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AUTOMATIC CAMERA PANNING WITH FACE MASK DETECTION

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Abstract — **In recent years, video surveillance systems have attracted a lot of attention as a way to satisfy the needs of many security elements such as industrial control and monitoring, environmental monitoring, personal care, and so on. They have contributed significantly to the reduction of crimes and the preservation of property. Starting from small offices to large factories, these systems became very necessary and important to satisfy the security aspects in various areas of life.**

Face mask detection is integrated with automatic panning video surveillance cameras, implemented in airpors, railway stations, offices, schools, and public places to ensure public safety guidelines are followed.

This work provides user with a wide range surveillance system with automatic panning in uniform intervals. Further expanded to exclusion zones, containment zones, biohazardous zones and crowded areas the work includes face mask detection feature with an alarm to alert the user if the safety protocols are violated.

This work aims to develop the face mask detector which is able to detect any kinds of face mask violation.

***Keywords*— Arduino UNO; Servo Motors; Mobile- net; Deep Neural Network;**

I. INTRODUCTION

An embedded system combines computer hardware and software to perform a particular function. Such systems may be fixed in full capability or programmable they can either do just one function or be a part of a large system with multiple functions. Everything from industrial machines to household appliances makes use of the embedded system to functions. They serve as computing systems, which may or may not have a user interface (UI). Devices which have a user interface can use either physical buttons or remote controllers to gain input from the user.

Artificial intelligence is when machines can learn and make decisions similarly to humans. There are many types of artificial intelligence including machine learning, where instead of being programmed what to think, machines can observe, analyze and learn from data and mistakes just like our human brains can. AI can augment our human efforts to solve our global challenges. It’s also an integral part of our safety and security systems.

The work is designed for using surveillance camera on a panning platform i.e., moving the camera, mounted on a SERVO motor in clockwise and anticlockwise direction in periodic intervals.

The live tracking system is implemented by interfacing Arduino C programming with python language where the input is taken from camera mounted on the SERVO motor.

The key features of Arduino board are −

- They can read analogue or digital input data from various sensors and convert them to an output, such as starting a motor, turning on/off LEDs, connecting to the cloud, and a variety of other functions.
- The Arduino IDE may be used to control the board's functionality by delivering a series of instructions to the board's microcontroller (referred to as uploading software).
- They do not require an additional piece of hardware to put fresh code into the board, unlike most prior programmable circuit boards. A simple USB cord would suffice.
- Furthermore, the Arduino IDE makes programming easier by using a simplified form of C++.
- Finally, Arduino offers a common form factor that condenses the microcontroller's functionalities into a more manageable size.

II. PROBLEM STATEMENT

To alert the user when safety protocols are being violated and to provide maximum area coverage with minimum manpower as shown in figure (1).

Fig (1) Working of face mask detection.

III. OBJECTIVES

- The main objective of the work is live tracking and face mask detection system which alerts the user when face mask protocol is being violated.
- This work has a lot of scope in crowded areas and bio hazard containment zones where wearing a mask is mandatory.
- This work would be sufficient to monitor a large area under single camera vision and have maximum video coverage.
- Future advancements in this work would be to also detect the social distancing range and alert the user if any violation is made.

IV. MOTIVATION

The motivation for this work was to combine the domains of AI and embedded systems to build a model that would provide maximum safety in terms of both health and security. Due to the fact that surveillance cameras are essentially stationary devices, 360-degree coverage is not achievable. However, if this proposed device is interfaced with the camera and powered to control the panning speed, 270-degree coverage is achievable. With the tilt of the camera as a feature of surveillance cameras, total 360-degree coverage is feasible.
This reduces manpower required in crowded areas to maintain safety and also increases the level of security provided by that organization.
This system can be used in real-time applications which require face-mask detection for safety purposes due to the ongoing global pandemic caused due to COVID-19 and also significantly reduces manpower.
Face-mask detection is integrated with automatic panning video surveillance cameras, which is an embedded system implemented in Airports, Railways, Stations, Offices, Schools and Public places.

Despite the fact that many individuals understand the significance of wearing a face protection mask as advised by the World Health Organization and scientific research, many people fail to do so. As a result of these findings, public health officials have begun a campaign to educate the public about the usage of masks. These initiatives, in particular, use preventative posters and illustrations to teach people how to use face protection masks appropriately. By establishing an image-based analytic technique and a digital tool for validating appropriate mask usage utilizing a smartphone's frontal camera, this effort aims to improve public health campaigns. Smartphones are beneficial since there are presently 3.5 billion smartphone users on the planet, accounting for 45.04 percent of the world's population.

The hardware used in this work are Arduino UNO, Pan-Tilt Servo Mechanism with 2X Servos(9G), Breadboard kit, PC Camera.

The software used in this work are Operating-system: Windows 10, 64-bit, Python == 3.1.0, Tensorflow ==1.15.2, keras==2.3.1, Opencv-python==4.2.0, Mobilenet, Arduino IDE (SERVO library).

V. METHODOLOGIES

The CNN model was trained using MobileNet instead of convolution because MobileNet uses depth wise separable convolutions.

MobileNet is a convolutional neural network for mobile vision applications that is simple, efficient, and computationally light. Object detection, fine-grained classifications, facial traits, and localization are just a few of the real-world applications that use MobileNet.

The depth-wise separable convolution is made up of two layers: depth-wise and point-wise. In essence, the first layer filters the input channels, while the second layer combines them to create a new feature.
Each input channel receives a single filter thanks to the depth-wise convolutions. The filters are applied to all of the input channels in a typical convolution, as shown in figure (2).

Because depth wise convolution just filters the input channel, it does not combine them to generate new features. As a result, a pointwise convolution layer is created, which computes a linear combination of the depth wise convolution output using a 1x1 convolution.

Despite the fact that the base MobileNet design is compact and computationally light, it contains two global hyperparameters that effectively reduce the computational cost.
There are two types of multiplayers: width multiplayer and resolution wise multiplayer.

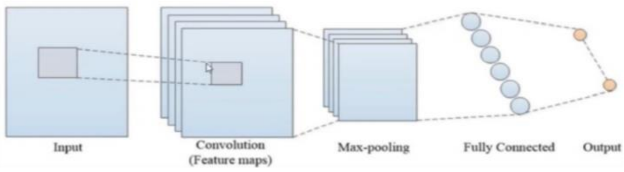

Fig (2) Depth-wise separable convolution

When compared to a network with regular convolutions of the same depth in the nets, it dramatically reduces the number of parameters.

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As a result, lightweight deep neural networks are created. Two operations are used to create a depth-wise separable convolution.

Face detection is done using OpenCV and the input is fed to the trained CNN model which classifies images with people wearing mask or otherwise and also alerts the user with a beep as shown in figure (3).

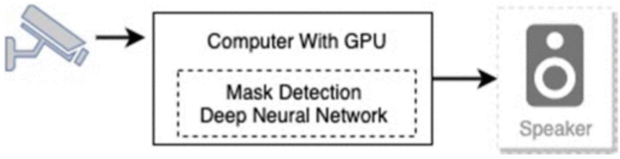

Fig (3) Software working

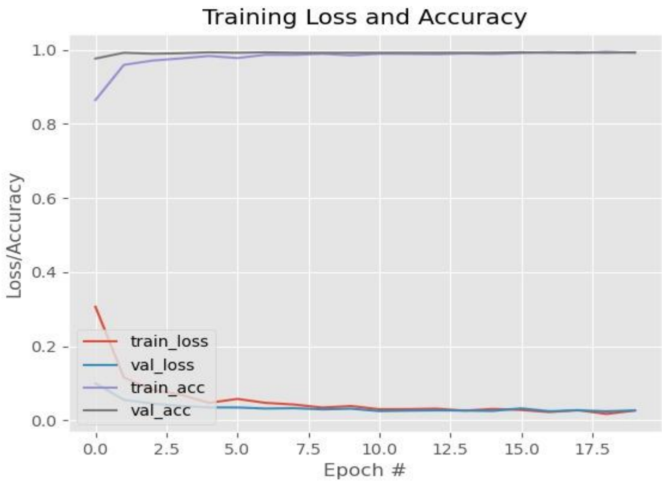

Fig (4) Training Accuracy

The hardware is made up of two self-assembled servo mechanisms, motors with a coverage of 180 and 90 degrees respectively adding upto a 270-degree coverage, the vertical and horizontal servos are set to sweep at a periodic interval of 15s and pan in the opposite direction as shown in figure (5).

Current model is developed using PC camera with a limited resolution of 30 frames per second fps however with the use of high-resolution cameras ranging from 240 to a million frames per second, the model will be extremely efficient in identifying covid-19 protocol violations even when it is deployed in highly crowded regions.

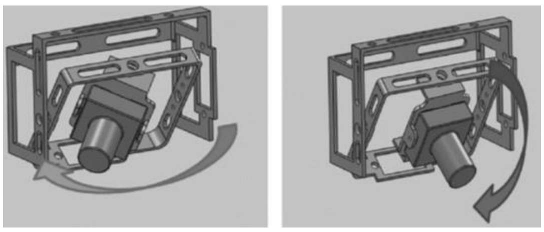

Fig (5) Motor Rotation

VI. RESULTS

As seen in the figures (6.1) and (6.2) the face mask detection is implemented successfully with alarm as an extra feature that alerts the user when they aren't wearing a mask or wearing it incorrectly. Also as shown in figure (4), the training accuracy obtained with face mask detection is about 98%.

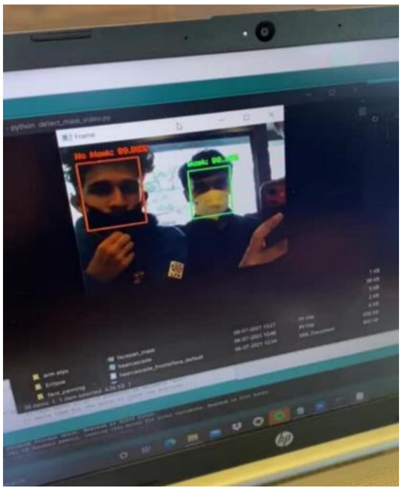

Fig (6.1) Software Implementation

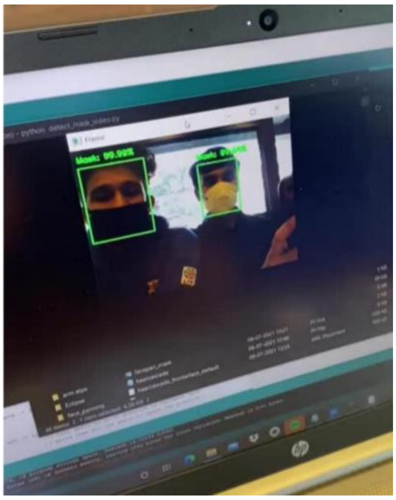

Fig (6.2) Software Implementation

As shown in the figure (6.3), the SERVO motor panning is implemented successfully using the PC camera to record the input with panning speed set to 15s per direction.

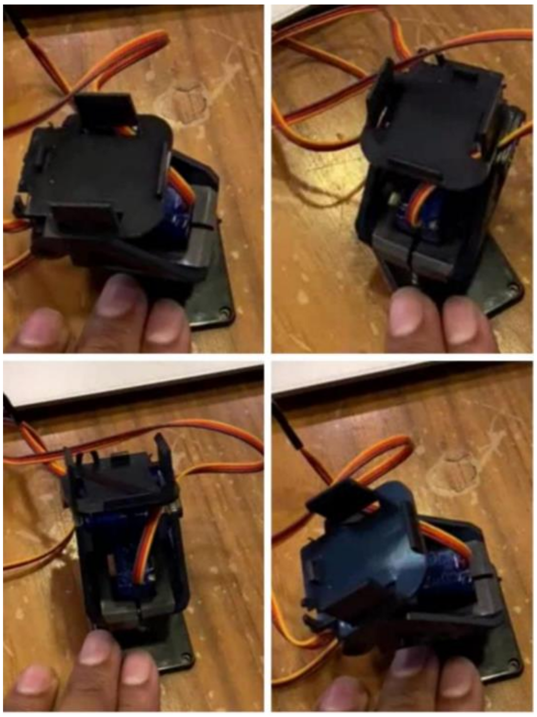

Fig (6.3) Hardware Implementation

VII. CONCLUSION AND FUTURE ADVANCEMENTS

To evaluate various analytical scenarios, several types of conventional masks and acquisition settings were employed. The effectiveness of the exploited face and face-feature detectors is crucial to the proposed technique's success.
In this study, wearing glasses showed no negative consequences. Rigid masks tend to be preferable because they reduce the risks of misalignment of the face. In this case, the prototype can be very beneficial. Furthermore, self-checking of correct mask wear might be used as a compliance element in monitoring-related apps. Future research might focus on training a deep learning network utilising specific facial characteristics or, more broadly, correctly/incorrectly worn mask classes to build very reliable detectors.
This work would also be able to identify the social distance range and notify the user if there is a violation.

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