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An Intelligent Approach for Monitoring Social Distancing, Temperature and Detecting Face Mask for Reducing COVID Spread

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***Abstract*: COVID- 19 contagion remains a source of concern and peril in ultra-modern times. With a huge on- the- go population and inadequate task force and coffers to administer them, manually covering social distancing norms is impossible. You need a feather light, durable, 24/7 videotape surveillance system that automates this process, as well as temperature monitoring and reporting. Crowds can be set up at musicales, rallies, marathons, colosseums, and train stations, among other places. Crowd analysis is necessary for security and surveillance, the discovery of rarities and thus the minimization of the threat of accidents, as well as the control of the alcohol position of people. This work provides a complete and practical result for people discovery, social distancing violation discovery and face mask discovery using machine literacy, temperature discovery, alcohol discovery, and crowd discovery. The system has a 91.2 percent delicacy standing.**

***Keywords*: COVID-19, vision cascade object detector, social distancing, Arduino, Ultrasonic sensor, LM35 sensor, Resistance Temperature Detector (RTD).**

1. Introduction

Corona viruses (CoV) are a family of viruses that cause illnesses ranging from colds to death diseases such as Middle East Respiratory Syndrome (MERS) and severe acute respiratory syndrome (SARS) [1]. As of January 2021, WHO had received reports of 90,054,813 confirmed cases of COVID-19, with 1,945,610 deaths [2]. Direct contact with infected persons or indirect interaction with a polluted environment can spread the COVID-19 virus. This happens with respiratory droplets, which are droplet particles with a diameter of more than 5-10 m. When a person is in close contact (less than 1 m) with a person who has respiratory symptoms, they are at risk of being exposed to possibly infective respiratory droplets in his or her mouth, nose, or eyes [3]. With the number of infected cases and deaths on the rise, keeping the virus under control is more important than ever.

To prevent the spread of COVID-19, social distancing should be used alongside other daily preventative measures such as wearing masks, avoid touching your face with unwashed hands and wash your hands periodically with soap and water for at least 20 seconds. The practice of keeping a safe distance between a person and his or her surroundings is known as social distancing [4]. The proposed distance to ensure the virus does not spread by contact is two meters (six feet). Adhering to social distancing norms reduced contact between people over 60 and children under 20 by 95% and 85%, respectively. This demonstrates the impact of following good social distancing rules on "flattening the curve".

COVID-19 is primarily transmitted from person to person via respiratory droplets. Coughing, sneezing, talking, shouting, or singing all cause respiratory droplets to be released into the atmosphere. These droplets can then enter people's mouths or noses or be inhaled. Masks must be worn to prevent the infection from spreading. Masks are an easy way to prevent the spread of respiratory droplets. Studies show that wearing a mask across the nasal passage reduces the spray of droplets.

Monitoring social distancing norms and manually checking people's masks is not only inefficient with limited resources, but can also lead to human error. Detecting body temperature is also important because a person with a high body temperature must isolate themselves to prevent the spread of the disease. The information about the ambient temperature is successfully used to derive a correction formula for accurately extracting body temperature from the typical infrared sensor reading. Crowds should be avoided to maintain social distance, preventing people with alcohol consumption also makes the environment healthier.

2. Literature Review

Mohamed Loey et al, created a model that combines deep transfer learning (ResNet50) and traditional machine learning algorithms. To increase model performance, the last level of ResNet50 has been removed and replaced three classic machine learning classifiers (Support vector machine (SVM), decision tree, and ensemble). One dataset, which included actual and fake face masks, had the most photos and took the longest to train than the others. Also, the accuracy of this type of dataset in related publications is not known. The decision trees classifier failed to achieve a satisfactory classification accuracy (68 percent) on fake face masks when trained on a dataset using

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real face masks.

Resnet is used as the backbone, FPN (feature pyramid network) is used as the neck, and classifiers, predictors, estimators, and other algorithms are used as the heads. However, learning algorithms find it challenging to learn improved features due to the small size of the face mask dataset. Face mask detection is the subject of little research, and higher detection accuracy is needed.

Rinkal Keniya developed a self-made model called SocialdistancingNet-19 for recognising a person's frame and presenting labels to determine if they are safe or harmful if the distance is less than a certain amount. If a webcam is to be used, persons must move continuously, or else the detection will be wrong. This could be related to the network's detection strategy, which involves detecting the complete frame and calculating the distance between people using centroids (brute force approach).

For social distancing Associate in Nursing mask discovered, Shashi Yadav instructed a deep learning answer with Single Shot Object Detection (SSD) victimization MobileNet V2 and OpenCV. The drawback with this approach is that it qualifies folks as cloaked if they need their hands over their face or if their face is obscured by things. This model isn't applicable for these cases. Although an SSD can detect multiple objects during a single frame, it can only detect a human during that system.

The majority of the publications targeted on either social distancing observation or mask detection. And even wherever each were used, there's still space to boost accuracy by using higher models. Our analysis emphasizes the importance of prediction time as Associate in Nursing analysis measure, that is needed for the system' actual usability. This characteristic is missing in previous works.

The article uses YOLOv3, a progressive object detection model, followed by DBSCAN to calculate the distances between people and achieve clustering to know if they are that far away or not, which is actually higher than alternative clustering strategies. Estimate brute force distance calculations or k-means where the number of clusters must be determined before clustering. We have DSFD for face recognition, which could be a powerful feature extractor with reasonable accuracy in face recognition. Compared to Xception and ResNet50, MobileNetV2 was the most efficient in mask classification. Finally, using knowledge-enhancement techniques, a mask dataset and annotated video dataset were created to test the system by annotating the video frames.

3. Dataset

The collection of unmasked and masked faces gathered from existing sources was insufficient, thus new and two data augmentation approaches were used to add masks to unmasked faces and blurred photos.On datasets with four types of masks, data augmentation for unmasked faces was accomplished..

The method starts by detecting the defining points of a face's contour. The top component of the mask can be found by locating the nasal bridge, and the bottom, left, and right parts can be found by locating the face's chin points. The mask's left and right halves are both made to the correct size. The mask's angle of rotation is computed using the face's orientation. The mask is placed on the face after the coordinates for superimposing it on the face are calculated.

Fig. 1. Unmasked and masked datasets

The final dataset includes 11,792 annotated photos with classes of 0 for no mask and 1 for a mask, with 10% of the data used for testing. There were no video datasets available because the problem was new. In the video, there was also no way to assess the overall performance of the system. As a result, 30 movies with a duration of 9-15 seconds were obtained and labeled separately. This was utilized to provide an unbiased assessment of the system's performance.

4. System Architecture

The face mask is detected using MatLab programming, and it is connected to the Arduino via UART. All other detecting devices, such as the temperature sensor (LM35), social distance detector (ultrasonic sensor), crowd detector (infrared sensor), and gas detector (gas sensor), have been defined using embedded c programming, and the output is delivered via LCD.

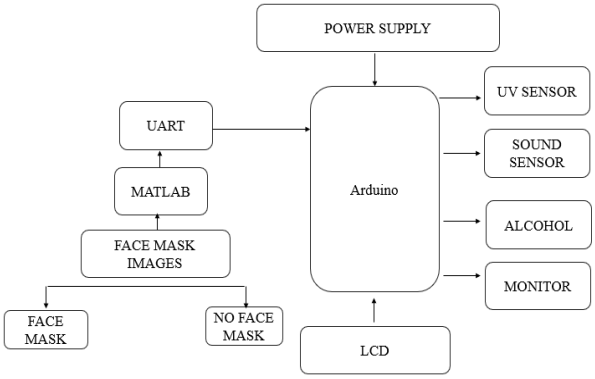

Fig. 2. Architecture diagram

5. Methodology

A. Face Mask Detection

1) Vision cascade object detector

The Viola-Jones method is employed by the cascade object detector to acknowledge people's faces, noses, eyes, mouths, and upper bodies. you'll also train a custom classifier to use with this technique object using the Image Labeler. See start with Cascade Object Detector for further information on how the

function works. Prepare Your Paper Before Styling.

2) To detect facial expression or upper body in an image

Create the vision.CascadeObjectDetector object and set its properties .Call the article with arguments, as if it were a function. By sliding a window across a picture, the CascadeObjectDetector System finds objects. A cascade classifier is then utilized by the detector to work out whether the window contains the item of interest. The window's size changes to spot objects of varied sizes, but it's ratio remains constant.

The first step is to import the photos. There are two datasets available, one with a mask and the other without. After importing the datasets, we must preprocess them according to our convention, develop a model, then train it with the preprocessed dataset; our model's accuracy is 91.2 percent. By using Matlab We are taking real-time input from the webcam, comparing it to our trained dataset, and delivering a result that matches.

B. Social Distance Detection

In our model, we are using a hardware device called an ultrasonic sensor to detect social distance. The buzzer will sound if the distance between persons is less than 50 meters, thus maintaining social distance.

1) Ultrasonic Sensor

An ultrasonic sensor is a device that uses sound waves to determine the distance to an item. It determines distance by emitting a sound wave at a specified frequency and listening for it to reflect back. It's vital to keep in mind that ultrasonic sensors could miss some objects. Ultrasonic sensors are devices that detect distance between the sensor and the target item by converting electrical energy into mechanical energy in the form of ultrasonic waves. Ultrasonic waves are longitudinal mechanical waves that move through a medium as a series of compressions and rarefactions in the direction of propagation. Ultrasound refers to any sound wave that exceeds the human aural range of 20,000Hz.

Fig. 3. Ultrasonic sensor

C. Temperature Detection

A hardware device called the LM35 is used to detect temperature in our model. If the temperature rises beyond 35 degrees, it is considered abnormal, and the individual is not allowed to enter the area where our system is installed.

1) LM35 sensor

A temperature sensor is a device that measures temperature via an electrical signal, generally a thermocouple or RTD. A thermocouple (T/C) is a device made up of two dissimilar metals that produces an electrical voltage in direct proportion to temperature variations. An RTD (Resistance Temperature Detector) is a variable resistor that adjusts its electrical resistance in a precise, repeatable, and nearly linear manner in response to temperature variations. Temperature sensor that measures temperatures outside the sensor using an external diode-connected transistor as the sensing element (for example, on a circuit board or on the die of a CPU). Produces a digital output in most cases.

Fig. 4. LM35 sensor

D. Crowd Detection

In our model, we use a hardware device called an infrared sensor to identify crowds using sound. It detects crowds based on noise levels and counts the number of persons entering the area; if the limit is exceeded, the buzzer will sound**.**

1) Infrared sensor

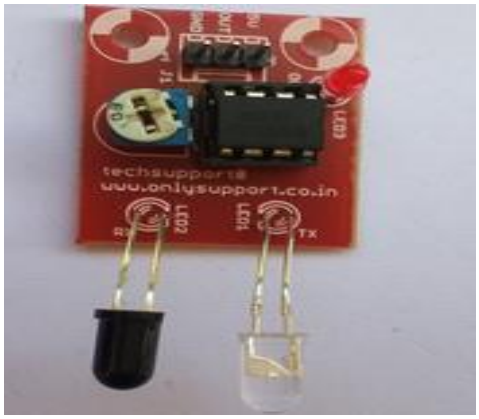

Fig. 5. Infrared sensor

These inexpensive devices operate at 940nm and are suitable for a variety of IR applications, including remote control and touchless object detection. Variable readings from the detector can be obtained using a basic ADC on any microcontroller. As with any LED device, the emitter is powered up to 50mA with a current limiting resistor. The detect is an NPN transistor that is biased by IR light that enters the circuit. An infrared sensor is an electrical device that uses infrared radiation to detect and/or emit information about its surroundings. Infrared sensors can detect motion as well as measure the heat of an object. Rather than generating infrared light, many of these sensors just measure it.

E. Alcohol Detection

Drunk people are typically barred from many areas in order to preserve a healthier environment, and our system detects alcohol using a hardware device known as a gas sensor. It detects drunk persons and prevents them from entering our establishment.

1) Gas sensor

A gas detector is a technological instrument that detects/ senses a signal, a physical situation, or chemical substances. By detecting these voltages, the detector can identify feasts. The current discharge in the contrivance can be used to determine the gas attention. The gas detector runs on 5V DC and consumes about 800mW. It has a discovery range of 200 to 10000ppm for LPG, Bank, Alcohol, Propane, Hydrogen, Methane, and Carbon Monoxide. By altering the resistance of the material within the detector, the detector provides a corresponding implicit difference grounded on the gas attention, which can be measured as the affair voltage.

Fig. 6. Gas sensor

F. Arduino

1) ATMega328 Microcontroller

There are 20 digital input/output pins on this board. A USB connector, a power jack, an ICSP header, and a reset button are among the features. ATmega328 microcontroller, 5 V operating voltage, 7-12 V input voltage (recommended). 6-20 V input voltage (limits), 14 digital I/O pins (of which 6 provide PWM output) 6 analogue input pins, 40 mA DC current per I/O pin, 50 Ma DC current for 3.3V pin, 32 KB flash memory, 0.5 KB consumed by bootloader.

Arduino is a programming language that allows you to create computers that can sense and control more of the physical environment than your typical desktop computer. It's an open-source physical computing platform that includes a development environment for building software for the board and a simple microcontroller board. Arduino may be used to create interactive devices that accept input from various switches or sensors and operate lights, motors, and other physical outputs.

Fig. 7. Arduino (ATMega328) microcontroller

Arduino projects can be self-contained or communicate with software installed on your computer. The boards can be hand-assembled or pre-assembled, and the open-source IDE can be downloaded for free. The Arduino programming language is based on the Processing multimedia programming environment and is an implementation of Wiring, a similar physical computing platform. The Arduino is a gadget that connects all of our sensors to embedded c programming and displays the results on a lcd or a buzzer.

2) LCD

The TV (Liquid Crystal Display) is a form of display that operates by using liquid chargers. We will take periodical input from the computer and upload the sketch to the Arduino from then. On the TV, the characters will be shown.

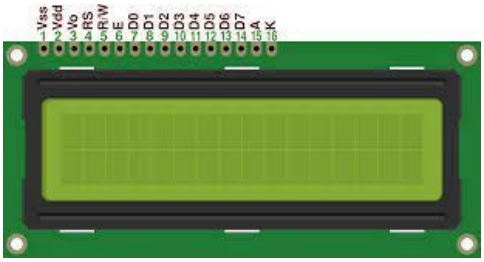

Fig. 8. Arduino LCD interface

3) Buzzer

A piezo buzzer is associate degree other name for an Arduino buzzer. It's primarily a touch speaker which is able to be directly connected to associate degree Arduino. you may programme it to emit a tone at a specific frequency. The buzzer makes sound by victimization the piezoelectric effect in reverse.

Fig. 9. Buzzer

The entire image of our kit, that connects associate degree Arduino to any or all of the preceding detection sensors.

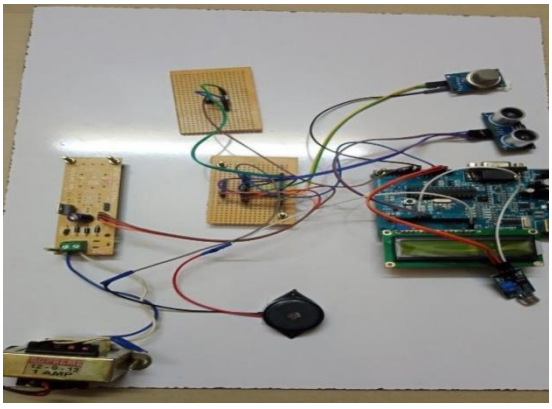

Fig. 10. Arduino connected with all sensors

6. Results

The face mask detection output sample. In our kit, it's displayed on both the system and the LCD.

OUTPUT FOR FACEMASK DETECTION

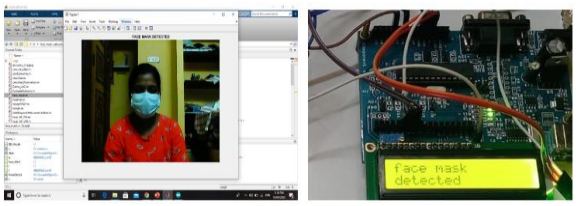

Fig. 11. Facemask detection

The output sample for detecting no face mask. In our kit, it's displayed on both the system and the LCD.

OUTPUT FOR NO FACEMASK DETECTION

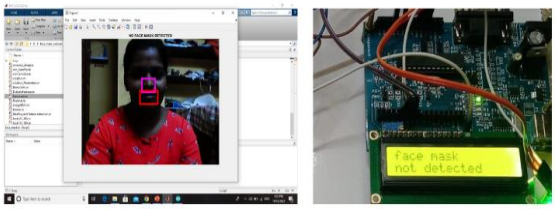

Fig. 12. Facemask not detected

The output for social distance detection utilizing an ultrasonic sensor defined with embedded C programming is shown in the image below.

OUTPUT FOR SOCIAL DISTANCE DETECTION

Fig. 13. Social distance detection

The output for temperature detection utilising the LM35 sensor defined with embedded C programming is shown in the figure below.

OUTPUT FOR TEMPERATURE DETECTION

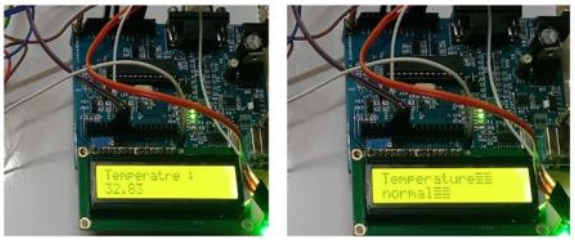

Fig. 14. Temperature detection

The output for crowd detection utilizing an infrared sensor defined with embedded C programming is shown in the image below.

OUTPUT FOR CROWD DETECTION

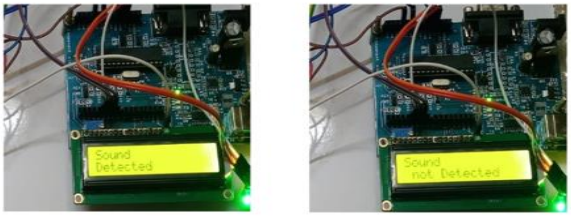

Fig. 15. Crowd detection

The output for gas detection detected using a gas sensor defined with embedded C programming is shown below.

OUTPUT FOR ALCOHOL DETECTION

Fig. 16. Alcohol detection

7. Conclusion

COVID-19 has varied effects on different persons. The majority of infected persons will experience mild to moderate sickness and recover without the need for hospitalization, and our model will track all of the safety precautions needed to avoid covid19.This study presents an effective method for monitoring facemask detection, social distancing detection, temperature detection, alcohol detection, and crowd detection in public locations when manual monitoring is difficult. With a 91.2 percent accuracy, the system performs admirably.

8. Future Scope

Although the system's accuracy and prediction time are both good, the following areas for improvement have been identified: First, the human detection module consumes the majority of video processing time. A simpler person detection algorithm could be created that takes less time to forecast and is as accurate as the existing model. Second, because the social distancing calculation and mask classification occur separately, parallelism can be employed to perform them both at the same time. Third, there is a scarcity of datasets for such a system, and it is not diverse enough to work in all scenarios. Because there aren't enough negative examples with beards in the system, it sometimes confuses beards with masks. A more powerful model can be trained once such datasets become accessible.

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