VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Jnana Sangama, Belagavi – 590014.

Internship Report

On

"B-Healthy"

(Digital Health Monitoring Unit)

Submitted in partial fulfillment of the requirement for the award of degree of

BACHELOR OF ENGINEERING

In

COMPUTER SCIENCE & ENGINEERING

&

INFORMATION SCIENCE & ENGINEERING

By

AMRUTHA BANDI	**1AP21IS002**
BASHA E	**1AP21CS009**
HARSHITA K	**1AP21IS011**

Under the guidance of:

AKHIL SAI

2024 - 2025

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

A P S COLLEGE OF ENGINEERING

Anantha Gnana Gangothri,

NH-209, Kanakapura Road, Somanahalli, Bengaluru-560116.

Project Completion Certificate

I, **Amrutha Bandi** (USN:1AP21IS002), hereby declare that the material presented in the Project Report titled **"B-healthy(Digital Health Monitoring Unit)** represents original work carried out by me in the **Department of Information Science & Engineering** at the **APS college of Engineering, Bengaluru** during the tenure **2 October, 2024 – 12, December, 2024**.

With My signature, I certify that:

- I have not manipulated any of the data or results.
- I have not committed any plagiarism of intellectual property and have clearly indicated and referenced the contributions of others.
- I have explicitly acknowledged all collaborative research and discussions.
- I understand that any false claim will result in severe disciplinary action.
- I understand that the work may be screened for any form of academic misconduct.

Date: **Student Signature**:

In my capacity as the supervisor of the above-mentioned work, I certify that the work presented in this report was carried out under my supervision and is worthy of consideration for the requirements of the B.E. Internship Work.

Advisor's Name: **Dr.Shivamurthaiah** Guide Name: **Akhil Sai**

Advisor's Signature **Guide Signature**

Project Completion Certificate

I, **Basha E** (USN:1AP21CS009), hereby declare that the material presented in the Project Report titled **"B-healthy(Digital Health Monitoring Unit)** represents original work carried out by me in the **Department of Computer Science & Engineering** at the **APS college of Engineering, Bengaluru** during the tenure **2 October, 2024 – 12, December, 2024**.

With My signature, I certify that:

- I have not manipulated any of the data or results.
- I have not committed any plagiarism of intellectual property and have clearly indicated and referenced the contributions of others.
- I have explicitly acknowledged all collaborative research and discussions.
- I understand that any false claim will result in severe disciplinary action.
- I understand that the work may be screened for any form of academic misconduct.

Date: **Student Signature**:

In my capacity as the supervisor of the above-mentioned work, I certify that the work presented in this report was carried out under my supervision and is worthy of consideration for the requirements of the B.E. Internship Work.

Advisor's Name: **Dr.Shivamurthaiah** Guide Name: **Akhil Sai**

Advisor's Signature **Guide Signature**

Project Completion Certificate

I, **Harshita K** (USN:1AP21IS011), hereby declare that the material presented in the Project Report titled **"B-healthy(Digital Health Monitoring Unit)** represents original work carried out by me in the **Department of Information Science & Engineering** at the **APS college of Engineering, Bengaluru** during the tenure **2 October, 2024 – 12, December, 2024**.

With My signature, I certify that:

- I have not manipulated any of the data or results.
- I have not committed any plagiarism of intellectual property and have clearly indicated and referenced the contributions of others.
- I have explicitly acknowledged all collaborative research and discussions.
- I understand that any false claim will result in severe disciplinary action.
- I understand that the work may be screened for any form of academic misconduct.

Date: **Student Signature**:

In my capacity as the supervisor of the above-mentioned work, I certify that the work presented in this report was carried out under my supervision and is worthy of consideration for the requirements of the B.E. Internship Work.

Advisor's Name: **Dr.Shivamurthaiah** Guide Name: **Akhil Sai**

Advisor's Signature **Guide Signature**

Evaluation Sheet

Title of the Project: B-healthy (Digital Health Monitoring Unit)

Name of the Students: Amrutha Bandi

Basha E

Harshita K

External Supervisor:

_____

Internal Supervisor:

_____

_____

Date:

Place:

ABSTRACT

Future health monitoring systems will transform healthcare by offering continuous and accessible tracking of vital health parameters. This proposed system uses a Raspberry Pi as the central unit to measure and monitor body temperature, pulse rate, and blood pressure. Compact and cost-effective, it integrates sensors for data collection and processes inputs to provide accurate, user-friendly readings. The data is displayed in real time on a laptop with wireless capabilities to transmit information to remote servers or mobile apps for advanced analysis. Caregivers can monitor patient health remotely and receive alerts for abnormal readings, ensuring timely intervention. The system is equipped with notifications and alarms to warn users of critical health changes, aiding in early detection and prevention. Designed for affordability and ease of use, this system is ideal for home monitoring and underserved areas. By leveraging the Raspberry Pi's capabilities, it ensures reliability at a low cost. This innovation empowers individuals to manage their health proactively while supporting healthcare professionals with remote monitoring tools, revolutionizing healthcare delivery and improving outcomes. In summary, this future health monitoring system will provide an innovative solution for tracking vital health parameters. It will empower individuals to take an active role in managing their well-being and offer healthcare providers a reliable tool for remote monitoring.

Table of Contents

INTRODUCTION

Objective

The objective of this project is to design and develop a health monitoring system using Raspberry Pi to measure and monitor critical health parameters such as body temperature, pulse rate, and blood pressure. The system aims to provide real-time data processing and display for users, ensuring accurate and accessible health tracking. By incorporating wireless communication and alert mechanisms, it seeks to enable remote monitoring and timely interventions. This project is focused on creating an affordable, reliable, and user-friendly solution for personal and remote healthcare management.

Problem Statement

In the modern healthcare landscape, there is an increasing demand for accessible and reliable systems that empower individuals to monitor their health independently. To address this, a health monitoring system has been developed using a Raspberry Pi to measure and monitor vital health parameters such as body temperature, pulse rate, and blood pressure. Despite the system's development, several challenges highlight the need for its implementation and optimization:

- **Inadequate Real-Time Health Tracking**: Traditional health checkups rely on periodic visits to healthcare facilities, which often fail to capture real-time variations in health parameters. This system addresses this issue by providing continuous monitoring and ensuring users have instant access to their vital metrics.
- **Challenges in Early Diagnosis**: Many health conditions, such as hypertension or arrhythmias, can develop silently over time. By enabling real-time tracking and alerting users to abnormal readings, this system facilitates early detection, potentially preventing serious complications.
- **Dependence on Healthcare Infrastructure**: People in remote need healthcare facilities for regular monitoring. This project introduces a portable and cost-effective device that users can operate at home, reducing their reliance on physical healthcare centres.

- **High Costs of Monitoring Systems**: Advanced health monitoring devices are often too expensive for widespread adoption, particularly in low-income communities. The use of Raspberry Pi ensures affordability without compromising functionality or accuracy, making health monitoring accessible to a larger population.
    - **Integration of Multiple Metrics**: Traditional devices usually measure only a single health parameter, requiring users to own and manage multiple devices. This system integrates body temperature, pulse rate, and blood pressure monitoring into one device, offering a comprehensive health tracking solution.
    - **Real-Time Alerts and Notifications**: Many existing systems fail to notify users when a parameter exceeds safe thresholds, leading to delayed responses in critical situations. This project includes an alert mechanism to ensure users and caregivers are informed of potential health risks immediately.
    - **Remote Monitoring Capabilities**: While the device processes and displays readings locally, it is also equipped with wireless communication features, enabling remote monitoring and data sharing with healthcare providers. This enhances its utility in remote care scenarios, especially for patients with chronic conditions.
    - **User-Friendly Design**: To ensure the system is accessible to people of all age groups and technical expertise, it has been designed to be simple, intuitive, and easy to operate. The device provides clear instructions, and the interface ensures that users can access and interpret their health data effortlessly.
    - **Portability and Convenience**: The compact design of the system ensures portability, making it suitable for both home-based and mobile usage. This allows users to monitor their health conveniently, regardless of their location.

    By addressing these challenges, the project demonstrates its effectiveness in providing a reliable, affordable, and efficient health monitoring solution. The system empowers individuals to take control of their health while also supporting healthcare providers in offering timely interventions. The integration of critical functionalities into one device showcases a step forward in personalized healthcare, addressing gaps in traditional monitoring systems and paving the way for innovative health management solutions.

APPLICATIONS

1. **Home-Based Health Monitoring**
    - The system enables individuals to monitor their vital health parameters, such as temperature, pulse rate, and blood pressure, from the comfort of their homes.
    - It is especially beneficial for elderly individuals, patients with chronic conditions, or those recovering from surgeries who require frequent monitoring without visiting healthcare facilities.
2. **Remote Patient Monitoring**
    - Healthcare providers can use this system to remotely track their patients' health data, particularly for those in rural or underserved areas.
    - The wireless communication feature allows seamless data sharing, ensuring timely interventions and reducing the need for frequent in-person consultations.
3. **Chronic Disease Management**
    - Patients with chronic conditions like hypertension, diabetes, or cardiovascular diseases can use this system to regularly monitor critical parameters and ensure their health remains stable.
    - Real-time alerts notify them and their caregivers of any abnormalities, helping to manage their conditions more effectively.
4. **Emergency Health Tracking**
    - The alert mechanism can detect and notify users of sudden changes in vital signs, such as high blood pressure or irregular pulse rates, which could indicate potential emergencies.
    - This feature is particularly valuable for individuals at risk of heart attacks or other medical crises.
5. **Fitness and Wellness Tracking**
    - Fitness enthusiasts can use the system to monitor their pulse rate during workouts, ensuring they stay within safe heart rate zones.
    - It can also help individuals track their overall health trends over time, promoting preventive healthcare practices.

6. **Portable Health Monitoring for Travelers**
    - The compact design makes it ideal for travelers who wish to monitor their health on the go.
    - It ensures individuals have access to vital health information even in areas where healthcare facilities may not be readily available.
7. **Hospital and Clinic Use**
    - Small clinics or hospitals can use this system as a low-cost alternative for initial health screenings or as a backup monitoring solution in resource-constrained settings.
    - It provides a quick and reliable method for gathering essential health metrics.
8. **Community Healthcare Programs**
    - The system can be deployed in public health campaigns or community healthcare programs to monitor the health of large groups, especially in remote or low-income areas.
    - Its affordability and ease of use make it a practical tool for improving healthcare accessibility in such settings.
9. **Educational and Research Applications**
    - Educational institutions can use this project as a practical demonstration for teaching concepts related to health monitoring, biomedical engineering, and IoT-based systems.
    - Researchers can further develop the system by integrating additional sensors or machine learning capabilities to enhance its accuracy and functionality.
10. **Health Monitoring in Workplaces**
    - Employers can use this system to monitor the health of their employees, particularly in high-stress environments or industries with occupational hazards.
    - It can also be used as part of wellness programs to promote a healthier workforce.

LIST OF COMPONENTS AND TOOLS USED

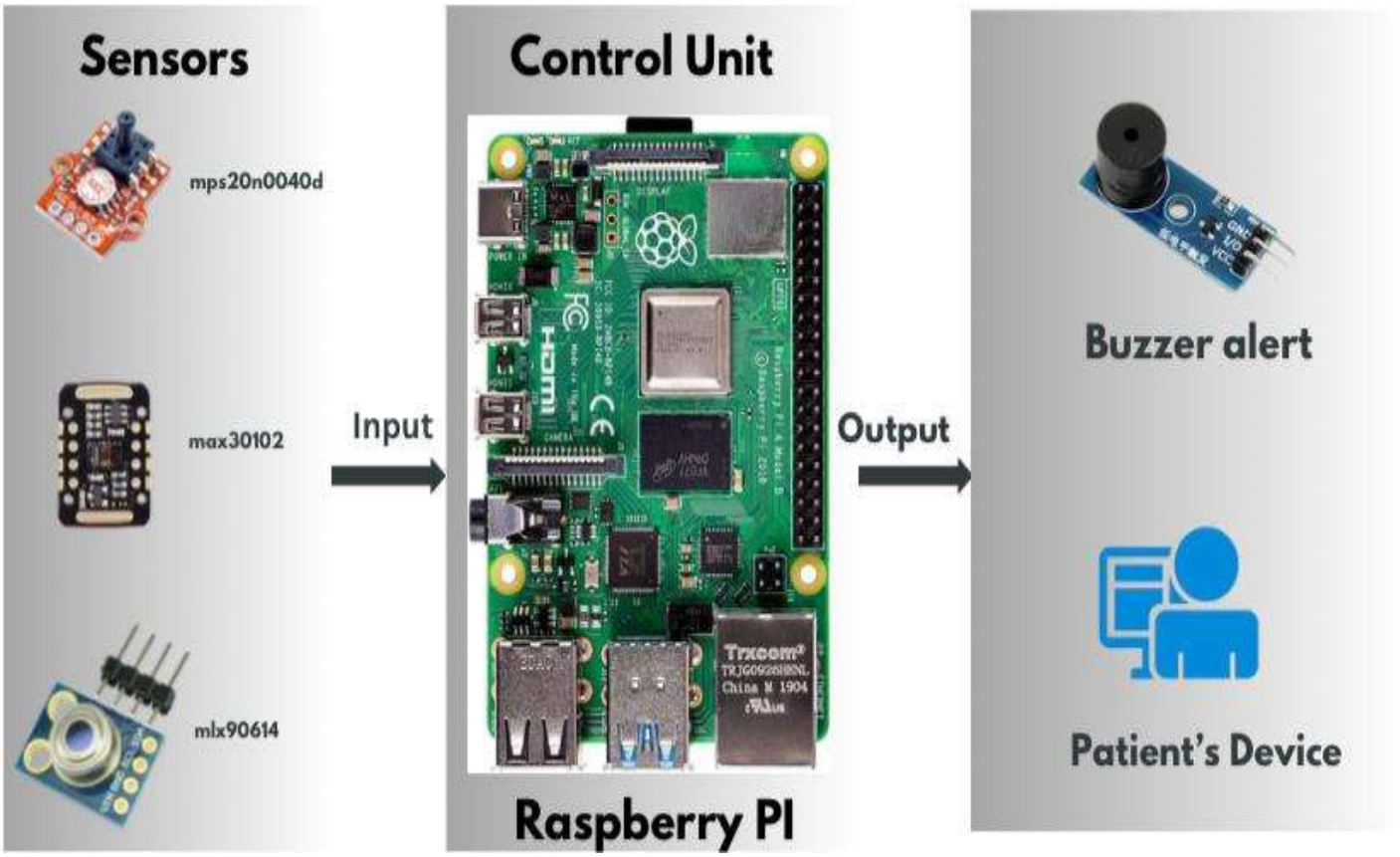
Hardware Components:

- Raspberry Pi 4 Model B (or any compatible Raspberry Pi model)
- Temperature Sensor
- Pulse Rate Sensor
- Blood Pressure Sensor Module
- GPIO Connection Cables
- Power Supply Unit for Raspberry Pi
- External Laptop/PC for data visualization
- Wi-Fi Dongle (if Wi-Fi is not inbuilt in the Raspberry Pi)

Software Tools:

- Raspberry Pi OS (or a compatible Linux-based operating system)
- Python programming language for sensor integration and data processing
- Libraries:
  - Flask, jsonify, time, threading, RPi.GPIO, flask_cors, csv, and StringIO for handling data and managing GPIO operations.
- Network configuration tools for enabling Wi-Fi or Bluetooth connectivity
- SSH or VNC Viewer for remote access to Raspberry Pi

BLOCK DIAGRAM



BLOCK DIAGRAM DESCRIPTION

The block diagram showcases the architecture of a Health Monitoring System implemented using a Raspberry Pi as the control unit. It illustrates the interaction between sensors, the control unit, and the output devices.

1. **Sensors (Input Stage)**:
    - A variety of sensors are used to collect health-related data, including:
        - **mpx2010-0040d**: Likely a pressure sensor for monitoring blood pressure or similar data.
        - **max30102**: A pulse oximeter and heart rate monitoring sensor, commonly used for detecting pulse rate and blood oxygen levels.
        - **mlx90614**: An infrared thermometer sensor used for non-contact temperature measurement.
    - These sensors capture real-time physiological data and transmit it to the Raspberry Pi.
2. **Control Unit (Processing Stage)**:
    - **Raspberry Pi**:
        - Acts as the central processing unit (CPU) of the system.
        - Handles raw data from the sensors and processes it using programmed algorithms.
        - Performs threshold checks (e.g., high temperature or irregular pulse).
        - Initiates alerts or communicates data to connected devices.
    - The Raspberry Pi interacts with the input (sensors) and output devices (alerts or notifications).
3. **Output Stage**:
    - **Buzzer Alert**:
        - Triggers a sound alert when abnormal conditions (e.g., high blood pressure or elevated temperature) are detected.
        - Helps provide immediate notification of potential health risks.
    - **Patient's Device**:
        - A connected device (e.g., smartphone, tablet, or computer) where the processed data is displayed.
        - Allows patients or caregivers to monitor real-time health parameters visually.
        - May also enable remote access and logging of the health data.

System Workflow:

1. Sensors collect real-time health data (temperature, blood pressure, and pulse rate).
2. Data is transmitted to the Raspberry Pi for processing and analysis.
3. The system checks if the data exceeds pre-set thresholds for abnormal conditions.
4. If abnormal conditions are detected:
    - The buzzer is activated to provide an alert.
    - Data is transmitted to the patient's device for display and logging.
5. The system continuously monitors and updates health data, ensuring real-time analysis and alerts.

This block diagram illustrates an efficient and modular design for monitoring vital health parameters, with a focus on real-time processing, alerts, and connectivity for improved patient care.

CONCLUSION

The health monitoring system developed in this project successfully demonstrated its capability to measure and monitor vital health parameters such as body temperature, pulse rate, and blood pressure using a Raspberry Pi as its core processing unit. By integrating multiple sensors for physiological data collection, the system efficiently captured and processed health metrics with accuracy and reliability. The collected data was displayed on a laptop interface, providing users with clear and real-time insights into their health conditions.

The inclusion of wireless communication features enabled the seamless transmission of data to remote devices, allowing caregivers and healthcare providers to monitor patient health effectively. Additionally, the built-in alert mechanism proved effective in notifying users or caregivers of abnormal health readings, facilitating early detection of potential health issues and enhancing preventive care. Designed with affordability and usability in mind, the system achieved its goal of being a portable and cost-effective solution. It was particularly well-suited for home-based health monitoring and provided an accessible tool for individuals in remote or underserved areas with limited access to healthcare services. The use of Raspberry Pi ensured the system's functionality while maintaining a low-cost profile, making it feasible for widespread adoption. The affordability and portability of the system made it an ideal solution for widespread use, particularly in areas with constrained healthcare resources. By utilizing the Raspberry Pi, the system achieved a balance between functionality and cost-effectiveness, ensuring accessibility for a broad user base. It also proved to be a versatile platform for future enhancements, such as integrating additional health sensors, enabling cloud-based data analytics, or expanding its compatibility with wearable devices. In conclusion, the project successfully addressed the objectives of creating a reliable, user-friendly, and affordable health monitoring system. It empowered users to take an active role in managing their health and provided a scalable framework for future enhancements, such as integrating additional sensors or expanding remote monitoring capabilities. This system serves as a step forward in making healthcare more accessible and proactive, bridging the gap between traditional healthcare facilities and real-time, personalized health monitoring solutions.

FUTURE ENHANCEMENT

The health monitoring system developed in this project has the potential for numerous future enhancements to expand its functionality, improve user experience, and cater to a broader audience. Below are detailed areas of future implementation:

1. Integration of Additional Health Metrics

- The system can be upgraded to monitor more health parameters, such as oxygen saturation (SpO2), ECG (Electrocardiogram), respiratory rate, and glucose levels.
- Adding advanced sensors like pulse oximeters, respiratory sensors, or non-invasive glucose monitoring devices will make the system a comprehensive health tracking solution.

2. Mobile Application Development

- A dedicated mobile application can be developed to provide users with on-the-go access to their health data.
- Features like notifications, reminders for regular health checks, and real-time alerts for abnormal readings can enhance usability.
- The app can also allow users to share data directly with healthcare providers or family members.

3. Wearable Device Integration

- The system can be integrated with wearable devices like smartwatches or fitness bands to provide continuous health monitoring throughout the day.
- This would be particularly useful for tracking activities like sleep, exercise, and daily health fluctuations in real-time.

5. Telemedicine Integration

- The system can be expanded to support telemedicine services by integrating video call capabilities, enabling users to consult with healthcare professionals directly through the system interface.
- Health data collected by the system can be shared in real-time with doctors, improving the quality of remote consultations.

6. Battery-Powered Portability

- Introducing battery power or solar charging capabilities would enhance the portability of the system, making it suitable for use in outdoor settings or areas with unreliable electricity.
- This upgrade would make the device ideal for deployment in disaster-stricken areas .

7. Enhanced User Interface

- The user interface can be optimized further to include accessibility features, such as support for multiple languages, voice guidance, and larger fonts for elderly users.
- A modular interface design can allow users to customize the displayed metrics based on their specific needs.

8. IoT Ecosystem Expansion

- The system can be integrated into a larger IoT ecosystem, allowing it to communicate with other smart devices, such as air purifiers, thermostats, or smart beds.
- For example, in the case of abnormal body temperature, the system could adjust the room's thermostat to a comfortable level automatically.

9. Regulatory Compliance and Medical Certification

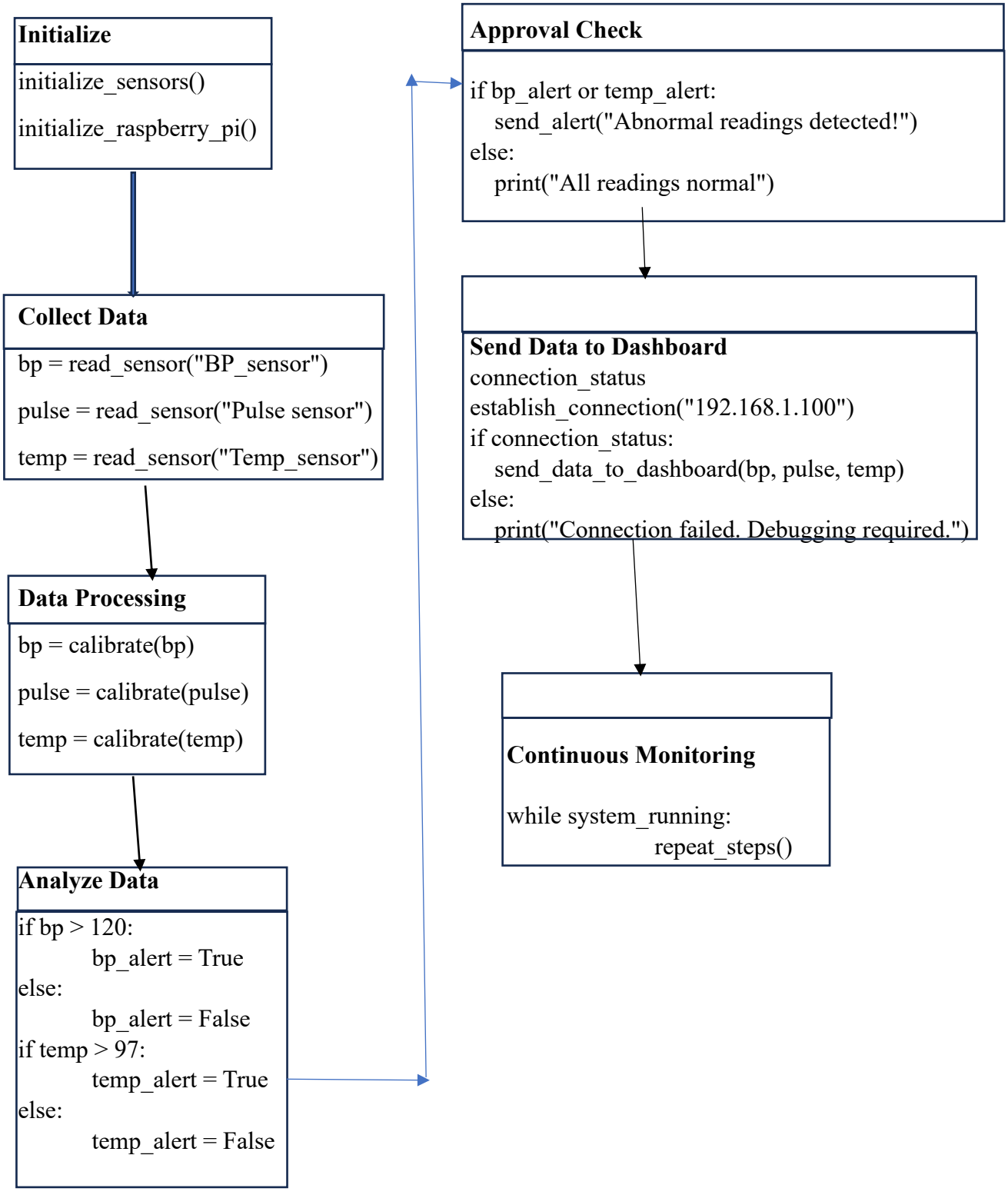
- To ensure broader adoption, the system can be refined to comply with medical device regulations and standards like ISO 13485 or FDA guidelines.
- Certification will enhance the credibility of the device and make it eligible for use in professional healthcare settings.

10. Low-Cost Variants for Mass Deployment

- A simplified, low-cost version of the system can be developed for large-scale deployment in underserved or remote areas.
- This version can include essential health monitoring features while maintaining affordability to support public health initiatives and rural healthcare programs.

By implementing these future enhancements, the health monitoring system will evolve into a robust and versatile platform that addresses a wide range of healthcare needs. Its potential to bridge the gap between traditional healthcare services and emerging technologies makes it a valuable tool for improving global health outcomes.

PSEUDOCODE


Initialize
initialize_sensors()
initialize_raspberry_pi()
Collect Data
bp = read_sensor("BP_sensor")
pulse = read_sensor("Pulse sensor")
temp = read_sensor("Temp_sensor")
Data Processing
bp = calibrate(bp)
pulse = calibrate(pulse)
temp = calibrate(temp)
Analyze Data
if bp > 120:
bp_alert = True
else:
bp_alert = False
if temp > 97:
temp_alert = True
else:
temp_alert = False
Approval Check
if bp_alert or temp_alert:
send_alert("Abnormal readings detected!")
else:
print("All readings normal")
Send Data to Dashboard
connection_status
establish_connection("192.168.1.100")
if connection_status:
send_data_to_dashboard(bp, pulse, temp)
else:
print("Connection failed. Debugging required.")
Continuous Monitoring
while system_running:
repeat_steps()