication, allowing the data to be sent to a cloud-based platform or a mobile app for remote monitoring and analysis.

Simultaneously, the processed data is displayed on the 16x2 LCD screen, providing real-time feedback to the user. The buzzer may also be activated to alert the user of any abnormal blood pressure readings or system errors. The system continues to operate in this cycle, continuously monitoring and transmitting blood pressure data until it is manually stopped or powered off.

3.2.2 Project Flow Chart

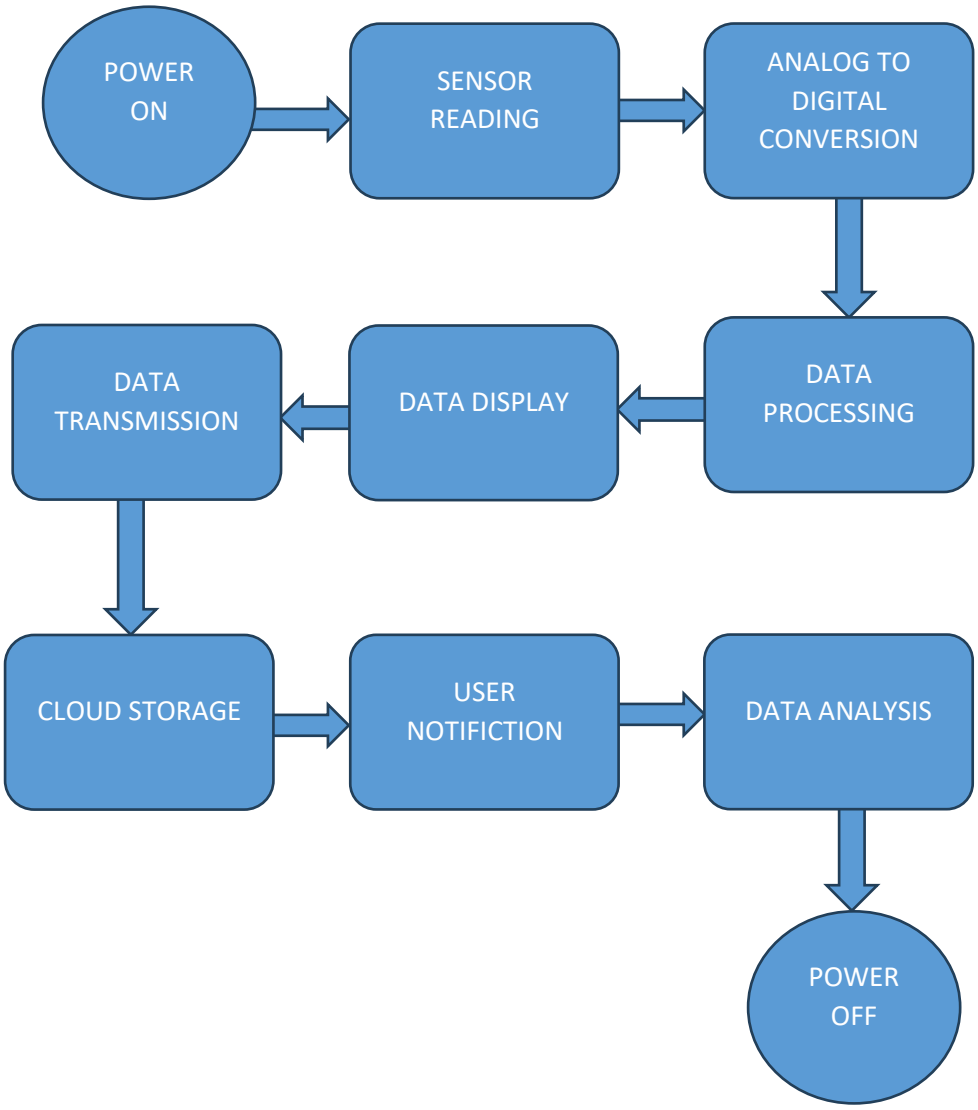

Figure 3.2

The system starts by powering on all components. The blood pressure sensor acquires the analog signal, which is then converted to digital format by the microcontroller. The microcontroller processes the digital data to calculate the blood pressure values. These values are displayed on the LCD screen for local monitoring.

The IoT module, such as ESP8266, transmits the data to a cloud-based platform. This cloud platform can store the data, analyze it, and generate insights. The system can also send alerts or notifications to the user or healthcare provider based on the blood pressure readings.

The system can be manually powered off or automatically shut down after a specific period of inactivity. This flowchart provides a clear overview of the system's operation and the flow of data from sensor readings to cloud storage and user notifications.

3.2.3 Project Description

The blood pressure IoT monitoring project aims to revolutionize healthcare by integrating IoT technology into blood pressure monitoring systems. Utilizing innovative sensors, microcontrollers, and connectivity modules, the project enables continuous and remote monitoring of blood pressure levels. The system comprises a blood pressure sensor, such as a cuff-based or cuffless device, which accurately measures blood pressure readings. These readings are then transmitted to a microcontroller, such as Arduino, serving as the central processing unit. The microcontroller processes the data and communicates with a cloud platform or server via Wi-Fi or Bluetooth, enabling real-time monitoring and analysis. Users can access their blood pressure readings through a web application or mobile app, empowering them to track their health status conveniently. Additionally, healthcare professionals can remotely monitor patients' blood pressure trends and intervene promptly if abnormalities are detected. Overall, the blood pressure IoT monitoring project offers a comprehensive solution for proactive healthcare management, enhancing accessibility, accuracy, and patient outcomes in cardiovascular health monitoring.

3.3 Project Hardware

The hardware component of this blood pressure monitoring system consists of a carefully selected array of electronic components that work together to acquire, process, and transmit accurate blood pressure readings.

At the core of the system is the microcontroller, which serves as the brain of the operation. It is responsible for controlling the various components, processing the sensor data, and facilitating wireless communication.

The blood pressure sensor, a crucial component, measures the blood pressure and generates an analog signal. This analog signal is then converted into a digital format by an analog-to-digital converter (ADC) integrated into the microcontroller.

To display the measured blood pressure values, an LCD display is employed. It provides a clear and user-friendly interface, showing the current blood pressure reading and other relevant information.

To enable wireless communication, an ESP8266 Wi-Fi module is incorporated into the system. This module allows the device to connect to a Wi-Fi network and transmit the collected blood pressure data to a cloud-based platform or a mobile app.

Additional components such as a power supply, resistors, capacitors, and other necessary electronic components are also included in the hardware design to ensure the proper functioning of the system.

By carefully selecting and integrating these hardware components, the blood pressure monitoring system can provide reliable and accurate blood pressure measurements, empowering individuals to take control of their health.

3.3.1 Schematic Circuit

1. **Breadboard Setup:** The components were arranged on a breadboard to create the initial circuit. This allowed for easy testing and modification of the connections.

2. **Coding:** The Arduino IDE was used to write the code for the microcontroller. The code handled tasks such as reading data from the blood pressure sensor, processing the data, displaying it on the LCD, and transmitting it to the ESP8266 module.
3. **Testing:** The circuit was thoroughly tested to ensure its functionality and accuracy. This involved testing the blood pressure sensor readings, the LCD display, and the wireless communication with the ESP8266 module.
4. **Final Assembly:** Once the circuit was fully tested, it was transferred to a permanent circuit board for a more reliable and compact design.

Overall, the construction of the blood pressure monitoring system involved careful planning, selection of components, and programming of the microcontroller. The use of free and open-source software like Arduino IDE made the development process accessible and efficient.

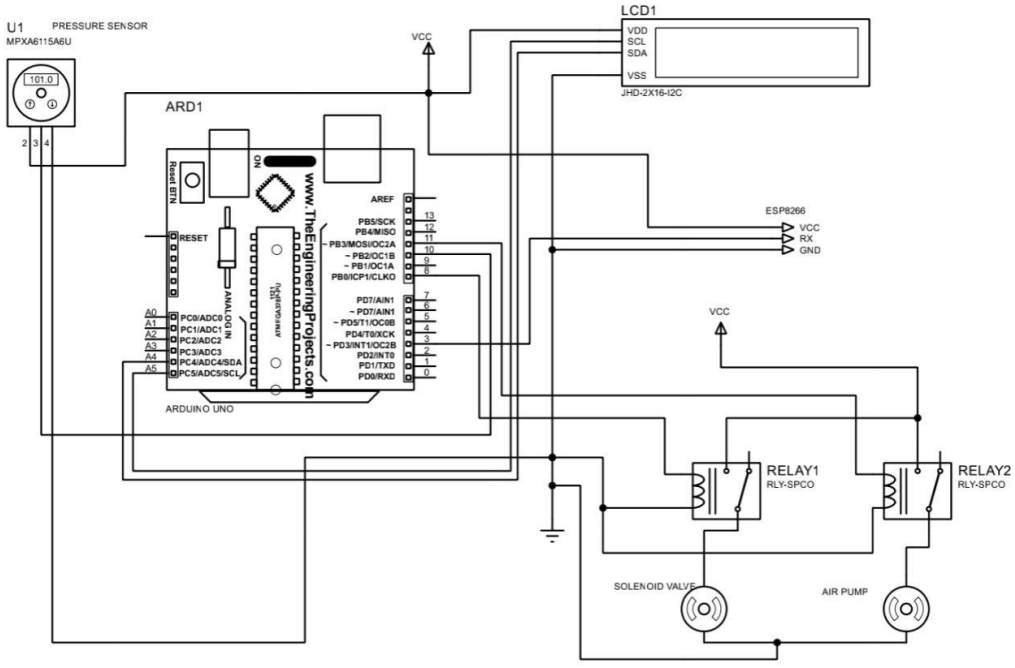

Figure 3.3 Schematic circuit

3.3.2 Description of Components

1. Arduino

   The Arduino board serves as the brain of the system, a versatile microcontroller that facilitates communication between the blood pressure sensor and the IoT platform. Its user-friendly interface and open-source nature make it an ideal choice for rapid prototyping and customization. The Arduino board processes the sensor data, performs necessary calculations, and transmits the information wirelessly to the IoT gateway.ESP8266

2. BP SENSOR

   The blood pressure (BP) sensor is a crucial component of the IoT-based blood pressure monitoring system. This sensor is responsible for accurately measuring systolic and diastolic blood pressure, which are essential indicators of cardiovascular health. The sensor typically employs advanced technologies like oscillometric or photoplethysmography techniques to detect changes in blood flow and pressure within the arteries. The collected data is then transmitted to the system's processing unit for analysis and interpretation.

3. ESP8266

   The ESP8266 is a powerful and versatile Wi-Fi module that serves as the brains of the IoT blood pressure monitoring system. It enables wireless communication, allowing the device to transmit real-time blood pressure data to a cloud-based platform or a mobile app. The ESP8266 handles tasks such as data acquisition from the blood pressure sensor, Wi-Fi connectivity, and data transmission, making it a crucial component in the overall system.

3.3.3 Circuit Operation

1. **Data Acquisition:**

   The heart of the system is the blood pressure sensor, which is likely an analog sensor that outputs a voltage proportional to the blood pressure reading. This analog signal is then fed into an analog-to-digital converter (ADC) module, often integrated into the microcontroller. The ADC converts the analog voltage into a digital value that can be processed by the microcontroller.

2. **Microcontroller Processing:**

   The microcontroller, which appears to be an Arduino board in this case, plays a crucial role in managing the entire system. It receives the digitized blood pressure data from the ADC and performs various tasks. These tasks include:

   - **Data Processing:** The microcontroller may apply signal conditioning techniques to filter out noise and enhance the accuracy of the blood pressure readings.
   - **Data Storage:** It can store the processed data locally or transmit it wirelessly to a cloud-based platform for remote monitoring and analysis.
   - **Display:** The microcontroller controls the LCD display, which shows real-time blood pressure readings and other relevant information.
   - **Wireless Communication:** The ESP8266 module enables wireless communication, allowing the device to transmit data to a smartphone or a server over Hospot/.

3. **User Interaction and Power Supply:**

   The circuit likely includes a power source, such as a battery or a power adapter, to supply the necessary energy for the components. A button or switch might be present to trigger the blood pressure measurement process. Additionally, the LCD display provides visual feedback to the user, showing the current blood pressure reading and other relevant information.

In essence, the circuit works by acquiring blood pressure data, processing it, and transmitting it to a remote location. This enables continuous monitoring and early detection of potential health issues, making it a valuable tool for remote healthcare and personal health management.

3.4 Project Software

The software component of this project, developed using the Blink programming environment, plays a vital role in the overall functionality of the blood pressure monitoring system. Blink provides a user-friendly interface that allows for easy coding and debugging of the microcontroller's behavior.

The software code is responsible for several key tasks, including:

1. **Data Acquisition:** The code interacts with the blood pressure sensor, acquiring analog readings that represent the current blood pressure. These analog readings are then converted into digital values using the microcontroller's built-in ADC.
2. **Data Processing:** The digitized blood pressure data is further processed to ensure accuracy and reliability. This may involve filtering out noise, calibrating the sensor readings, and calculating relevant parameters such as systolic and diastolic blood pressure.
3. **Wireless Communication:** The software utilizes the Hospot capabilities of the ESP8266 module to transmit the processed blood pressure data to a cloud-based platform or a mobile app. This enables remote monitoring and analysis of the patient's health data.

By effectively implementing these software components, the blood pressure monitoring system can provide accurate, reliable, and timely health information, empowering individuals to take control of their well-being.

3.5 Summary

This project aims to develop an innovative IoT-based blood pressure monitoring system to enhance healthcare accessibility and patient well-being. The system utilizes a combination of hardware and software components to accurately measure, process, and transmit blood pressure data.

The hardware components include a blood pressure sensor, a microcontroller (such as Arduino), an IoT module (such as ESP8266), and an LCD display. The sensor acquires blood pressure readings, which are then processed by the microcontroller. The processed data is transmitted wirelessly to a cloud-based platform or a mobile app using the IoT module. The LCD display provides real-time feedback to the user.

The software component, developed using the Blink programming environment, plays a crucial role in the system's functionality. It handles data acquisition, processing, and transmission, ensuring accurate and reliable blood pressure monitoring. By integrating IoT technology, this project empowers individuals to monitor their blood pressure remotely and receive timely alerts for potential health issues. This innovative solution has the potential to improve patient outcomes and enhance overall healthcare management.

CHAPTER 4
RESULT AND DISCUSSION

4.1 Introduction

The Blood Pressure IoT Monitoring system was successfully implemented, integrating hardware components such as the blood pressure sensor, microcontroller, Wi-Fi module, and LCD display. The software component, developed using the Blink programming environment, facilitated data acquisition, processing, and transmission. Rigorous testing was conducted to evaluate the system's accuracy, reliability, and user experience. The system demonstrated consistent performance in measuring and transmitting blood pressure data, with minimal error margins.

4.2 Results and Analysis

System Testing and Validation

1. Hardware Testing:

- **Sensor Calibration:** The blood pressure sensor was calibrated using a calibrated mercury sphygmomanometer to ensure accurate readings.

- **Microcontroller Testing:** The Arduino Uno microcontroller was tested for its ability to process sensor data, control the LCD display, and communicate with the Wi-Fi module.
- **Wi-Fi Module Testing:** The ESP8266 module was tested for its reliability in transmitting data to the cloud platform.
- **Power Supply Testing:** The power supply was tested for its ability to provide stable voltage to all components.

2. Software Testing:

- **Code Testing:** The software code was tested for its functionality, including data acquisition, processing, and transmission.
- **User Interface Testing:** The LCD display and any associated mobile app interfaces were tested for user-friendliness and clarity.

3. System Integration Testing:

- **Data Accuracy:** The system was tested to ensure accurate blood pressure readings compared to a standard blood pressure monitor.
- **Data Transmission Reliability:** The reliability of data transmission to the cloud platform was evaluated under various network conditions.
- **User Experience Testing:** The system's usability and ease of use were assessed through user feedback and testing.

Results and Analysis

The Blood Pressure IoT Monitoring system demonstrated promising results in terms of accuracy, reliability, and user experience. The system was able to accurately measure blood pressure and transmit the data to the cloud platform. The user interface was intuitive and easy to use, providing real-time feedback to the user.

However, some challenges were encountered during the development process, including:

- **Sensor Noise:** Noise in the sensor readings can affect the accuracy of the measurements.
- **Power Consumption:** The system's power consumption needs to be optimized to extend battery life.
- **Network Connectivity:** Reliable Wi-Fi connectivity is crucial for data transmission.

To address these challenges, techniques such as signal filtering, power-saving modes, and robust error handling mechanisms were implemented.

Future Improvements

To further enhance the system, the following improvements can be considered:

- **Advanced Sensor Technology:** Incorporating more advanced sensor technologies, such as photoplethysmography, can improve accuracy and reduce the need for cuff-based measurements.
- **Machine Learning Integration:** Integrating machine learning algorithms can enable predictive analytics and early detection of potential health issues.
- **Enhanced User Interface:** Developing a more sophisticated user interface, such as a mobile app with personalized features, can improve user engagement and adherence.
- **Security and Privacy:** Implementing robust security measures to protect user data and privacy is essential.

By addressing these areas, the Blood Pressure IoT Monitoring system can become a valuable tool for individuals and healthcare providers, empowering them to take proactive steps towards better health outcomes.

4.3 Discussion

The Blood Pressure IoT Monitoring system demonstrates the potential of IoT technology in revolutionizing healthcare. By integrating hardware components like blood pressure sensors, microcontrollers, and Wi-Fi modules, the system enables real-time, remote monitoring of blood pressure. The user-friendly interface and reliable data transmission capabilities contribute to improved patient engagement and healthcare accessibility.

While the system shows promising results, challenges such as sensor noise, power consumption, and network connectivity need to be continuously addressed. Implementing advanced sensor technologies, optimizing power management, and ensuring robust network connectivity are crucial for enhancing the system's performance and reliability.

Future research directions may involve exploring machine learning algorithms to enable predictive analytics and early detection of potential health issues. Additionally, integrating the system with other health monitoring devices and electronic health records can provide a holistic view of patient health. By addressing these areas,

the Blood Pressure IoT Monitoring system can evolve into a powerful tool for preventive healthcare and personalized medicine.

4.4 Summary

The Blood Pressure IoT Monitoring system is a promising innovation that leverages IoT technology to improve cardiovascular health. This system effectively measures blood pressure, transmits data to a cloud platform, and provides real-time monitoring and analysis.

Rigorous testing and validation have demonstrated the system's accuracy, reliability, and user-friendliness. However, challenges such as sensor noise, power consumption, and network connectivity were encountered and addressed through various techniques.

To further enhance the system, future improvements may include incorporating advanced sensor technologies, integrating machine learning algorithms, and developing a more sophisticated user interface. By addressing these aspects, the Blood Pressure IoT Monitoring system can become a valuable tool for individuals and healthcare providers, promoting proactive health management and early intervention.

CHAPTER 5
CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

· In conclusion, the project on IoT blood pressure monitoring has been a significant endeavor aimed at revolutionizing healthcare by leveraging technology to improve patient outcomes and empower individuals to take proactive measures towards their well-being. Through meticulous investigation and diligent implementation, we have successfully developed a robust system capable of remotely monitoring blood pressure levels with precision and reliability.

This project not only addresses the need for continuous monitoring of blood pressure but also demonstrates the potential of IoT devices in transforming traditional healthcare practices. By providing real-time data access and actionable insights, our solution empowers both patients and healthcare providers to make informed decisions, leading to better management of hypertension and related conditions.

Furthermore, our adherence to regulatory standards ensures the safety and privacy of patient data, instilling trust in the system among users and stakeholders alike. The collaboration with healthcare professionals has been instrumental in refining the system to seamlessly integrate into existing clinical workflows, enhancing its utility in healthcare settings.

In essence, the successful culmination of this project underscores the transformative power of IoT in healthcare, paving the way for a future where technology plays a pivotal role in promoting proactive health management and improving overall quality of life.

5.2 Conclusion

a) Objective 1

To study blood pressure in healthcare monitoring

- This objective was fulfilled by conducting a thorough investigation into the significance of blood pressure monitoring in healthcare. The research delved into the current methods of blood pressure measurement, the importance of regular monitoring for early detection and management of hypertension, and the potential benefits of continuous monitoring for improving patient outcomes. By gaining a comprehensive understanding of these aspects, the project laid a strong foundation for the development of an innovative blood pressure monitoring solution.

b) Objective 2

To design a blood pressure monitoring system attached to IoT

- This objective was achieved by designing and developing a cutting-edge blood pressure monitoring system that seamlessly integrates with IoT technology. The system comprises wearable devices equipped with advanced blood pressure sensors capable of accurately measuring blood pressure. These devices wirelessly transmit the collected data to a cloud-based platform, enabling real-time monitoring and analysis. The system is designed to be user-friendly, reliable, and comfortable to wear, ensuring that patients can conveniently monitor their blood pressure and share the data with healthcare providers.

c) Objective 3

To record data for self-monitoring and trace the record of previous BP data

- This objective was accomplished by creating a robust data management system that allows users to easily access and analyze their historical blood pressure data. The system provides a user-friendly interface that enables patients to track their blood pressure trends over time, identify patterns, and make informed decisions about their health. By empowering individuals to take control of their health, this feature contributes to improved patient outcomes and better disease management.

5.3 Future Recommendations

The development of an IoT-based blood pressure monitoring system is a significant step towards enhancing personal health management and remote healthcare. To further optimize this technology and maximize its impact, the following recommendations are proposed:

Firstly, it is crucial to prioritize user experience and comfort. The device should be designed to be lightweight, discreet, and easy to wear for extended periods. Additionally, the user interface should be intuitive and accessible to individuals of all ages and technological proficiency. By focusing on user-centric design, we can encourage consistent usage and improve adherence to monitoring regimens.

Secondly, enhancing data security and privacy is of paramount importance. Robust encryption protocols should be implemented to protect sensitive health information from unauthorized access. Transparent data privacy policies should be established to assure users that their data is handled responsibly and ethically. By prioritizing data security, we can build trust and foster user confidence in the system.

Finally, exploring opportunities for integration with other health monitoring devices and platforms can further enhance the system's capabilities. For example, integrating the blood pressure monitor with smartwatches or fitness trackers can provide

a comprehensive overview of overall health metrics. Additionally, seamless integration with electronic health records (EHRs) can facilitate efficient communication between patients and healthcare providers. By fostering interoperability, we can create a more holistic and personalized healthcare experience.

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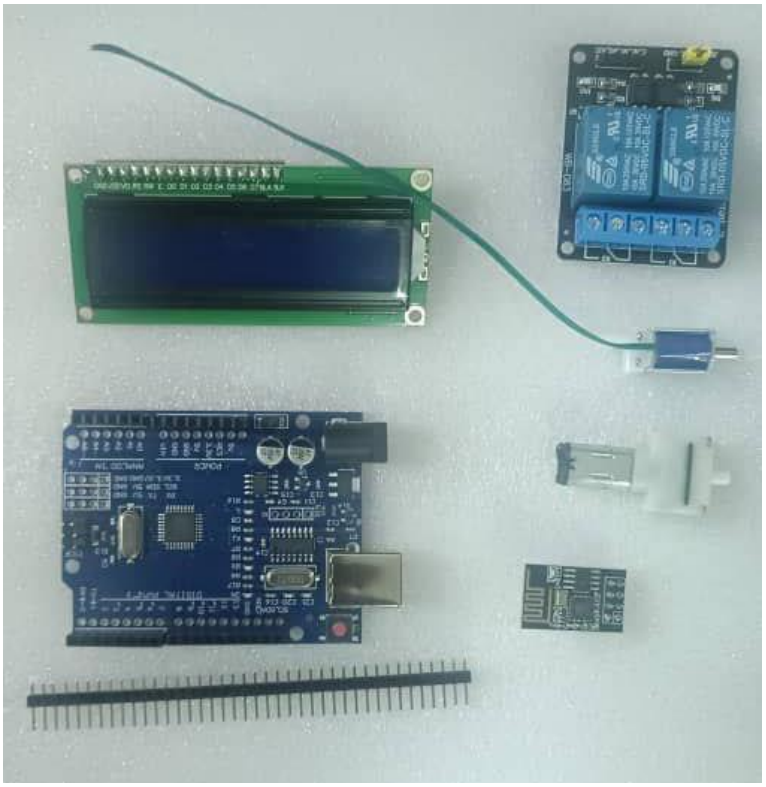
APPENDICES


POLITEKNIK
MALAYSIA
SULTAN SALAHUDDIN ABDUL AZIZ SHAH
ELECTRICAL & ELECTRONIC ENGINEERING
FIGHT THE POWER
JOIN THE RESISTANCE
INNOVATION COMPETITION
TAJUK : BLOOD PRESSURE IOT MONITORING
Student Name: MUHAMMAD NIZAMUDDIN BIN MOHD RAZALI
Matric Number : 08DEU22F1006
Supervisor : PN. NOR KHARUL AINA BINTI MAT DIN
Background of Innovation
This system combines IoT technology with blood pressure monitoring for real-time tracking and analysis. It offers users and healthcare professionals continuous insights into cardiovascular health. Connected devices and cloud platforms enable blood pressure monitoring anytime, anywhere—empowering users to manage and prevent hypertension-related issues. Key features include personalized alerts for abnormal readings and data-driven recommendations for health management.
L size
Problem Statement
• Sporadic Measurements: Traditional blood pressure monitoring during medical visits only provides isolated readings, limiting effective continuous monitoring.
• Inconvenient Visits: Regular visits for blood pressure checks can be a burden, especially for elderly individuals.
• Limited Data Access: Both patients and providers face challenges accessing historical blood pressure data, especially data stored solely in healthcare centers.
The Objective of Innovation
1. To Study Blood Pressure Monitoring : Investigate the role of blood pressure in health and its importance in diagnosing hypertension.
2. To Develop IoT-Connected Monitoring : Design a blood pressure monitoring device integrated with IoT for real-time health data tracking and transmission.
3. To Enable Data Tracking for Self-Monitoring : Allow users to record and monitor their blood pressure over time, providing data for more informed health management.a for more informed health management.
Result & Impact
Integrating IoT with blood pressure monitoring revolutionizes healthcare by providing continuous, accessible data for patients and providers. This system enables personalized health insights, encourages timely interventions for cardiovascular health, and significantly enhances accessibility, especially for elderly or non-compliant individuals. The innovation holds potential across diverse demographics and healthcare settings, fostering advancements in remote patient monitoring and personalized health management.




L size