AUTOMATIC FACE MASK DETECTION AND TEMPERATURE SCANNER

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Abstract: Face masks detection and Temperature scanner is an IoT device, that prevents the spread of Corona virus to people. This is done by ensuring that each and everyone are wearing mask and body temperature is less than the ambient temperature. Mask monitoring often requires additional staff resources. Some of the symptoms of covid-19 include fever, tiredness, sore throat, nasal congestion, loss of taste and smell. In most cases, it's transmitted directly (person to person) through respiratory droplets, but also indirectly via surfaces. Therefore, by using face mask and sanitizer, we can prevent the spread of corona virus. However, the crucial problem is that they are lack of approved vaccine and drugs to fight against corona virus. Histogram of oriented gradients (HOG) is a feature descriptor used to detect objects in computer vision and image processing. The HOG descriptor technique counts occurrences of gradient orientation in localized portions of an image - detection window, or region of interest (ROI). This helps in accurate detection of mask. MLX90614 is a temperature sensor, that efficiently detects the body temperature of a person.
Keywords: HOG, MLX90614, Computer Vision, Image Processing, Gradient Orientation.

INTRODUCTION

The COVID-19 pandemic, also called the coronavirus pandemic, is a global pandemic of coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The novel virus was first identified from an outbreak in Wuhan, China, in December 2019. Attempts to contain it there failed, allowing the virus to spread to other areas of China and later worldwide. The World Health Organization (WHO) declared a Public Health Emergency of International Concern on 30 January 2020 and a virulent disease on 11 March 2020. As of 16 July 2022, the pandemic had caused over 561 million cases and 6.36 million confirmed deaths, making it one of the deadliest in history. COVID-19 symptoms range from undetectable to deadly, but most typically include fever, dry cough, and fatigue. Severe illness is more likely in elderly patients and people with certain underlying medical conditions. COVID-19 transmits when people breathe in air contaminated by droplets and the little airborne particles containing the virus. The chance of breathing these in is highest when people are in close proximity, but they will be inhaled over longer distances, particularly indoors. Transmission may also occur if contaminated fluids reach the eyes, nose or mouth, and, rarely, via contaminated surfaces. Infected persons are typically contagious for 10 days, and might spread the whether or not they are doing not to develop symptoms. Mutations have produced many strains (variants) with varying degrees of infectivity and virulence. During the COVID-19 pandemic, face masks, includingFFP2, N95, surgical, and cloth masks, are employed as public and private health control measures against the spread of SARS-CoV-2.

In community and healthcare settings, their use is intended as source control to limit transmission of the virus and also for private protection to prevent infection. Properly worn masks both limit the respiratory droplets and aerosols spread by infected individuals and help protect healthy individuals from infection. Masking has proven effective in reducing the spread of Corona virus. Masks vary in how well they work, with N95 and surgical masks outperforming cloth masks, which are more common due to supply shortages, but even cloth masks, with their variability in fabric type and mask fit, provide wearers with substantial protection from particles carrying COVID-19. Double-layered cotton, hybrid masks, and cotton flannel perform best and filtration effectiveness generally improves with thread count. Healthcare workers, like doctors and nurses given their exposure, are recommended against using cloth masks. Despite the limited evidence for its effectiveness, thermal screening at points of entry has increasingly become a standard protocol in numerous parts of the world in response to the COVID-19 pandemic. Traditionally, additional staffs are required to watch the mask and temperature of people that is inefficient.

To solve these limitations, we have combined deep learning with IOT technology to build an automatic face mask detection and temperature scanner. Our contributions are as follows:

1. On the basis of deep learning and IOT technology, we have built an automatic face mask detector that detects whether a person is wearing mask or not.
2. A contactless temperature scanner using MLX90614 that senses the temperature of a person standing in front of the device.

METHODS

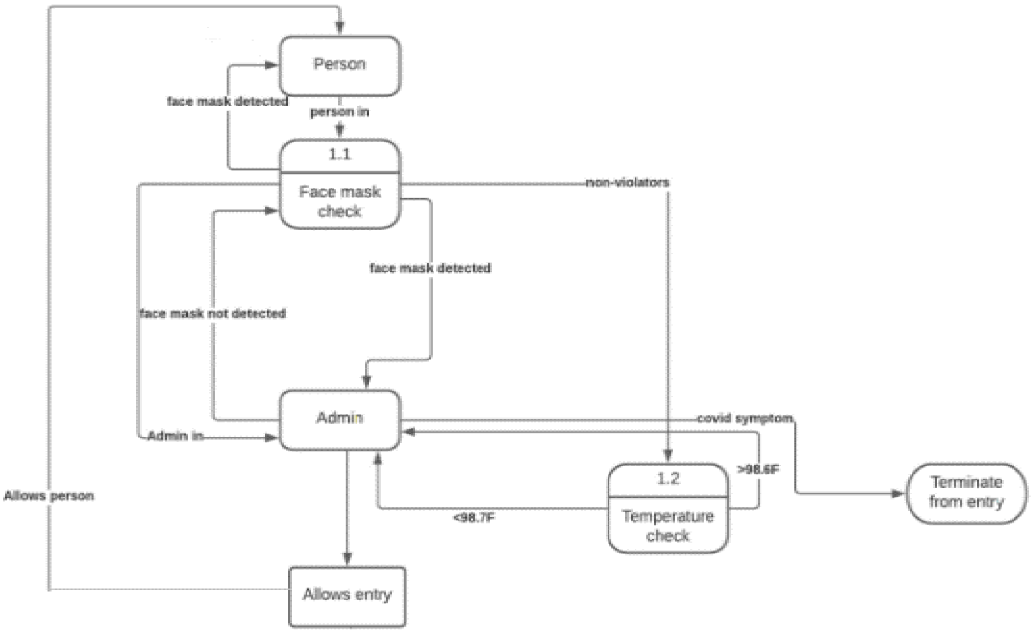
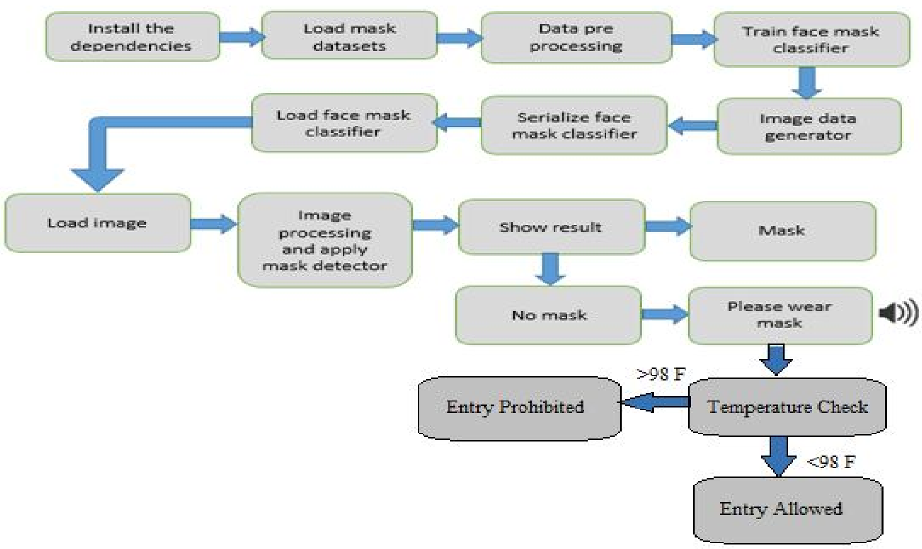


Figure 1: Dataflow Diagram



The dataflow diagram as shown in Figure 1. represents Face sketch recognition. Here, the sketch of a person drawn by an artist is fed as input to the system and it is subjected to certain modifications like resizing, change of contrast, brightness, etc. Then the feature vector of this particular image is obtained using HOG feature descriptor which is then given as input to the SVM classifier and finally the images stored in the database that match with the input image and whose percentage of match is minimum 75% or above is displayed as the end result.

Figure 2: Architectural diagramFigure 2. shows architectural diagram of automatic face mask detection and temperature scanner. System Architecture is an organized description that defines the structure, behaviour and the system views. It describes the main components, their relationships, structures and how they interact with each other. Software architecture and design has several contributory factors such as quality attributes, Business strategy and many more. Software Architecture and Design can be classified into two phases - Software Architecture and Software Design. Software architecture refers to the basic structure of a software system where each structure contains the elements of the software, the relationship between them and the properties of elements and the relations.

Train face mask detector

Training face mask detector is the first stage where it involves three phases loading the data sets, training the face mask classifier and serializing face mask classifier to disk.

Loading the datasets

Figure3. Shows data loading, it is the process of copying and loading data or data sets from a source file, folder or application to a database or similar application. It is usually implemented by copying digital data from a source and pasting or loading the data to data storage or processing utility.

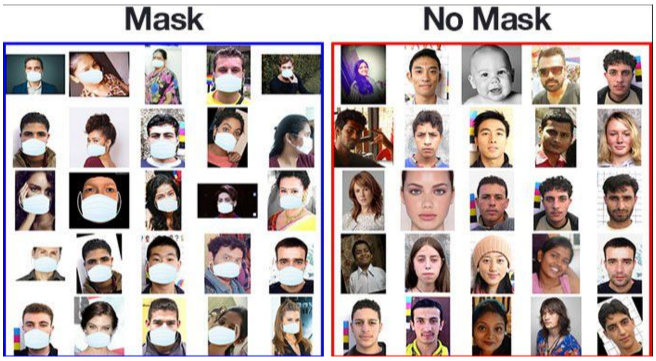


Figure 3: Datasets

Load Face Mask Classifier from Disk

Load face mask classifier from disk Detect faces in image/video stream and the extracts each face region of interest (ROI), applies classifier to each face ROI to determine whether mask is worn or not.

Face Detection from Image/Video

Figure 4. shows face detection from video, face detection is the process of automatically locating human faces in visual media (digital images or video). A face that is detected is reported at a position with an associated size and orientation. Once a face is detected, it can be searched for landmarks such as the eyes, nose and mouth.

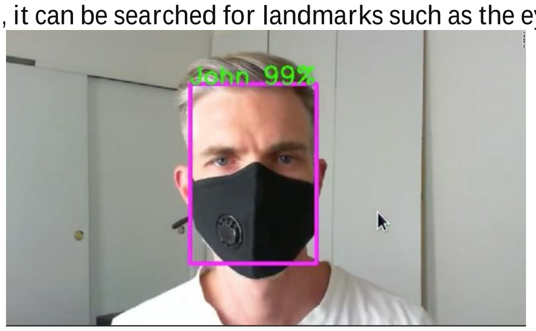


Figure 4: Face detection from video

Image Processing

Before extracting features, we must pre-process face images to boost the face recognition rate. To feed them to the system, they have to be standardized and cleaned up. Reducing the complexity and increasing the accuracy of the applied algorithm is important and can be done by employing pre-processing of image. A number of the image pre-processing techniques can be used in the system. One way is by converting the coloured images to gray scale can help to reduce computation complexity. Here it becomes useful to lose unnecessary information from the pictures to reduce space or computational complexity. In many objects, color isn't necessary to acknowledge and interpret a picture. Grayscale are often adequate for recognizing certain objects. Because colored images contain more information than black and white images, that may be unnecessary information and may require more space.

Standardize images

One important constraint that exists in some machine learning algorithms, such as SVM and KNN, is the need to resize the images in the dataset to a unified dimension. This implies that the images must be pre-processed and scaled to have same widths and heights before fed to the machine learning algorithm. Also, here the image's contrast is modified. For example, the image's brightness can be decreased or increased to meet a desired contrast. In this module, the most important part is resizing of the images and bring down the width to height ratio to 1:1. The image size should preferably be 224 x 224. This is because we will be dividing the image into 8*8 and 16*16 patches to extract the features. Having the specified size (224 x 224) will make all our calculations simple.

Temperature Check

After the face mask detection phase is carried out, the next phase is the temperature check. The temperature of the person is checked using the contactless infrared sensor. The ambient temperature is fixed to 98.6F. Melexis Microelectronics Integrated systems manufactures MLX90614 sensor, it works on the principle of InfraRed thermopile sensor for temperature measurement. There are two units inside this kind of temperature sensor. The primary unit is the sensing unit that has an infrared detector which is followed by the second unit that performs the computation of the data with Digital signal processing. It basically works on Stefan-Boltzmann law that explains the power radiated by a black body in terms of its temperature. In other words, any object that emits infrared rays and the intensity of that will be directly proportional to the temperature of that object. The computational value is converted into 17-bit ADC and which may be accessed using the I2C communication protocol. It measures the object temperature with the resolution calibration of 0.02°C.

Alert System

The buzzer will be linked to the microcontroller. If the temperature threshold is exceeded and the face mask is not detected, the alarm will be activated to notify the security that a person with high temperature is trying the enter into public place. If both the face mask and the temperature are set to normal, then the gate will be opened for the person to enter the place

RESULTS

Figure 5. shows model of automatic face mask detection and temperature scanner. The face image is taken as input through the webcam and is processed using pre-programmed raspberry pi. If face mask is not detected, then 'No face mask detected, please wear mask' message is displayed on LCD display. Else, temperature sensor senses the body temperature of a person, if the temperature is higher than the ambient temperature, then buzzer makes the sound where people around get alert, else the person is allowed inside the area.

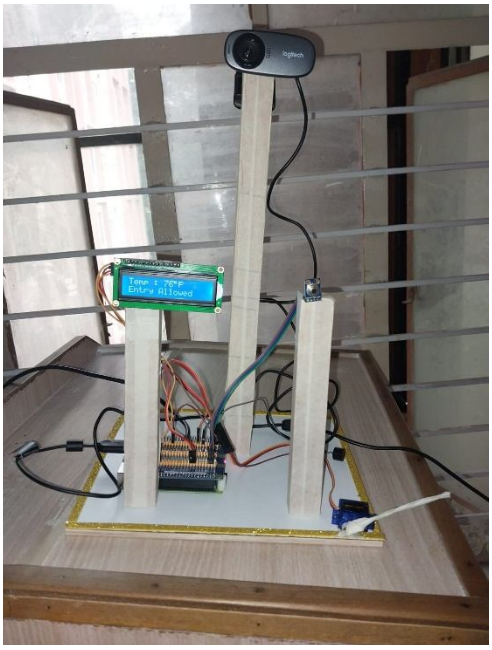


Figure 5:Model of Face Mask Detection and Temperature Scanner

Figure 6. shows a person experimenting the device wearing mask and has temperature less than the ambient temperature. As the person is wearing mask and has normal temperature, the person is allowed to enter the area.

Figure 6: A person experimenting the IoT device

Figure 7. shows ' No face mask detected' on the computer screen. The system recognizes that the person is not wearing mask.

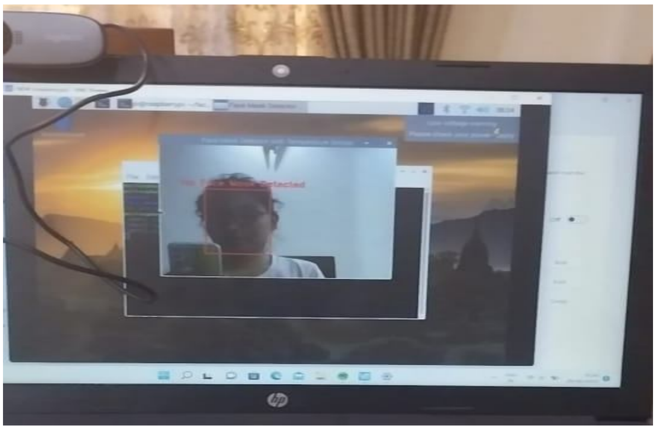


Figure7: 'No face mask detected' message shown on computer screen

DISCUSSION

In this paper we have effectively carried out a functioning model for Face Mask and Body Temperature recognition system. This paper can be utilized in where enormous social events of individuals happens like schools, universities, workplaces, shopping centers and so on. The exactness of facemask recognition can be accomplished via preparing the module with a bigger picture dataset. All in all, Face Mask and internal heat level recognition can help us in the huge get-together of individuals in a single spot without veils and furthermore by this we can decrease the danger of getting tainted. SARS-CoV-2 virus is responsible for Corona virus infectious disease. Some people will have minor respiratory issues and have mild symptoms. They don't require medical attention. However, some will have major issues with the respiratory organ and sometimes leads to death. Older people who suffer from medical conditions like cardiovascular disease, diabetes, chronic respiratory disease, or cancer are more likely to develop serious illness.

CONCLUSION

For future work, we will include the feature of automatic sanitization where if all the test cases are passed, then the sanitizer will be provided to that person. New developments and the availability of smart technologies force to the creation of new models, which will help meet the needs of developing countries. In this work, an IoT-enabled smart door is developed to monitor body temperature and detect facemasks that can enhance public safety. This will help to reduce manpower while also providing an extra layer of protection against the spread of Covid-19 infection. The model uses a real-time deep learning system using Raspberrypi to detect facemasks, and temperature detection as well as monitor the count of people present at any given time. The device performs excellently when it comes to temperature measurement and mask detection, the trained model was able to achieve a result of 97percent. The test results demonstrate a high level of accuracy indetecting people wearing and not wearing face masks, as well as it also generates alarms monitored and recorded. Further more, there are numerous techniques to enhance performance to improve results. Future development will include improving the accuracy of these steps, using a combination of various features, and improving performance, as well as producing a mobile app with a user-friendly interface for monitoring. As a result, authorities will be able to take immediate action following pandemic safety standard. This detection can also be used for video stream or camerafed inputs. The Future development of the project is planned to involve the identification of a person and sent the intimation message to the persons mobile who were not wearing facemasks.

This can be implemented in offices and institutions by means of training the database with employee images or students images and by means office recognition the person is identified by which the mobile number and other details of the person is obtained from database and hence it will be easy to notify that particular person or useful for taking any actions regarding not wearing face mask.

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