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Artificial Intelligence based Smart Door with Face Mask Detection

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***Abstract*—In this pandemic situation, health plays an important role in everyone's life. Most of the people are not aware of preventing themselves and their surroundings from this pandemic. Face mask is essential to prevent ourselves and others. So, people are in need to wear face mask regularly. People who visit home won't wear mask due to their unawareness which may affect people. People may not know if someone visits their home when they are not there. AI based smart device (Raspberry pi with AI model with camera) is proposed in this project which identifies whether a person is wearing face mask and gives us an alert message (via mobile app). This device is integrated with a mobile app. Mobile app identifies if someone enters home when people are not physically present in their home. This smart device automatically opens the door only if people wear face mask. This device works both day and night. It can be used in multiple places like malls, shops, hospitals and temples**

Keywords—Face mask, AI model, Automatic opening and closing of door, Mobile app

I. INTRODUCTION

In this paper the idea is in this pandemic situation, face mask is the essential thing that everyone should wear. Due to unavoidable situations, people may visit home and people will be unaware of wearing face mask sometimes. This may affect people and so the solution for this problem is designing a smart device which will detect face mask. It will also act as smart door and if the person comes home wearing a face mask, it will open the door and if not, it won't open the door. It is integrated with a mobile app so that owner will receive notification, if someone visits home. In this pandemic situation, checking of temperature plays a vital role in public places so that this smart device can also be integrated with the temperature measurement so that it would be more benefited to the society

II. FACE MASK DETECTION

Wearing a face mask has become a mandatory rule in almost all the country because of the COVID 19 Pandemic. It is been an effective tool in controlling the spread of the COVID 19 virus. So wearing a face mask has created a normal situation in the pandemic. However regulating and monitoring large group of people wearing a mask is a tedious process. Also it led to many hazels among people in public places like Super market, Mall, Church etc. It is really a challenging job to recognize a face mask on any monitoring system. Face mask detection is to detect whether a person wearing a mask or not and to detect the location of the face. The problem is related to general object detection to detect the classes of objects and face detection is to detect a particular class of objects. Nowadays in public places like malls, temples, hospitals, wearing face mask is mandatory so that our smart device will be very useful in those public places. This smart device can be inserted in the entry point of those places so that people can prevent themselves from this pandemic. The Fig.1 and 2 depicts the working of the Face Mask Detection Platform.

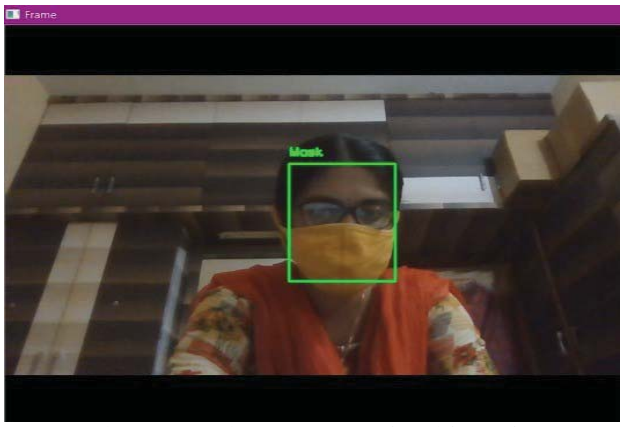

Fig.1. Detection of face mask: with mask

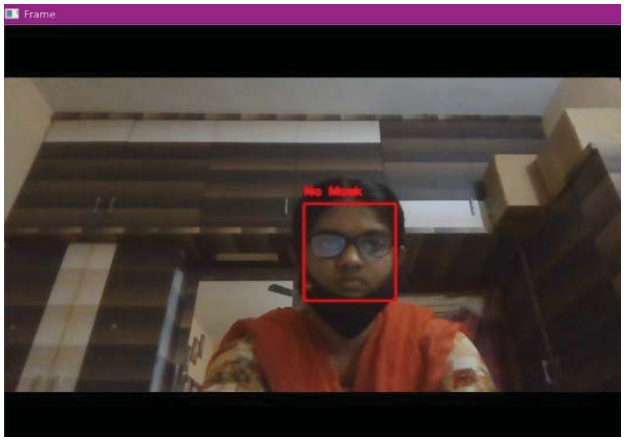

Fig.2. Detection of face mask: without mask

III. FACE RECOGNITION SYSTEM

Facial recognition refers to the optimal way to find and recognize the facial features using any technology like Artificial Intelligence with the help of any hardware device to capture the images like Video Cameras. Generally in facial recognition software the facial features from the live

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image or video will be mapped using biometric details. The result is achieved by comparing these images with predefined dataset containing the desired images. Also Several countries initiative and the demand for surveillance systems increased the need for facial recognition. So in the trends of market, facial recognition formed to raise rapidly and the value can be expected to reach a value of 9.06 billion USD by 2024[1].

It is always good to adapt and design according to the market demands. Because of the pandemic, there is a huge demand for optimal facial recognition systems. The AI powered facial recognition system uses the biometric data of each individual to obtain the facial features to classify the images accordingly. It also can alert if someone not wearing the mask. It can be done using mobile apps, software etc. [2].

TensorFlow is used in the Convolutional Neural Network (CNN) model which includes Keras library and OpenCV to identify the face mask to protect themselves. For building this model, face mask dataset is used and the value consist of about 1,376 images with 690 images containing people with face masks and without face masks available with 686 images. The generated images are required to build a CNN model using TensorFlow to identify a face mask from the webcam of PC.

IV LITERATURE REVIEW

Deep learning method is proposed to distinguish facial recognition and the person is recognized whether the person is wearing a facemask or without a facemask. It is implemented by using a Raspberry Pi, OpenCV,Tensor Flow and Python programming languages. An alarm system consists with the real time facemask recognition by way of Convolutional Neural Networks which need for noticing of persons wearing a facemask or without the facemask. The validation accuracy was achieved with high performance by the trained model of the CNN [4]. A new facemask-wearing condition identification method was developed by combining of classification networks (SRCNet), image super-resolution and measures a three category classification problem based on 2D facial images. Image pre-processing, facial detection cropping, facemask wearing condition identification are the major steps in the proposed algorithm. identification of facemask-wearing conditions with the High accuracy was achieved by the proposed SRCNet. To improve the performance on low-quality images and the proposed method achieves higher accuracy [5].

The proposed system is designed to identify either a person is wearing a mask or without mask and reporting the corresponding authority in a smart city network. Deep learning plays an amazing role in object detection which is trained on the dataset that consists of images of people from various sources. Labeled image data are trained and testing the dataset where the facial images with mask and the person without the are detected. The system is designed with the with a specific components capture the person GPS location of the CCTV camera and The corresponding authority cwn detetct the image with meticulous time is sent via SMS to the corresponding authority [6]. The proposed method is presented to generate the accurate face segmentation masks from arbitrary image size. The proposed model also shows the recognizing non-frontal faces. Multiple facial marks in a single frame can be detected[7]. For any arbitrary, The circuit face segmentation and detection using semantic segmentation on any arbitrary. To perform the unmanned semantic segmentation of human face. This method reduces the problem of erroneous predictions and find applications in latest tasks such as facial part detection is also the task[8].

The mask detection system is presented to detect a type of mask and masks of different shapes from the video streams for following the rules that applied. Deep Learning algorithm and PyTorch Library is used for detection from the images/video streams. The proposed system is developed to detect the people with masks or without masks. The MobileNETV2 classifier training process is used as the first phase of the model done by using the PyTorch framework of deep learning and implementation formed with the OPENCV of python [9]. The Multi-Task Cascaded Convolutional Neural Network (MTCNN) approach is used for the occluded faced detection problem. The embedded model in the Google FaceNet is performed by the facial features extraction. CNN is successively applied for detection and recognition problems. The Support Vector Machine (SVM) classification task has been characterized [10]. The FaceNet trained model tested on the datasets to show the better face recognition rates. Receiver Operating Characteristics curve is a visualization technique is used to displays the definite presentation of a classification model. FaceNet model is a baseline for a deep network and included with 22 deep convolutional network layers. This model is the characteristics of identification, face recognition, verification, detection of images, prediction of real images and clustering of neural networks [14].

V ATTRIBUTES

To detect to a face, we need its complete facial features. So it becomes difficult to detect a masked face since it gives incomplete facial features [15]. However modern technologies have come to rescue us. With the help of Artificial intelligence and Machine Learning. We can develop different models for different applications such as classification, processing etc., with accurate results. However it requires several attributes such as Face orientation, Eye location, Mask location, Face location bounded by shapes such as a square:

- Shape ie., square is annotated by the Location of Faces, annotated by a shape
- Face Alignment, includes left-front front, left, , right, right-front.
- Eye centres which mask as the Location of eyes
- Location of Masks with necessity details are annotated by a shape i.e., rectangles.
- Different type of Mask presents in the market: i.e, man-made masks or without logo, face mask covered by hand, etc.
- Sealing Degree, the function of face for recognition consist into four regions - eyes, nose, chin and mouth.

VI CONNECTING AI WITH DATABASE

Once the device detects number of people entering and detect whether those people wearing face mask in accurate

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way and if someone is detected with no face mask then alert notification will be sent [16].

Detection of face mask is completely based on python and linking with database so also based on python. By adding firebase library and sending a json data of number of people present, number of people taken responsible to wear mask or number of people without wearing the mask [17]. This value will reflect in app and real time database needs library files to be imported in the device and create a project in firebase database which is shown in fig.3

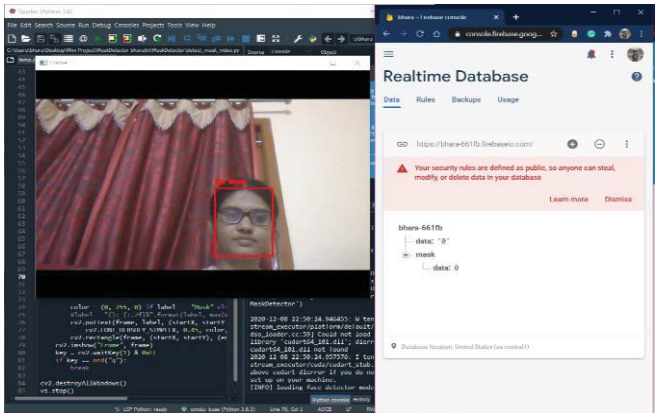

Fig.3. Connecting AI with firebase

VII SETTING UP DATABASE

To start a new project, create an account in firebase database and open a new project shown in fig. 4.

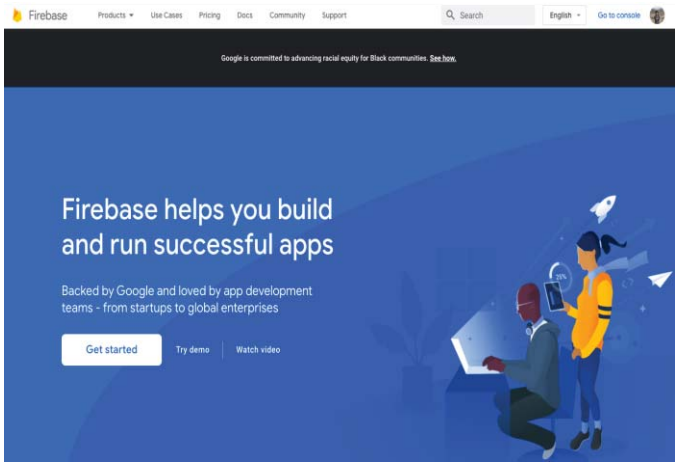

Fig.4. Firebase

Open up the project which is created and produce a realtime database in build and make security and testing mood to read and write value in database [18]. After creating a database a link and security key will be generated which will be using in this python code.

VII SIMULATION

To get a virtual door it needs a simulation software there are no simulation software available to simulate a door using firebase and so by using html css created a new simulation software i.e. a webpage which is local hosted in a device shown in fig.5.

Fig.5. Simulation website

A. Connecting database with simulation software

Create a web app in firebase to interface with the simulation software. After creating a web app in firebase, it will generate a code snippet as in fig.6.

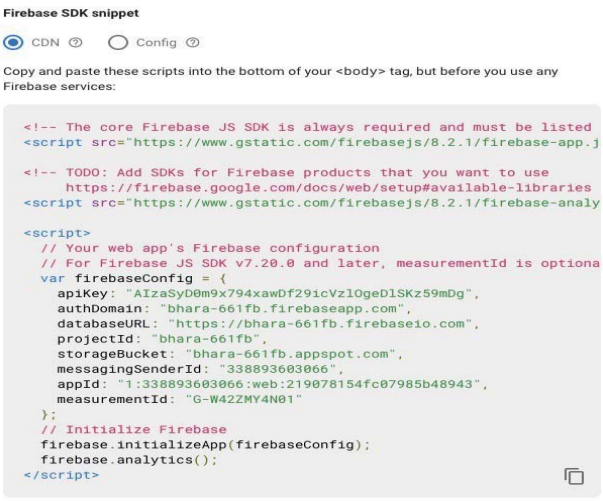

Fig. 6. Code for connecting simulation websie with firebase

By the code shown in fig 7, the data from the firebase can be fetched and according to the variations in the data, the door will automatically open and close. This particular code is responsible for simulation. Since we have added firebase analytics, we can get the usage of database.

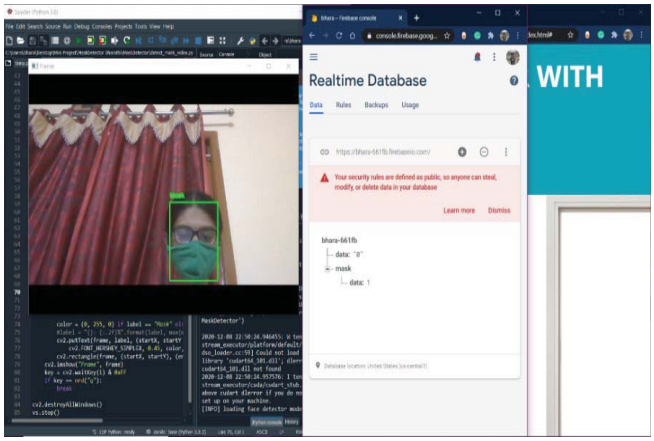

Fig.7 Interfacing AI with firebase and website

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VIII MOBILE APPLICATION

Mobile application helps the owner to know whether someone enters their home when they are not available in the home. It also acts as a security system. When someone enters home, smart device will capture the image and immediately sends to the owner via mobile app so that the owner can allow the known person inside.

A. Create app using MIT App Inventor

The MIT App Inventor which is an intuitive, visual programming environment is shown in fig. 8 that allows everyone even children to build fully functional apps for

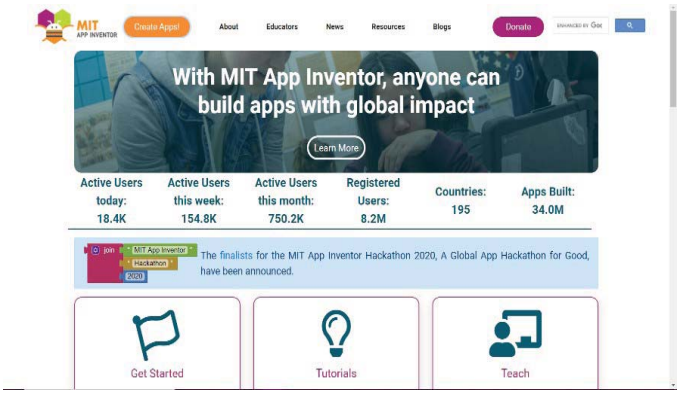

Fig 8. MIT App Inventor

Mobile phones and tablets. The people innovative to MIT App Inventor with the responsible with create invention take a generate the first app up and time required for running is less than 30 minutes.

B. Front End

In the designer page, there are multiple options like labels, textbox, buttons shown in 9. In the front panel number of people entering, detects the number of people taken responsibility to wear masks and specific number of people not wearing masks are displayed using labels in the app inventor where the count value is taken from the firebase database shown in fig.10.

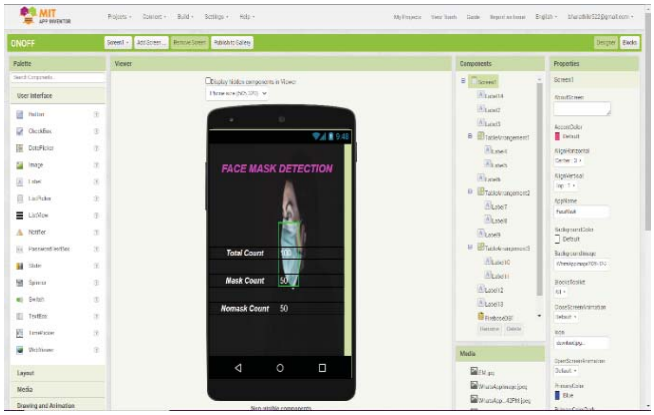

Fig.9. Designing App

Fig.10 Front panel of mobile app

C. Back End

The database values which are continuously updated by the AI model device which is used to give alert notification and monitor the activities shown in fig. 11. The back end is completely coded with google's blocky language. which is simple and easy to develop from the particular code and data can be fetched continuously from the database.

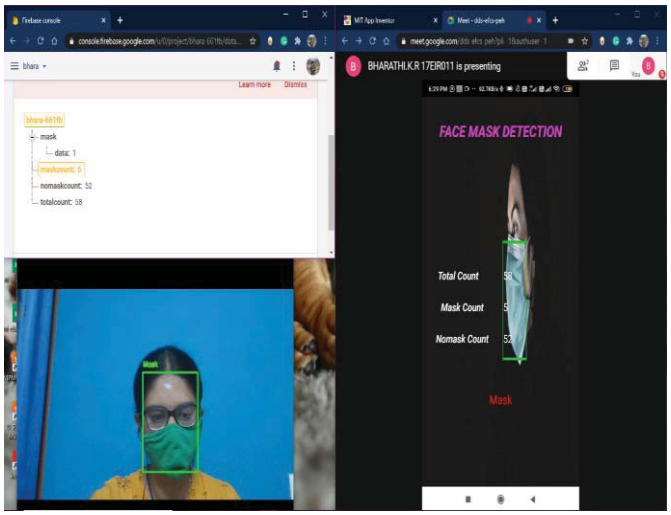

Fig.11. Interfacing AI model with mobile app

IX EXISTING METHOD

The World is now facing unprecedented pandemic like this because COVID 19 is having high spreading and reproductive rates than any other germ which caused pandemic before. Until people find an efficient vaccine, the only way to curb the spread of corona virus by wearing the mask. However, the process of observing and identifying the huge number of groups people is tough. The existing technology is available for detecting the face mask but our idea differs from the existing method is that the smart device will be inserted in the door and the mobile is designed so that owner will get notification and it also acts as a smart door and if the person wore face mask, the door will open automatically and if not the door won't open.

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X. PROPOSED METHOD

The proposed system detects whether a individual is wearing of a face mask and follows the safety measures or not using a detector which employs SSD for face detection and a neural network to detect presence of a face mask. If that detects a person with face mask the door will open and close and there will be an alert from the mobile app if people enters without mask. From fig, 12, the block diagram for smart door with mask detection consists of Firebase, mobile app, push notification, device and AI model, simulation of door, html5, css, bootstrap. Convolution operation is an element-wise matrix multiplication operation.Convolutional layers take the three-dimensional input matrix we mentioned before and they pass a filter (also known as convolutional kernel) considered in the image, it formed to creating in a small window of pixels at a time (i.e 3x3 pixels) and this window until the whole image has been scanned. The dot product is used The convolutional operation calculates the dot product generation of the pixel values in the current filter window including with the weights defined in the filter. The output of this operation is the final convoluted image.

Convolutional Neural Networks (CNN) are neural networks most commonly used to analyze images. A CNN receives an image as an input in the form of a 3D matrix. The first two dimensions corresponds to the width and height of the image in pixels while the third one corresponds to the RGB values of each pixel.

CNNs consist of the following sequential modules (each one may contain more than one layer)

1. Convolution
2. Activation function
3. Pooling
4. Fully connected layers
5. Output layer

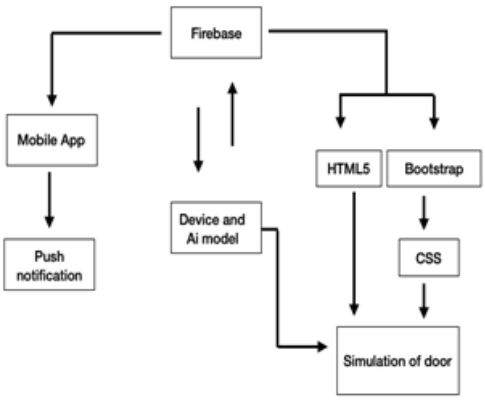

Fig.12. Block diagram for smart door

X1.RESULT AND DISCUSSION

This smart device automatically opens the door only if people wear face mask and notify people who does not wear mask. It acts as smart door which automatically opens and closes the door and it is integrated with a mobile app which send notifications to owner. The software developed in the project is about detecting the face with mask or without mask which identifies a person is wearing face mask and gives us alert (via mobile app). This device is integrated with a mobile app. Mobile app let us to know if someone enters home when people are not physically present in their home. This smart device automatically opens the door only if people wear face mask. This device works both day and night. It can be used in multiple places like malls, shops, hospitals, temples and other public places. The merits of face mask detection is that people can prevent themselves from this pandemic and it also acts as a smart door .The demerits of this smart device is that during night time the image won't be clearly visible .

REFERENCES

[1] Vinitha, Velantina, "COVID-19 Facemask Detection with Deep learning and Computer Vision", IRJET, vo.7, issue 8, pp.3127-3132, 2020

[2] Meenpal, "Facial Mask Detection using Semantic Segmentation", International Conference on Computing, Communications and Security, 2019.

[3] Sammy V. Militante, Nanette V. Dionisio, "Real-Time Facemask Recongition with Alarm System using Deep Learning", 11th IEEE Control and System Graduate Research Colloquium (ICSGRC 2020), pp.106-110, 2020

[4] Bosheng Qin, Dongxiao Li, "Identifying Facemask-Wearing Condition Using Image Super-Resolution with Classification Network to Prevent COVID-19", Sensors, MDPI, pp.1-23, 2020

[5] Mohammad Marufur Rahman, Md. Motaleb Hossen Manik, Md.Milon Islam, Saifuddin Mahmud, Jong-Hoon Kim, "An Automated System to Limit COVID-19 Using Facial Mask Detection in Smart City Network", IEEE International IOT, Electronics and Mechatronics Conference (IEMTRONICS), 2020.

[6] Toshanlal Meenpal, Ashutosh Balakrishnan, Amit Verma, "Facial Mask Detection using Semantic Segmentation", 4th International Conference on Computing, Communications and Security (ICCS), pp.1-5, 2019

[7] Sneha Sen, Harish Patidar, "Face Mask Detection System for COVID 19 Pandemic Precautions using Deep Learning Method", Journal of Emerging Technologies and Innoative Research (JETIR), vol. 7, issue 10, pp.16-21

[8] Md.Sabbir Ejaz and Md.Rabiul Islam, "Masked Face Recognition using Convolutional Neural Network", International Conference on Sustainable Technologies for Industry 4.0(STI), 2019

[9] Geraldine B. Mangmang,"Face Mask Usage Detection Using Inception Network", JARDCS, Vol.12, issue,7, pp:1660-1667, 2020.

[10] Anubhav Kumar Singh, "Analysis & Study of Face Recognition and Detection", IRJET, Vol.07, issue 04 pp. 3289-3293, 2020

[11] Karthik A Patil, Niteen Vittalkar, "Smart Door Locking System using IoT", IRJET, Vol.07 issue: 05, pp. 30890-30894, 2020

[12] Nikita Raut, Varun Dhuldhoya, "A Review on Various Techniques for Face Detection", IRJET, Vol.05, issue: 10 pp. 108-110, 2018

[13] Khaoula Karimi, "Secure Smart Door Lock System based on Arduino and Smartphone App", JARDCS, Vol.12 issue 0, pp.407-414, 2020

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[14] Gunawan, Gani, Rahman, Kartiwi, "Development of Face Recognition on Raspberry Pi for Security Enhancement of Smart Home System", IJEEI, Vol. 5, issue 4, pp. 317-325, 2017.

[15] H.Archana, A.Arunjagadeshwaran, R.Kamatchi, K.N.Baluprithviraj, "Disinfectants Spraying BOT in Silkworm Rearing House",IJIRT, vol.5, issue 9, pp.150-155, 2019

[16] Baluprithviraj.K.N, Idhikash.S, KirubaharanS.R, Ashwin.V, Guru Prasad.R.S, "Automatic Penalty of Vehicles for Violation of Traffic Rules using IoT", International Journal of Recent Technology and Engine ering, vol.8, issue 6, pp.415-420, 2020

[17] Mengbo, "Multi-view face detection using frontal face detector", IEEJ Transactions on Electrical and Electronic Engineering, Vol.13 issue 07, pp. 1011-1019, 2018

[18] Viraktamath S.V,"Face Detection and Tracking using OpenCV", The SIJ Transactions on Computer Networks & Communication Engineering, Vol.04 Issue: 03 pp. 01-06, 2016

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