

Electric Street Cart with Protocols for Airborne Diseases

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ABSTRACT

Airborne diseases can spread rapidly through respiratory droplets and aerosols generated by infected individuals during coughing, sneezing, or close interpersonal interaction. Preventive practices such as wearing face masks and maintaining adequate social distance can reduce the possibility of disease transmission. However, continuously monitoring these practices in crowded public areas is difficult. This paper presents an Electric Street Cart with Protocols for Airborne Diseases, designed using a Raspberry Pi platform, webcam, IR sensors, and speaker. Artificial intelligence, deep learning, and image-processing techniques are employed to identify whether a person is wearing a face mask. The webcam captures real-time images, which are processed by the Raspberry Pi to classify individuals as wearing or not wearing a mask. When a violation is detected, an audio warning is generated through the speaker. IR sensors are additionally used for social-distance monitoring and generate an audio alert when the required distance is not maintained. The developed system provides a low-cost approach for assisting street vendors and other public environments in maintaining airborne-disease safety protocols.

Keywords— Airborne diseases, Raspberry Pi, face mask detection, social distancing, deep learning, artificial intelligence, OpenCV, MobileNetV2, IR sensor.

INTRODUCTION

Airborne diseases are caused by pathogenic microorganisms that can be transmitted through respiratory droplets, aerosols, and close contact with infected individuals. The microorganisms released through coughing or sneezing may remain suspended in air or settle on surrounding surfaces. Consequently, preventive measures such as wearing masks, maintaining sufficient interpersonal distance, practicing respiratory etiquette, and maintaining hygiene can play an important role in reducing disease transmission.

Street vendors frequently interact directly with customers while selling essential products such as vegetables and fruits. During periods of widespread airborne disease, such close interaction can increase health risks. Manual observation of every customer for compliance with mask and distancing requirements is difficult. Therefore, an automated monitoring system can provide a practical means of assisting vendors in implementing these preventive protocols.

The proposed system employs artificial intelligence and image-processing techniques for automatic face-mask detection. A webcam captures real-time images, while the Raspberry Pi processes the images and determines whether the detected person is wearing a mask. Deep-learning techniques based on convolutional neural networks are used for classification. In addition, IR sensors are incorporated for distance monitoring. When a person without a mask or a social-distance violation is detected, the speaker provides an appropriate audio warning.

LITERATURE SURVEY

Ma *et al.* [1] discussed advances in airborne microorganism detection using biosensors and reviewed biochemical, immune, and molecular detection technologies. Although these techniques provide useful detection performance, limitations remain with respect to stability and practical airborne microorganism monitoring. Nguyen *et al.* [2] investigated blockchain- and AI-based solutions for combating coronavirus, emphasizing the role of artificial intelligence in disease-related applications and blockchain technology for secure healthcare-data management. Lingan Gouda *et al.* [3] discussed face-mask detection and related protocols using machine learning, deep learning, and image-processing approaches. Their work highlights the importance of automated monitoring systems for identifying individuals who are not complying with mask requirements.

B. Shiva and Jyothi [4] presented a face-mask detection system using deep learning and discussed the use of AI-based automated systems for monitoring mask compliance. Such systems can support public-health measures by automatically identifying individuals who are not wearing masks. Belhumeur *et al.* [5] presented work related to face recognition using class-specific linear projection, forming part of the broader development of machine-based facial analysis techniques. Based on these studies, the present work combines AI-based mask detection with distance monitoring to provide an integrated safety-protocol system suitable for a street-vending environment.

PROBLEM STATEMENT

Airborne infections can spread through aerosols and droplets released from the nose or mouth of infected individuals during coughing, sneezing, or close interaction. In crowded public environments, manually verifying whether every individual is wearing a mask and maintaining the required distance is difficult. Therefore, an automated system is required to detect face-mask compliance and monitor interpersonal distance while providing immediate warnings whenever safety protocols are violated.

OBJECTIVES

1. To develop an AI- and deep-learning-based automatic face-mask detection system using a Raspberry Pi and webcam for identifying individuals with and without face masks.
2. To develop a social-distance monitoring system using IR sensors and provide automatic audio warnings whenever mask or distancing protocols are violated.

PROPOSED SYSTEM

The proposed Electric Street Cart with Protocols for Airborne Diseases integrates a Raspberry Pi 4 Model B, webcam, speaker, IR sensors, and connecting wires. The Raspberry Pi acts as the central processing unit of the system. The webcam continuously captures real-time images of customers approaching the cart and supplies the image information to the Raspberry Pi. The trained face-mask detection model processes the captured images and classifies the detected face according to mask status. When the system identifies a person without a mask, an audio warning is generated through the speaker.

The IR sensors provide an additional safety function by monitoring the proximity of persons to the cart. The sensor information is processed through the Raspberry Pi GPIO interface. When the programmed distancing condition is violated, the system generates a spoken warning requesting the individual to maintain social distance. Thus, mask detection and distance monitoring operate together to provide an automated protocol-monitoring platform.

BLOCK DIAGRAM

Fig. 1 shows the block diagram of the proposed Electric Street Cart with Protocols for Airborne Diseases. The webcam and sensor provide real-time inputs to the Raspberry Pi, which processes the data for face-mask and distance monitoring. When a safety protocol is violated, the speaker generates an audio alert to warn the user.

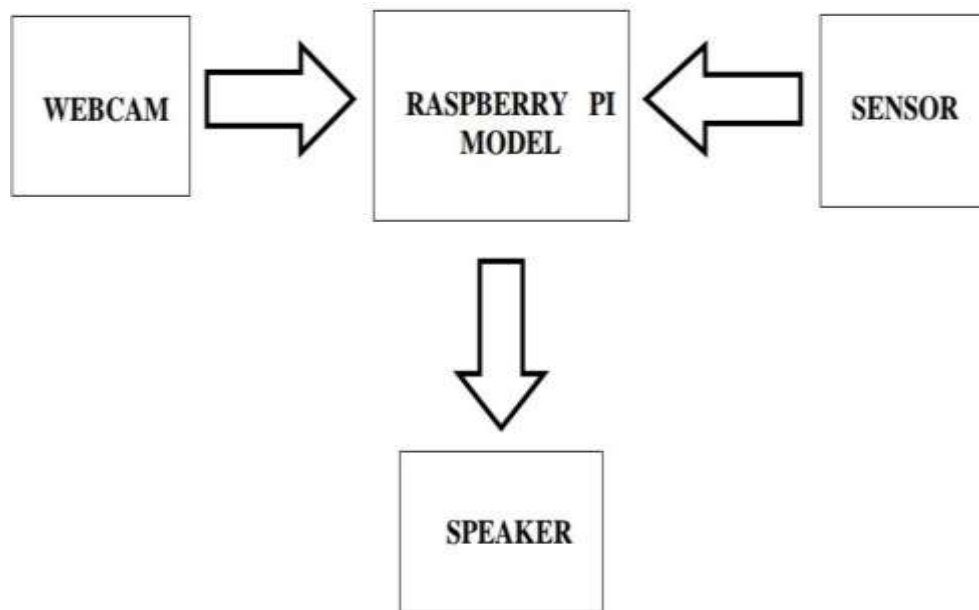


Fig 1 Block Diagram

CIRCUIT DIAGRAM

Fig. 2 illustrates the integrated circuit connections of the proposed system using the Raspberry Pi 4 Model B as the central controller. The webcam and IR sensor provide inputs for face-mask and distance detection, while the speaker generates audio alerts and the monitor displays the real-time detection results.

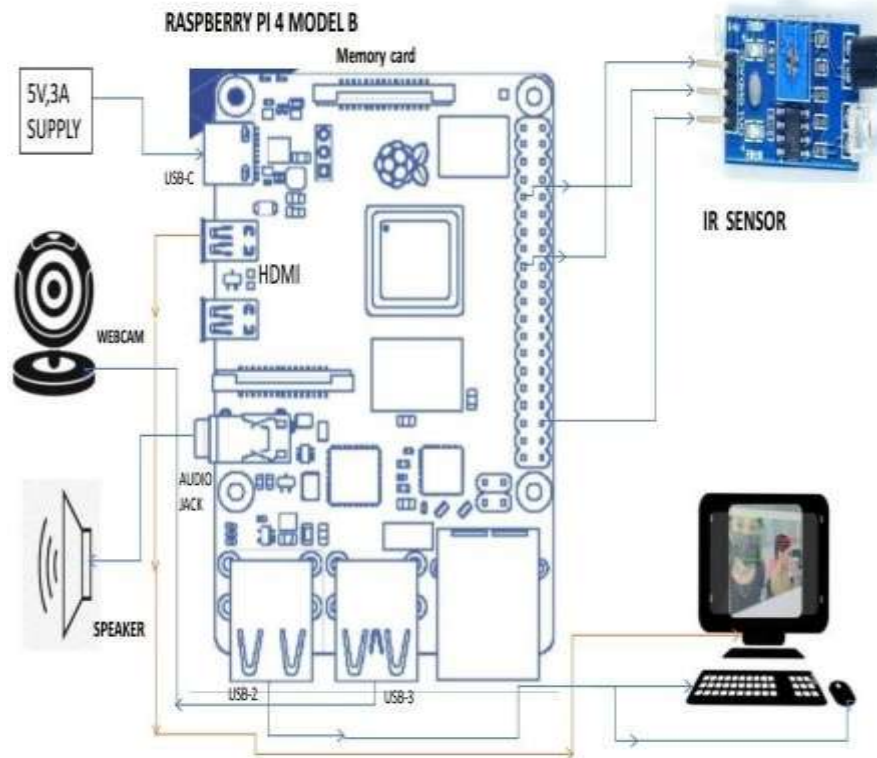


Fig 2: Circuit Diagram of Electric Street Cart with Protocols for Airborne Diseases

METHODOLOGY

The proposed methodology consists of dataset preparation, model training, real-time image acquisition, mask classification, distance monitoring, and audio-warning generation. Initially, images representing faces with masks and without masks are collected and labeled. According to the report, the dataset contains more than 1000 images. The images undergo preprocessing before being used for network training and classification. MobileNetV2 is employed as the classifier for the face-mask detection system.

After training, the model is deployed on the Raspberry Pi. The webcam continuously captures video frames and the face-detection algorithm locates facial regions within each frame. These regions are supplied to the trained model for mask classification. Simultaneously, the IR sensors monitor proximity conditions. When either mask or distancing requirements are violated, the Raspberry Pi activates the speaker to provide an immediate warning. This approach combines computer vision, deep learning, embedded processing, sensing, and audio feedback in a single prototype.

RESULTS AND DISCUSSION

The Fig. 3.1, Fig. 3.2, and Fig. 3.3 developed system demonstrates the successful implementation of face-mask detection using both static images and real-time video streams. The trained MobileNetV2-based model processes live camera frames and classifies detected faces as either **with mask or without mask**. The implementation involves dataset collection, image labeling, preprocessing, model training, classification, and real-time testing to achieve effective automatic mask monitoring.

During operation, the system provides different responses depending on the detected condition. A person wearing a mask is recognized as compliant, whereas detection of a person without a mask produces an alert requesting the individual to wear a mask. The distance-monitoring subsystem complements the mask detector by using sensor inputs to identify proximity violations and produce an audio message requesting social distancing. Therefore, the experimental prototype demonstrates the integration of real-time computer vision and sensor-based monitoring for automatically enforcing basic airborne-disease protocols.



Fig 3.1 Hardware Setup



Fig 3.2 Without face mask

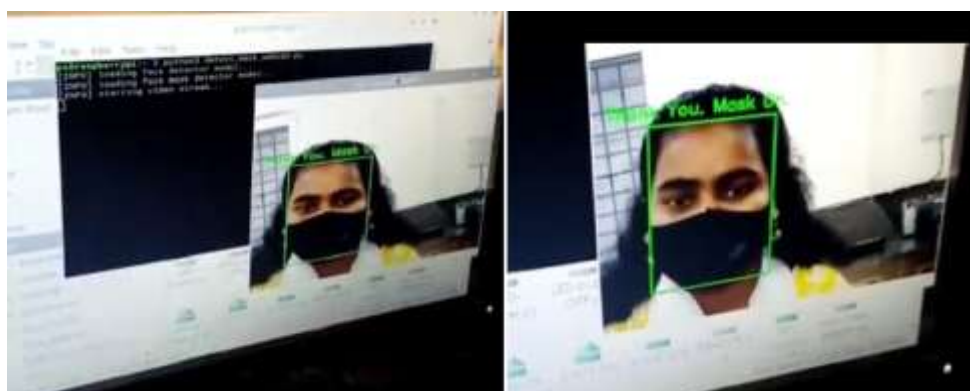


Fig 3.3 With face mask

CONCLUSION

An Electric Street Cart with Protocols for Airborne Diseases has been developed using Raspberry Pi, artificial intelligence, deep learning, image processing, webcam-based face detection, IR sensing, and audio-warning techniques. The implemented system automatically identifies individuals with and without face masks and generates an alert when mask requirements are violated. The sensor-based distance-monitoring subsystem additionally provides an audio warning when the required distance is not maintained. The integration of these functions provides a practical prototype for assisting street vendors in maintaining basic airborne-disease safety protocols. The proposed approach can be further extended to surveillance systems and other public environments where automatic mask and social-distance monitoring is required.

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