Smart Access System for Public Transport

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Abstract : **:** According to data obtained by the World Health Organization, the global pandemic of COVID-19 has impacted the world severely. To combat the virus there are certain mandatory protocols set by the World Health Organization. Those are wearing face masks and following social distancing in public places in order to prevent the spread of the virus. Wearing masks will effectively stop airborne viruses so that such infections cannot reach a human body. In this project deep learning techniques are applied to construct a classifier that will collect pictures of people wearing masks and those who are not from the database and differentiate between these classes of mask wearing and non facemask wearing. To create a safe environment that contributes to public safety, we have designed a computer vision-based approach focused on the automatic monitoring of people to detect face masks in public places by implementing the model on Raspberry Pi to survey activity and detect breaches through cameras. After detection of breach, the Raspberry pi sends a red signal. Thus, the proposed system favours the society by saving time and helps in lowering the spread of the virus. It can be used effectively in current situations when lockdown is eased to inspect persons in public transports i.e railway stations, airports, bus stations etc. Automated inspection reduces manpower to inspect the public transport stations mainly and also can be used in any place.

Keywords: **Facemask detection, Raspberry Pi, OpenCV, Deep Learning, COVID-19.**

I. INTRODUCTION

The main aim of this project is to make a Smart Access System to monitor and identify those who are complying with the rules by wearing the mask and those who are not. In the present scenario due to Covid-19, there are no efficient face mask detection applications which are now in high demand for transportation means, densely populated areas, residential districts, large-scale manufacturers and other enterprises to ensure safety. To combat such virus outbreaks and transmissions, there are certain guidelines set by the WHO like wearing face masks compulsorily. Wearing masks can effectively suppress these virus transmissions and help prevent community outbreaks. It is essential to develop an automated detection system which will help in giving individual protection from such viruses. Smart Access System is dominant in detecting a human face whether he/she is wearing a face mask. Access control with mask detection is a simple solution to help reduce the risk of getting infected, and also a good reminder to wear masks before entering certain areas. It is difficult to monitor the number of people just using surveillance cameras. Along with the ticketing system, public transport organizations will have to check for face masks. The manpower required to monitor large crowds will be tremendous. To overcome that problem an intelligent system is installed at checkpoints and crowded areas Therefore, an automated and more scalable solution to check for a face mask in advance is key.

II. LITERATURE SURVEY:

Research paper presented as “Real-Time Facemask Recognition with Alarm System using Deep Learning” the author has proposed an alarm system which will classify the masks wearers and non-masks ones and send an alert to the system in the form of an alarm. The author uses deep learning techniques to construct a classifier that will collect the images from databases and differentiate between facemask wearing and non-facemask wearing ones. System uses a Raspberry Pi and Pi camera and Image processing algorithms. From that research paper we are trying to implement a Smart Access System using Raspberry Pi that will detect the facemask and act as a security system in Public Transport Systems.[1] To create a safe environment that contributes to public safety, we propose a computer vision based approach focused on the automated monitoring of people to detect face masks in public places by implementing the model on Raspberry Pi 3 to monitor activity and detect violations through camera.[1] In the research paper “ Multi-Stage CNN Architecture for Face Mask Detection” the author aims to design a binary face classifier which can detect any face present in the frame. It uses image processing and computer vision technologies to detect face masks. The author has proposed a two staged process of implementing a CNN based face mask detection system i.e., Face Mask Detector and Face Mask Classifier. An unbiased dataset of masked and unmasked faces was created.[2] To implement this idea we will need a Raspberry Pi, Pi camera module along with a channel relay and dc motor, to develop a hands-free automated access control system. Steps such as Image Acquisition, Image processing, Feature Extraction and classification are performed for face mask detection. These steps are part of Convolutional Neural Network (CNN) which is a structured deep learning process, applicable for computer vision and image-based applications. Accuracy up to 96% can be achieved using these techniques.[3] In the research paper “Deep Learning based Safe Social Distancing and Face Mask Detection in Public Areas for COVID-19 Safety Guidelines Adherence” the author has proposed a system which is powered by Raspberry Pi and the final output is displayed on the screen. The Author built a system working model to show a detection system to identify people with/without masks. Authors model can detect masks in real time surveillance systems.[4] In the research paper “The use of facemasks to prevent respiratory infection: a literature review in the context of the Health Belief Model” the author has stated that the use of facemasks has proven to be an effective barrier to curb the aerosol spread of such diseases. And conducted a literature review to determine the factors that influence the use of facemasks as a primary preventive health measure in the community.[5]

III. NEED OF THE SYSTEM

As the current virus of COVID-19 which stands for Coronavirus of 2019 continues its spread there is a need for an innovative and robust technology to fight the virus. As wearing face masks is an efficient way to prevent the spread of the virus, an automated facemask monitoring system is in demand. Organizations and public sectors would want a robust and automated facemask monitoring system to make sure everyone is wearing facemasks all the time. The facemask detection system can automatically detect a person without facemask using analytics through Raspberry Pi camera.

IV. OBJECTIVES

The primary aim of this project "Smart Access System for Public Transport" is to develop an automated face mask monitoring system used in public transport places like railway stations, airports, bus stations, ferries etc. The aims of this project are as follows: -

- To prevent the spread of COVID-19 by creating a system for classifying facial images using effective technology to detect the face mask.
- To overcome the problem of tremendous manpower required to monitor places with large crowds.
- To deploy this system at Airports, Hospitals, Corporate Offices, Sports Venues, Malls, etc. i.e., places with large numbers of crowds ensuring safety of people.
- To make an efficient access system and grant entrance to public transport to only those people who wear face mask.

V. OVERVIEW

A. RASPBERRY PI

Raspberry Pi acts as a central control for this project. The Raspberry Pi is a small, credit card sized computer that powers the whole thing. The Raspberry Pi will be equipped with a micro-SD card which will be loaded with operating systems like Raspbian. This uses a computer display along with a mouse and a keyboard.

- **SOC:** Broadcom BCM2837
- **CPU:** 4× ARM Cortex-A53, 1.2GHz
- **MEMORY**: 1GB LPDDR2-900 SDRAM (i.e., 900MHz)
- **RAM:** 1GB LPDDR2 (900 MHz)
- **NETWORK:** 10/100 Ethernet, 2.4GHz 802.11n wireless
- **BLUETOOTH:** Bluetooth 4.1 Classic, Bluetooth Low Energy
- **STORAGE:** microSD
- **PORTS:** HDMI, 3.5mm analogue audio-video jack, 4× USB 2.0, Ethernet, Camera Serial Interface (CSI), Display Serial Interface (DSI)
- **POWER SOURCE:** 5V via micro-USB or GPIO header
- **SIZE:** 85.60mm*56.5mm
- **WEIGHT:** 45g (1.6oz)

Fig 1. Raspberry Pi 3

B. RASPBERRY PI CAMERA MODULE

The Camera Module can be used to take high-definition video, as well as stills photographs. The Raspberry Pi Camera Module is a 5MP CMOS camera with a fixed focus lens that is capable of capturing still images as well as high-definition video. The Camera module weighs around 3g and has a 5-megapixel resolution making it perfect for mobile or other applications where size and weight are important. This camera module is adequately ideal for projects such as hidden security cameras.

Fig 2. Pi Camera Module

C. RELAY MODULE

Relays are small switches that open or shut circuits; they control circuits by the same method. The relay module we have used in this project is the Single Channel Relay module which is used to control high voltages, high current load and AC loads. This single channel relay module is designed to interface with Raspberry Pi.

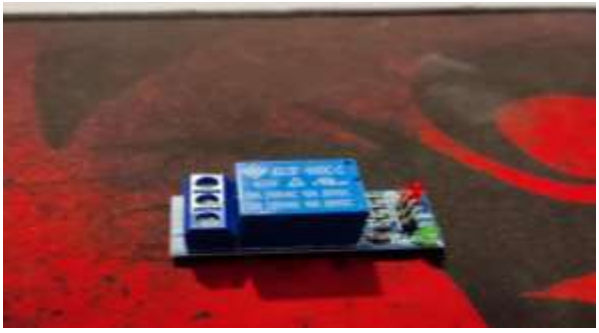

Fig 3. Channel Relay Module

D. DC MOTOR

A DC motor is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. A DC motor consists of a stator, an armature, a rotor and a commutator with brushes. Opposite polarity between the two magnetic fields inside the motor causes it to turn. We will use a DC motor driver module to operate the DC motor. The DC motor will act as a security indicator in this project.

Fig 4. DC motor

FOR SOFTWARE

A. RASPBIAN OS

Raspbian Operating System is available for no cost and easy to download and use, it's an open-source Debian Linux based operating system which is manufactured to be used on Raspberry Pi microcontroller boards. Raspbian OS is a very efficient operating system and is excellent for desktop use. It can be customized for individual user's requirements. Raspbian OS uses a tweaked version of Lightweight X11 Desktop Environment(or LXDE) as its desktop environment.

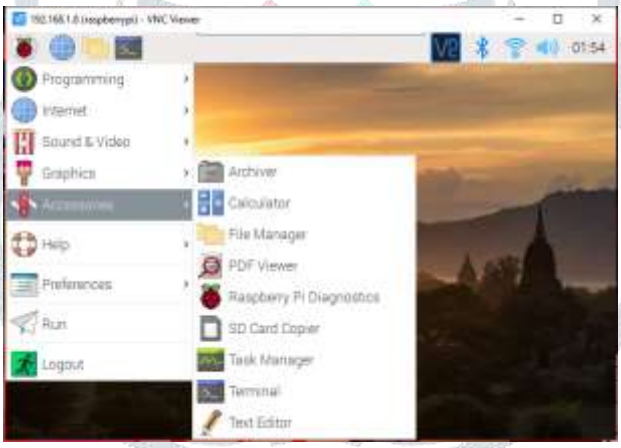

Fig 5. Raspbian OS

B. PYTHON

The proposed system uses the Python programming language because it is very simplified and it is quick to learn the language. It is an object oriented and high-level programming language which is compatible with Raspberry Pi. The syntax is very easy to learn and date structures are very basic and reduces maintenance costs. Python is interactive, interpreted and beginner's language.

C. OPENCV

OpenCV is a computer vision library which is open source and is used very popularly in the field of Image processing. OpenCV can be used in JAVA, C++ or Python languages. In this proposed system we are using OpenCV for python programming language. It is used to process images and videos to identify patterns, objects, faces etc. OpenCV is available in different platforms including Windows, Linus, MacOS, Android and iOS. OpenCV is mainly used to identify image patterns and their particular features.

D. TENSORFLOW

TensorFlow is a symbolic mathematical library; it is a suite of software and an ecosystem for developing machine learning models. It is used to make numerical computations. It is one of the popular options for deep learning because it is simple to scale projects on, for documentation, it provides multiple abstractions. TensorFlow is a math library that users use for neural networks and dataflow programming. Main features of TensorFlow are that it efficiently works with mathematical expressions involving multi-dimensional arrays and provides high scalability of computation across machines and huge data sets.

VI. PROPOSED SYSTEM

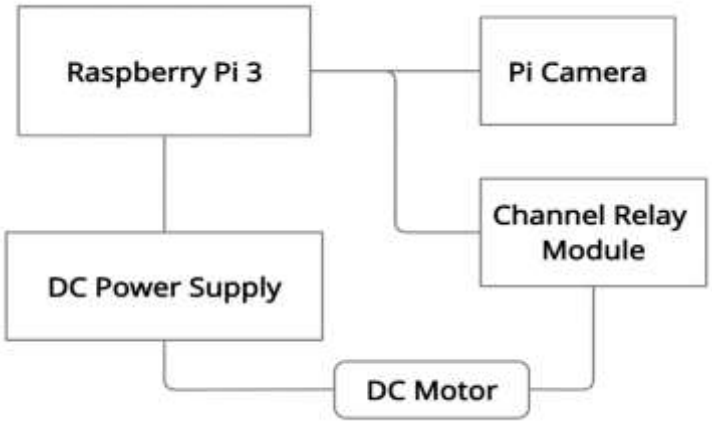

Fig 6. Proposed System

Proposed system architecture and block diagram for the Smart Access System for Public Transport are shown in figure above. The system design aims to create a hands-free automated face mask detection system for access control in public transport. Scanning the face mask using the Raspberry Pi Camera module and verify if the face mask is worn or not using image processing in Python programming language. The proposed system utilizes a transfer learning approach to performance optimization with a deep learning algorithm and a computer vision to automatically identify and monitor people in public places with a camera integrated with a Raspberry Pi 3 and to detect people with mask or without mask. The Raspberry Pi is connected to the Pi camera using a flex cable. The channel relay module is used to control low voltages and contains two LEDs red and green indication. The DC motor acts as a switch and gets turned on when the person not wearing a face mask gets detected. The DC motor is operated using a motor driver module. Raspberry Pi 3 can be powered through many different ways from an AC adapter the same way you charge your phone through a USB port. Or one can connect the raspberry pi to any laptop or computer to power it on. The mode will help authorities in alerting the breach via DC motor ensuring a safe working environment.

VII. RESULTS

Integrating all the components of our proposed system, we thus get a highly accurate and robust Face Mask Detection System. The resultant system exhibits high performance and has the capability to detect face masks in images with multiple faces over a wide range of angles. The resultant system exhibits high performance and has the capability to detect face masks in images. The output of the Smart Access System for Public Transport is displayed on a monitor. The result of our model was trained on 100 epochs.

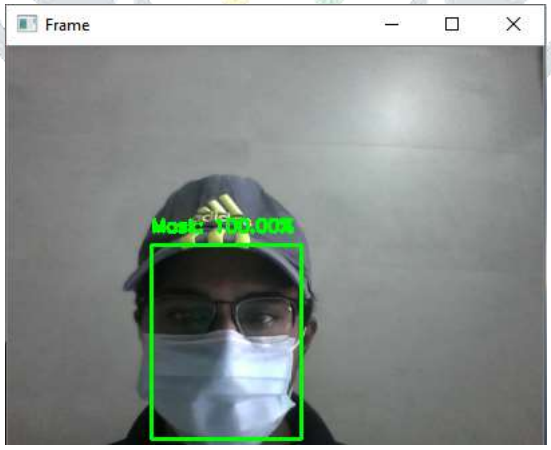

Fig 5.1 Detection of Facemask

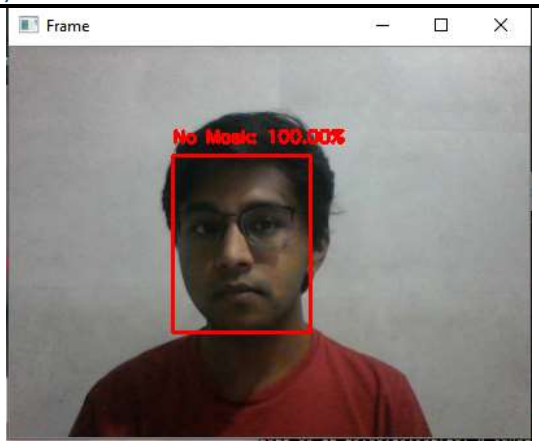

Fig 5.2 Detection of No Facemask

VIII. FUTURE WORK AND CONCLUSION

With the help of upcoming innovative technologies, smart access systems for public transport can be advanced to integrate physical distancing which measures distance between each person and creates an alarm. Use of Machine Learning in the field of mobile deployment is rising rapidly. Hence, we plan to port our model to their respective TensorFlow Lite versions. Temperature Screening can be implemented in our present system with the use of IR thermometers where we can ensure safety of public transport commuters and staff as well. Working to make the project look more aesthetic and robust to be deployed in public transport systems to decrease the spreading of the virus.

This project proposed a system on real-time facemask recognition with an alarm system using Raspberry Pi 3. This process gives precise and speedy results for facemask detection. The test results show a distinguished accuracy rate in detecting and monitoring persons wearing a facemask and not wearing a facemask. The dataset was obtained from a publicly available source, cleaned, made balanced and further pre-processed to suit our task. Moreover, the proposed system presents a useful access control tool in battling the spread of the COVID-19 virus by detecting a person who wears a facemask or not and sets an alarm if the person is not wearing a facemask in public transport. This system contributes to public healthcare and can be easily deployed for automated monitoring of the use of face masks at public transport stations, which will help make them safer and ensure that public safety guidelines are followed.

IX. ACKNOWLEDGEMENT

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