VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Jnana Sangama, Belgaum – 590014

Internship Project Report

On

"IoT Temperature and Mask Scan System"

Submitted in partial fulfillment of the requirement for the award of

BACHELOR OF ENGINEERING

IN

COMPUTER AND INFORMATION SCIENCE ENGINEERING

By

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2024-2025

DEPARTMENT OF COMPUTER AND INFORMATION SCIENCE ENGINEERING

A.P.S COLLEGE OF ENGINEERING

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Evaluation Sheet

Title of the Project**: IoT Temperature and Mask scanning system**

Name of the Students: Lakshmi S **(1AP21CS023)**
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External Supervisor:

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Date:

Place:

Project Completion Certificate

I, **Lakshmi S** (Roll No: 1AP21CS023), hereby declare that the material presented in the Project Report titled **"IoT Temperature and Mask scanning system"** represents original work carried out by me in the **Department of Computer Science and Engineering** at the **APS college of Engineering, Bangalore** 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.Tech. Internship Work.

Advisor's Name: **Dr SHIVAMURTHAIAH** **Guide Name: AKHIL SAI**

Advisor's Signature **Guide Signature**

Project Completion Certificate

I, **Sahaana R** (Roll No: 1AP21IS030), hereby declare that the material presented in the Project Report titled **"IoT Temperature and Mask scanning system "** represents original work carried out by me in the **Department of Information Science and Engineering** at the **APS college of Engineering, Bangalore** during the tenure **2 October, 2024 – 12, December, 2024**.

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Advisor's Signature **Guide Signature**

Project Completion Certificate

I, **Vaishnavi Sampemane** (Roll No: 1AP21IS042), hereby declare that the material presented in the Project Report titled **"IoT Temperature and Mask scanning system "** represents original work carried out by me in the **Department of Information Science and Engineering** at the **APS college of Engineering, Bangalore** during the tenure **2 October, 2024 – 12, December, 2024**.

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ABSTRACT

The "IoT Temperature & Mask Scan System" is an innovative solution aimed at enhancing public health and safety during pandemics. This project integrates IoT technology with temperature and mask detection systems to create a contactless entry system. The system uses temperature sensors to measure the body temperature of individuals and a camera module powered by AI algorithms to verify if a person is wearing a mask. Data collected is processed in real time and can be transmitted to a central server for monitoring and record-keeping, ensuring seamless and efficient management of entry points in public spaces such as offices, malls, and schools. This automation minimizes human intervention, thereby reducing the risk of virus transmission.

Designed for scalability and ease of deployment, this system emphasizes accuracy, reliability, and user-friendliness. It combines hardware components like microcontrollers, infrared temperature sensors, and cameras with software for IoT-based data communication and control. Alerts are triggered if abnormal temperatures are detected or masks are absent, preventing unauthorized access. The project demonstrates a practical application of IoT and AI technologies to address contemporary challenges posed by infectious diseases, promoting safer environments and fostering trust in public health measures.

CHAPTER 1

INTRODUCTION

In today’s world, ensuring safety and health compliance in public and private spaces has become increasingly important. Traditional methods of temperature screening and mask verification often rely on manual processes, which can be time-consuming and prone to errors. To address these challenges, the "IoT Temperature & Mask Scan System" provides a fully automated, contactless solution for monitoring body temperature and mask compliance at entry points. By leveraging advanced sensors and IoT technology, this system ensures efficient and reliable health screening in a wide range of settings, including workplaces, educational institutions, and commercial establishments.

The system employs infrared temperature sensors to measure body temperature accurately and integrates a camera module powered by AI to detect whether an individual is wearing a mask. With IoT capabilities, the collected data is transmitted in real-time to a central monitoring system, enabling remote supervision and record-keeping. Alerts are generated for instances of elevated temperature or absence of masks, preventing unauthorized access and ensuring compliance with safety standards. This automated approach reduces the need for human intervention, improving hygiene and streamlining the screening process.

The "IoT Temperature & Mask Scan System" demonstrates the potential of combining hardware and software technologies to create innovative safety solutions. Its scalable, user-friendly design makes it suitable for various applications while addressing the growing need for efficient health monitoring systems. This project not only enhances entry management but also lays the groundwork for future advancements in IoT-driven safety and compliance systems.

1.1 OBJECTIVE

The "IoT Temperature & Mask Scan System" aims to provide an automated, contactless solution for monitoring health compliance at entry points, ensuring accurate temperature checks and mask verification. By leveraging IoT and AI, it enhances screening accuracy, reduces human error, and enables real-time data transmission for efficient management and record-keeping. The system is scalable and adaptable for various environments, with potential for future upgrades. Ultimately, it contributes to safer, more efficient health and safety management.

1.2 PROBLEM STATEMENT

- In high-traffic environments, manual temperature screening and mask verification are inefficient, prone to human error, and compromise safety.
- These traditional methods require close interaction, increasing the risk of hygiene issues.
- The absence of a reliable, automated solution for health monitoring creates vulnerabilities in maintaining a secure environment.
- The "IoT Temperature & Mask Scan System" addresses these challenges by offering an accurate, contactless, and scalable solution for health compliance at entry points.

CHAPTER 2

APPLICATION

1. Workplace Safety

The "IoT Temperature & Mask Scan System" is ideal for workplaces, including offices and industrial facilities, where employee safety is paramount. By automating the process of temperature checks and mask verification, the system ensures seamless entry management while minimizing human intervention. It helps organizations maintain a hygienic environment, reducing the risk of health-related disruptions. Additionally, the system provides detailed logs of health data, enabling compliance with safety protocols and audits.

2. Educational Institutions

In schools, colleges, and universities, managing large crowds during entry and exit times is a significant challenge. This system simplifies the screening process by ensuring that all individuals meet health compliance standards before entering. Its contactless operation makes it particularly effective in maintaining safety in high-traffic areas like classrooms, cafeterias, and auditoriums. The system also fosters a sense of security among students, parents, and staff, ensuring uninterrupted academic operations.

3. Commercial Establishments

Shopping malls, retail outlets, and entertainment centers can leverage this system to ensure customer and staff safety. The automated screening process reassures visitors that necessary precautions are being taken, enhancing customer confidence. By providing real-time alerts for non-compliance, the system prevents potential health risks, ensuring that public spaces remain safe and welcoming for everyone.

4. Healthcare Facilities

Hospitals, clinics, and diagnostic centers can use the system to monitor patients, visitors, and staff. The ability to detect abnormal temperatures or the absence of masks in real-time is critical in maintaining a safe environment in healthcare settings. By automating the screening process, the system reduces the workload on healthcare workers, allowing them to focus on patient care while ensuring adherence to health standards.

5. Public Transportation Hubs

The system is particularly useful in transportation hubs such as airports, bus stations, and railway terminals. These locations often experience high foot traffic, making manual health screening cumbersome and inefficient. The "IoT Temperature & Mask Scan System" ensures quick and accurate screening of passengers, minimizing delays while maintaining health and safety compliance.

6. Event Venues

Concert halls, sports arenas, and conference centers can benefit from the system by ensuring health compliance among attendees. The system's ability to handle large volumes of people efficiently makes it ideal for events where safety is a top priority. By integrating this technology, event organizers can create a secure environment, allowing attendees to focus on enjoying the event without concerns about health risks.

CHAPTER 3

SYSTEM REQUIREMENTS

3.1 HARDWARE COMPONENTS:

1. Raspberry Pi

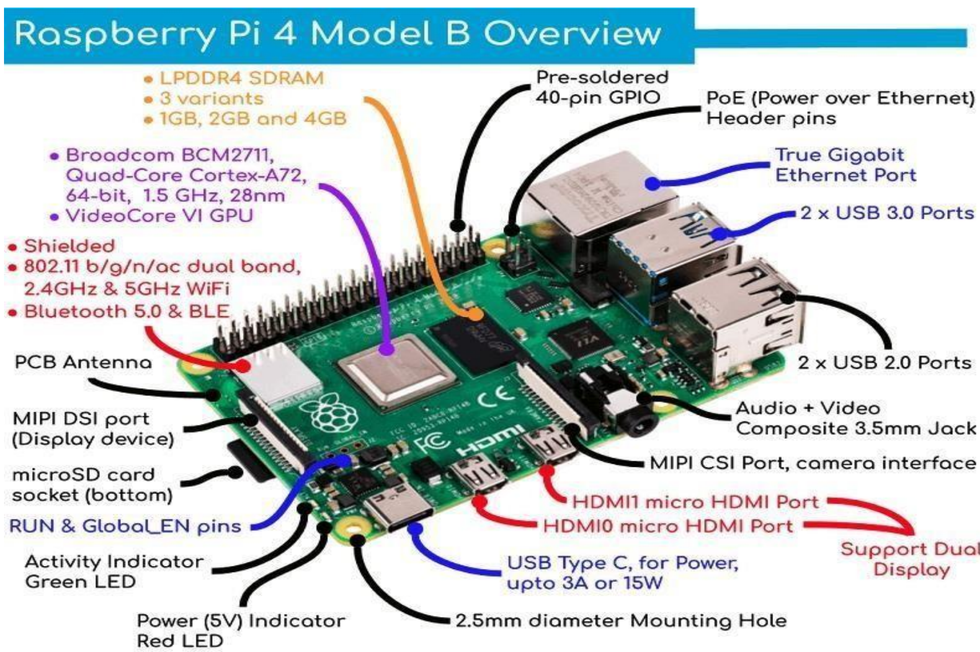


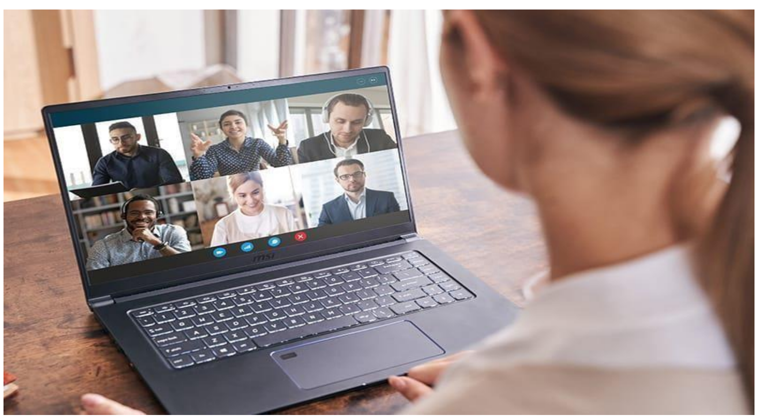
Fig: 3.1.1

The Raspberry Pi serves as the core controller of the system. It processes the data from various sensors, triggers alerts, and communicates with the cloud platform (ThingSpeak). The Raspberry Pi has multiple GPIO (General Purpose Input/Output) pins to connect and control sensors and output devices like the buzzer and LED. It also provides Wi-Fi connectivity for cloud communication. The Raspberry Pi 4 Model B is a powerful single-board computer designed for a variety of applications, from education to industrial automation. It features a quad-core ARM Cortex-A72 processor, up to 8GB of RAM, dual micro-HDMI ports supporting 4K output, and USB 3.0 connectivity.

2. Temperature Sensor (DHT22):

The DHT22 sensor is used to measure the ambient temperature of an individual. This is a digital sensor capable of detecting both temperature and humidity with a higher degree of accuracy and reliability compared to lower-cost alternatives like the DHT11. It is connected to the Raspberry Pi via GPIO pins and provides real-time data, which is crucial for determining if an individual has a fever. The data from the sensor will be processed to assess whether the temperature exceeds predefined thresholds, indicating a potential health concern.

3. Camera Module (Webcam):



The webcam will capture images or video streams of the individuals approaching the system. The camera will be used for face detection and mask detection. Face detection is necessary to locate a person's face in the image, while mask detection will verify whether the individual is wearing a face mask. Face detection can be performed using machine learning models, and mask detection can be done by analyzing the detected faces. A high-quality camera is important for reliable facial recognition and accurate mask detection in varying lighting conditions.

4. Buzzer:

The buzzer serves as an alert system for notifying the user when a person has a high temperature or is not wearing a mask. The buzzer is a simple yet effective way to provide an audible warning in real-time, prompting immediate corrective actions. For instance, if the system detects a fever or an individual not wearing a mask, the buzzer will sound, alerting both the person and any nearby staff members.

5. Power Supply:

A 5V/2.5A power supply is required to ensure the Raspberry Pi, sensors, and camera module receive sufficient power to function properly. Raspberry Pi models generally require this amount of power, and a stable power supply is necessary to maintain smooth operation, especially when running peripherals like the camera module and sensors simultaneously.

3.2 SOFTWARE COMPONENTS:

1. Operating System: Raspberry Pi OS

The Raspberry Pi OS (formerly Raspbian) is the most widely used operating system for Raspberry Pi. It is a Linux-based OS designed specifically for the Raspberry Pi hardware. It includes essential libraries and packages that facilitate the easy setup and integration of hardware components. Raspberry Pi OS supports programming languages such as Python, which is essential for implementing the system's logic and interfacing with the sensors and camera.

2. Programming Languages: Python

Python is the primary programming language used for implementing the Temperature and Mask Scan system. Python's versatility, ease of use, and large library ecosystem make it the perfect choice for developing IoT applications. Python will handle the logic for temperature readings, image processing, mask detection, and interfacing with the buzzer and other hardware components. Libraries like OpenCV and Flask can be used within Python to perform advanced tasks like image processing and web communication.

3. Face and Mask Detection Libraries: OpenCV

OpenCV (Open Source Computer Vision Library) is an open-source computer vision and machine learning software library that provides tools for image processing, video capture, and face detection. In this system, OpenCV will be used for face detection to locate human faces in the captured images. Once faces are detected, OpenCV can also be used to assess whether the person is wearing a mask by using pre-trained deep learning models.

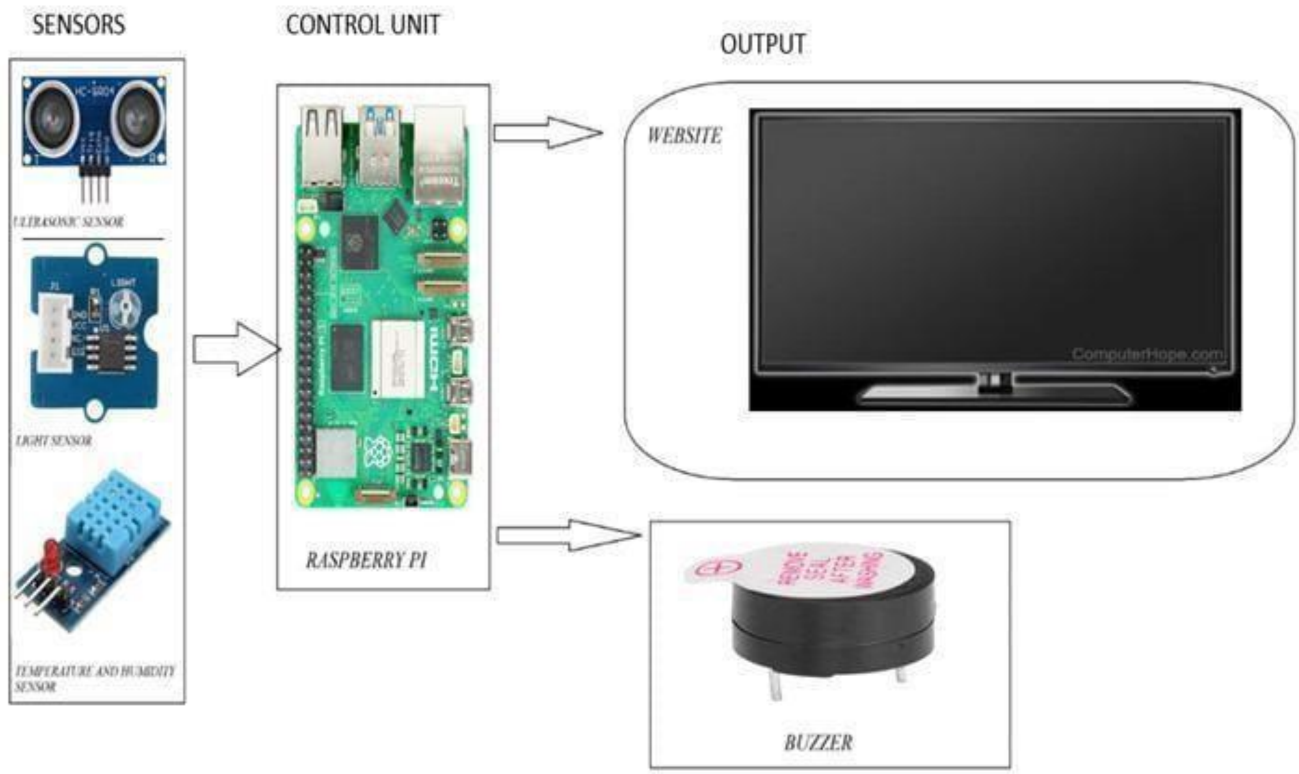
The mask detection part can be performed by training a model to differentiate between masked and unmasked faces. The system will analyze the face region, comparing it to mask-wearing criteria, and flag the person if no mask is detected.

4. Flask (Web Interface):

Flask is a lightweight web framework for Python that enables the creation of web applications. In this project, Flask can be used to create a simple web interface to monitor and control the system remotely. This interface can display live data such as the temperature readings and the status of mask detection.

CHAPTER 4

FLOWCHART



CHAPTER 5

CONCLUSION

The IoT-based Temperature and Mask Scan System using Raspberry Pi is a robust and efficient solution to address the challenges posed by modern health and safety requirements. By integrating non-contact temperature measurement and mask detection, the system offers a reliable and automated way to ensure the compliance of individuals entering a facility, thereby reducing manual effort and minimizing the risk of infection spread.

This project demonstrates the potential of IoT and machine learning technologies in creating innovative solutions for real-world problems. The Raspberry Pi serves as the central processing unit, efficiently handling data from the temperature sensor and the camera module. Using pre-trained mask detection models and real-time temperature sensing, the system ensures quick and accurate decision-making. The integration with cloud-based IoT platforms for data logging further enhances the system's functionality, providing remote monitoring and analytics capabilities for administrators.

The system is highly scalable and customizable, allowing for integration with additional features such as automated door control, alerts for non-compliance, and extended logging for health records. It is also cost-effective, leveraging affordable hardware and open-source software frameworks to achieve its objectives.

In conclusion, this project highlights the importance of technology in creating safer and smarter environments. It addresses critical health and safety needs, particularly in high-traffic areas such as offices, schools, hospitals, and public venues. With further refinement and adoption, such systems can play a significant role in enhancing public health protocols and ensuring safe interactions in a post-pandemic.

CHAPTER 6

FUTURE WORK

The future of temperature and scan detection systems holds significant promise, particularly in the realms of healthcare, public safety, and industrial applications. As technology advances, these systems will become increasingly sophisticated, enabling more accurate, real-time detection and analysis of temperature variations and other vital signs. The integration of artificial intelligence (AI) and machine learning (ML) into these systems will enhance their predictive capabilities, allowing them to not only detect abnormal temperatures but also identify potential trends, assess risks, and provide automated alerts for timely interventions.

In healthcare, these systems will play a crucial role in monitoring patients' vital signs remotely, detecting early signs of infection or fever, and enabling more efficient management of contagious diseases. The development of non-invasive, high-precision sensors will allow for continuous, seamless monitoring of individuals, especially in environments like hospitals, airports, or workplaces, where public health surveillance is critical. Additionally, AI-powered algorithms could help prioritize cases based on severity, optimizing healthcare resources and reducing human error.

In terms of public safety, temperature and scan detection systems could be used more extensively for screening in crowded areas, such as transportation hubs, schools, or large events. Advanced thermal imaging systems will be combined with facial recognition technology to quickly and accurately identify individuals who may be showing symptoms of illness, such as elevated body temperature. This could lead to more efficient and less invasive screening processes, reducing wait times and improving the overall effectiveness of public health measures, especially during epidemics or pandemics.

Industrial applications of temperature detection will likely become more prevalent in manufacturing, energy, and infrastructure sectors. Systems that monitor equipment and machinery in real-time can help prevent overheating, identify faulty components, and predict maintenance needs before failures occur, improving safety and reducing downtime. These systems will be integrated with the Internet of Things (IoT) to create smarter, more efficient production environments.

Overall, the future of temperature and scan detection systems will be defined by greater precision, real-time data analysis, and seamless integration with other technologies. As these systems evolve, they will become invaluable tools not only for healthcare and safety but also for enhancing operational efficiency and preventing crises across various industries.

CHAPTER 7

APPENDIX

1. System Overview

A Temperature and Mask Detection System integrates thermal imaging technology and AI-powered algorithms to detect elevated body temperature (fever) and check if individuals are wearing masks. This combination of temperature and mask detection serves as a quick, non-invasive method for screening large groups of people in environments where the risk of contagious diseases, like COVID-19, is high.

Core Components:

- **Thermal Camera:** A high-resolution infrared camera capable of detecting temperature variations across individuals' faces or foreheads. The system is designed to detect body temperature from a distance, offering quick, real-time readings.
- **Mask Detection Sensor:** Often integrated into the same platform as the thermal camera, this system uses computer vision to analyze whether an individual is wearing a mask. This is typically done through image processing and facial recognition algorithms that detect facial coverings.
- **AI and Machine Learning Algorithms:** These algorithms process data from both the thermal camera and the mask detection system. They classify temperature readings (e.g., normal or elevated) and mask status (e.g., worn or not worn) while minimizing false positives or false negatives.
- **User Interface (UI) and Alerts System:** The system provides a user-friendly interface for operators and sends automated alerts if an individual with a high temperature or no mask is detected. Alerts can be visual (e.g., screen notifications) or auditory (e.g., alarm sounds).

2. Functionality and Workflow

- **Step 1: Temperature Scanning**
  As individuals walk through the detection area, the thermal camera captures their temperature without any direct contact. The system uses infrared sensors to detect the heat emitted from their body. A temperature threshold (e.g., 100.4°F / 38°C) is set in the system's software to trigger alerts if exceeded.
- **Step 2: Mask Detection**
  Simultaneously, the mask detection algorithm analyzes the facial image to check if the person is

wearing a mask. If the individual is not wearing a mask or is improperly wearing one (e.g., below the nose), the system flags the person for follow-up action.

- **Step 3: Real-Time Alerts**
  If the system detects either an elevated temperature or a mask violation, an alert is immediately generated. Alerts can include visual displays (e.g., red light on a monitor), notifications to security personnel, or direct communication to the individual (e.g., via a loudspeaker instructing them to wear a mask or seek medical attention).
- **Step 4: Data Logging and Reporting**
  The system logs temperature readings, mask detection status, and alert incidents. Data can be stored locally or in the cloud for future reference, statistical analysis, or compliance reporting, depending on regulatory requirements.

3. Applications of Temperature and Mask Detection Systems

- **Public Health Safety:** In high-traffic public areas such as airports, train stations, and shopping malls, these systems can screen people for fever symptoms and ensure mask compliance without the need for human intervention. They play a vital role in reducing the spread of infectious diseases in large crowds.
- **Workplace Environments:** In offices, factories, and warehouses, the system can be used to monitor employees' temperatures as they enter the building. Non-compliance with mask-wearing policies can be automatically detected, contributing to a healthier, safer work environment.
- **Hospitals and Healthcare Settings:** Hospitals can use these systems to screen visitors, patients, and staff to identify potentially infected individuals quickly. These systems can reduce wait times and help prioritize cases, especially during infectious disease outbreaks.
- **Schools and Educational Institutions:** During health crises like the COVID-19 pandemic, schools can employ these systems at entrances to check for temperature elevations and ensure students and staff adhere to mask mandates.
- **Large Events and Venues:** Concerts, sporting events, conferences, and other large gatherings can use these systems at entry points to efficiently screen attendees before allowing them into the venue.

4. Advantages of Temperature and Mask Detection Systems

- **Non-invasive Screening:** These systems provide a quick, non-contact method for identifying individuals with fever symptoms and mask violations, improving efficiency and reducing the potential for cross-contamination.

- **Scalability and Automation:** These systems can be easily scaled to accommodate high-volume environments like airports or stadiums. Automation minimizes the need for human staff to manually check temperatures or enforce mask-wearing.
- **Reduced Risk of Transmission:** By preventing individuals with elevated temperatures from entering crowded spaces, and ensuring mask compliance, these systems can help reduce the risk of airborne infectious diseases spreading.
- **Real-time Monitoring and Alerts:** The system provides immediate feedback, enabling staff to take swift action if an issue arises. For instance, an individual flagged for a high temperature can be directed to a medical screening station for further evaluation.

5. Challenges and Limitations

- **Accuracy of Temperature Measurement:** Thermal cameras may be influenced by environmental conditions, such as ambient temperature or lighting, which could lead to inaccurate readings. Calibration and proper setup are critical to ensuring reliable results.
- **Mask Detection in Varied Conditions:** Mask detection algorithms may struggle in certain situations, such as with people wearing scarves or face shields, or if the mask is not clearly visible due to angles or occlusions.
- **Privacy Concerns:** While these systems often do not rely on identifying individuals, the use of facial recognition or logging body temperatures could raise privacy concerns. Adherence to local data protection regulations (e.g., GDPR) and transparent communication about data collection practices is essential.
- **Dependence on System Maintenance:** Like any automated system, regular maintenance, calibration, and updates are necessary to ensure continued effectiveness, especially as new mask designs or virus variants emerge.

6. Future Developments

The future of temperature and mask detection systems will likely include:

- **Integration with Health Monitoring Platforms:** Systems will be integrated with broader health data management platforms that track an individual’s health status, vaccination records, or screening history for better decision-making and response.
- **Enhanced AI Algorithms:** Advanced machine learning models will improve accuracy in both mask detection (e.g., distinguishing between masks, face shields, and other face coverings) and temperature screening, even in complex or dynamic environments.
- **Mobile and Remote Monitoring:** As mobile technology advances, the ability to monitor

temperatures and mask compliance remotely through mobile apps or cloud-based systems will increase. This would allow real-time analysis and the ability to deploy remote responses.

- **Multi-Sensor Fusion:** Combining thermal imaging with other sensors, such as air quality monitors, biometric scanners, or motion detectors, could provide a more comprehensive picture of public health, improving system reliability and flexibility in a variety of environments.

CHAPTER 8

PSUEDOCODE

Pseudo Code for Face Mask Detection with Raspberry Pi Integration

1. Import Required Libraries

Import libraries for computer vision, machine learning, and HTTP requests.

2. Load Pre-trained Model

Load the face mask detection model.

Define labels and colors for "Mask" and "No Mask".

3. Set Raspberry Pi Details

Define the Raspberry Pi's IP address and endpoint for controlling the buzzer.

4. Initialize Video Capture and Face Detection

Open the webcam for real-time video capture.

Load the Haar Cascade classifier for face detection.

5. Start Video Stream

Enter a loop to process each frame from the webcam.

Flip and resize the frame for better processing.

6. Detect Faces in Frame

Use the classifier to detect faces in the frame.

For each detected face:

Extract the face region.

Preprocess the face (resize, normalize, reshape).

7. Predict Mask Status

Use the model to predict whether the person is wearing a mask or not.

Assign a label based on the prediction.

8. Send Signal to Raspberry Pi

If "No Mask" is detected, send a signal to turn on the buzzer.

If "Mask" is detected, send a signal to turn off the buzzer.

9. Draw Bounding Box and Label

Draw a rectangle around the face and display the prediction label.

10. Display the Frame

Show the frame in a window titled "Face Mask Detection".

11. Exit Loop

Check for the "Esc" key press to exit the loop.

12. Release Resources

Release the webcam and close all OpenCV windows.

Pseudo Code for Temperature Detection with Flask and Raspberry Pi

1. Import Required Libraries

Import Flask for the web server.

Import RPi.GPIO for Raspberry Pi GPIO control.

2. Set Up GPIO

Disable GPIO warnings.

Set the GPIO mode to BOARD.

Configure GPIO pin 38 as an output pin.

3. Initialize Flask Server

Create an instance of the Flask application.

4. Define the /buzzer Endpoint

Create a route (/buzzer) that listens for POST requests.

Parse the JSON data from the incoming request.

5. Control the Buzzer Based on Input

Check if the JSON data contains the key "buzzer".

If "buzzer" is "on", set GPIO pin 38 to HIGH (turn on the buzzer).

If "buzzer" is "off", set GPIO pin 38 to LOW (turn off the buzzer).

Return appropriate success or failure responses based on the input.

6. Handle Invalid Requests

If the data is missing or invalid, return a 400 Bad Request response.

7. Run the Flask Server

Start the Flask server, listening on all network interfaces (0.0.0.0) and port 5000.

8. Graceful Exit

Handle keyboard interruptions.

Cleanup GPIO settings when the server stops.

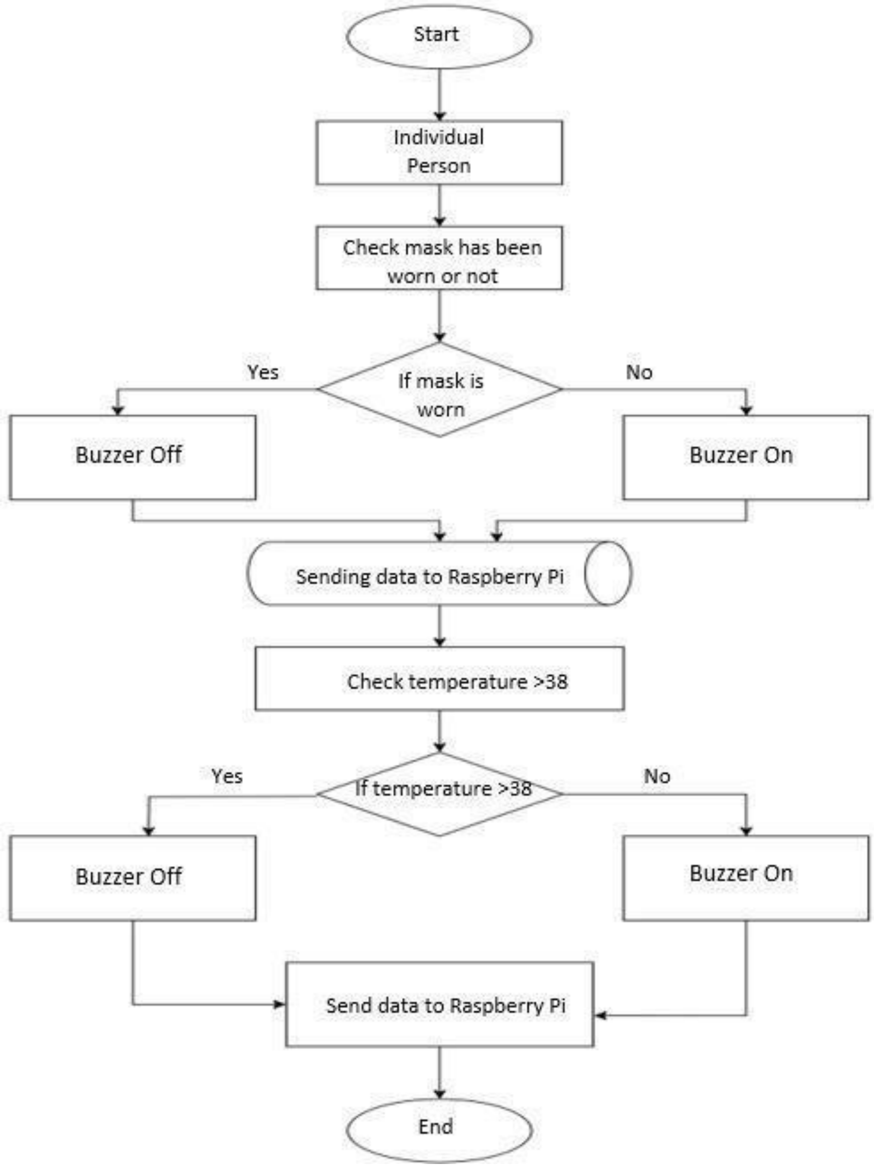


Fig 8.1: Work flow