

Deep Learning Technique for Automated Entry Checkpoint System Using Raspberry pi

Submitted in partial fulfilment of the requirements for the award of

Bachelor of Engineering Degree in
Electronics and Communication Engineering
By

SHANKAR SAHU (37130375)

SHAIK TASREEM (37130374)



**DEPARTMENT OF ELECTRONICS AND COMMUNICATION
ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

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JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

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Accredited with “A” grade by NAAC
Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai-600119
www.sathyabama.ac.in



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of Shankar Sahu (37130375) and Shaik Tasreem (37130374) who carried out the project entitled **“Deep Learning Technique for Automated Entry Checkpoint System Using Raspberry pi”** under my supervision from November 2020 to April 2021.

Project Guide
Dr.N.M.Nandhitha

Dr.T.RAVI,M.E.Ph.D
Head of the Department

Submitted for Viva voice Examination held on _____

Internal Examiner

External Examiner

DECLARATION

We, **SHANKAR SAHU (37130375)** and **SHAIK TASREEM (37130374)** hereby declare that the Project Report entitled “**Deep Learning Technique for Automated Entry Checkpoint System Using Raspberry pi**” done by us under the guidance of **Dr.N.M.Nandhitha** is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

DATE:

PLACE:

SHANKAR SAHU (37130375)

SHAIK TASREEM (37130374)

SIGNATURE OF CANDIDATES

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We convey our thanks to Electronics And **Dr. N. M. Nandhitha, M.E, Ph.D.**, Dean, School of Electrical and Electronics and **Dr.T.RAVI, M.E. Ph.D** Head of the Department, Dept. of Electronics and Communication Engineering for providing us necessary support and details at the right time during the progressive reviews.

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We wish to express my thanks to all Teaching and Non-teaching staff members of the Department of Electronics and Communication who were helpful in many ways for the completion of the project.

ABSTRACT

During these COVID-19 pandemic time which is an airborne disease which can spread easily from human to human interactions. Social distancing is the only remedy that can prevent this disease to spread. We propose a new design of IOT-based touchless entry checkpoint which utilizes edge computing and deep learning technologies. This concept will enable touchless and with less human interaction entry in many public places. Without a mask, the system will not allow entry to the premise and raise an alarm if anyone tries to cross. With a proper mask, the system detects the mask and gives a signal for entry without touching anything. The major area of applications is Mall, School, College, and housing property.

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CHAPTER 1

INTRODUCTION

Face masks have become the necessity of hour and it is advocated that it is the foremost necessity to stay safe. Hence it is important for the people to out only with masks. However due to year-long lethargy of not wearing masks, humans tend to step out without masks. As per Government norms, in public places, work places, industries, temples, ETC, permission must be given only for the people with masks. Hence the security personnel at the entrance of the above mentioned places, has an additional task of prohibiting people without masks from entering into the places. However if the system is automated then it will be relief for the security personnel.

Automation of this has already been attempted and various techniques are in use. But these systems are semi-automatic in nature and hence it requires a completely automated system. The proposed system must be capable of acquiring the face image of the person, detect for the presence of mask and accordingly allow or deny the person. Images can be acquired using a state of art camera and can be processed and stored. Major challenge in the above technique lies in developing techniques for mask detection.

The detection of object is trending in the field of image processing and computer vision. Ranging from small scale personal applications to large scale industrial applications, object detection and recognition is used during a wide selection of industries. Some examples include the image retrieval, security and the intelligence, OCR, medical imaging and the agricultural monitoring. In the object detection technique, an image is read and one or more objects in that image are categorized. The location of the object is also specified by the boundary called the bounding box. Traditionally, researchers used pattern recognition to predict faces supported prior face models. A breakthrough face detection technology then was developed named as Viola Jones detector that was an optimized technique of using Haar digital image features utilized in visual perception. However, it failed because it didn't perform well on faces in dark areas and non frontal faces. Since then, researchers want to develop

new algorithms supported deep learning to enhance the models. Deep learning allows us to find out features with end to finish manner and removing the necessity to use prior ideas for forming features extraction. There are various methods of object detection supported deep learning which are divided into two categories. The first neural network is employed to get region proposals and therefore the other refines these region proposals (Performing a coarse to fine detection). This strategy leads to high detection performance compromising on speed.

Faster RCNN is that the evolution of RCNN and Fast RCNN, and because the name implies its training and testing speed is bigger than those of its predecessors. While RCNN and Fast RCNN use selective search algorithms limiting the detection speed, Faster RCNN learns the proposed object regions itself employing a region proposal network (RPN). On the opposite hand, a stage one detector utilizes only one neural network for the region proposals and for detection; Some primary ones being SSD.

The weights for every category were chosen victimization the formula below:
$$\text{Class Weight} = 1 - \frac{\text{Class Cardinality}}{\text{Cardinalities of all classes}}$$
to load the data efficiently this project used the data loader. For the instance, in this project, they used the PV-torch lighting, and to load them for the training and validation they divided data into 32 batches and assigned the works of loading to 4 number of the workers, and this procedure allowed them to perform the multi process data loading. Most of the projects, this project can also used Adam optimizer. If any one of the Model has the high rate of learning, it learns faster, but it bounces a lot to reach the global minima and may diverge from the global minima. However, a little learning rate may take considerably lower time to coach, but it reaches to the worldwide minima. If the loss of the model declines quickly for any learning rate, then that learning rate would be the simplest learning rate. However, it seems that this project considered the 0.00001 learning rate would be the best for their model so that it could work efficiently. To train the model they defined a model check pointing callback where they wanted to save the best accurate and the low loss. They tried to train the model for 18 epochs and after finding optimal epoch, they saved the model for 6 epochs to test on the real data. To get obviate the matter of occlusions of the face which causes trouble face detectors to detect masks within the images, they used a builtin OpenCV deep learning face detection model.

In another method, it takes the picture of a person who is not wearing the mask, and, then, it detects the portion of that person's face. After knowing the situation of the face within the image, it extracted the face Region of Interest (ROI). After localizing facial landmarks, a picture of a mask is placed into the face. In this project, embedded devices are used for deployment that would reduce the cost of manufacturing.

However in all the above techniques, features were extracted and then the classifiers were used for detecting the presence or absence of the mask. Hence it is necessary to develop that imitates the human brain which accepts the input images and makes the right decision.

1.1 PROBLEM STATEMENT

The proposed research work aims at developing RESNET10 based neural network architecture for the detection of face ask and a hardware using Raspberry Pi for decision making.

1.2 OBJECTIVES

The objectives of the research work are as follows:

- To acquire the research database
- To preprocess the database to remove the noisy and corrupted images
- To identify an appropriate Convolutional Neural Network for classifying the images (with mask or without mask)
- To test and validate the network
- To download the validated version of the software into Raspberry Pi
- To connect a camera, buzzer and other sensor to Raspberry Pi (if needed)
- To test and implement the hardware

1.3 Organization of the report

Chapter 2 provides a detailed literature survey. Research database is provided in Chapter 3. Proposed methodology is explained in Chapter 4. Chapter 5 concludes the work and provides the future directions.

Chapter 2

LITERATURE SURVEY

Serial No	Author	Title	Year of Publishing	Objective
1	Hatchett RJ, Mecher CE, Lipsitch M	Public health interventions and epidemic intensity	2007	To improve the quality of life through prevention
2	Dick EC, Jennings LC, Mink KA	Aerosol transmission of rhinovirus colds	2005	To resolve limitations in conventional Airborne transmission
3	Wong TW, Lee CK, Tam W	Cluster of SARS among medical students exposed to single patient	2004	To review the severe acute respiratory syndrome infection control practices
4	Chen N, Zhou M, Dong X	Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus	2020	To identify factors related to the occurrence of diseases

5	Mizumoto K, Kagaya K, Zarebski A	Estimating the asymptomatic proportion of coronavirus disease 2019 (COVID-19)	2020	Using Covid-19 data from different countries to show the prediction are sensitive
6	Hoffmann M, Kleine-Weber H, Schroeder S	SARS-CoV-2 cell entry depends on ACE2 and TMPRSS2 Cell.	2020	It blocks by a proven protease inhibitor
7	Wrapp D, Wang N, Corbett KS	Cryo-EM structure of the 2019-nCoV spike in the prefusion conformation.	2020	To reveal conformations of dynamic molecular complexes
8	Seto WH, Tsang D, Yung RW	Effectiveness of precautions against droplets and contact in prevention of nosocomial transmission of severe acute respiratory syndrome (SARS)	2003	To control the pandemic without the vaccination
9	Duan SM, Zhao XS, Wen RF	Stability of SARS coronavirus in human specimens and environment and its sensitivity to heating and U.V.	2003	To increase the survival rate of humans by this environment

10	Otter JA, Donskey C, Yezli S	Transmission of SARS and MERS coronaviruses and influenza virus in healthcare settings: the possible role of dry surface contamination.	2016	To implement the testing strategies which can be rapidly adaptable
11	van Doremalen N, Bushmaker T, Morris DH	Aerosol and surface stability of SARS-CoV2 as compared with SARS-CoV-1.	2020	To contrast the set side by side for Effectiveness
13	Alford RH, Kasel JA, Gerone PJ	Human influenza resulting from aerosol inhalation.	2005	To check the credibility of precautions
14	Moser MR, Bender TR, Margolis HS	An outbreak of influenza aboard a commercial airliner	2007	To have a safety measures with necessary implements
15	Xie X, Li Y, Sun H	Exhaled droplets due to talking and coughing.	2009	To maintain a suitable space between the group

16	Bourouiba L, Dehandschoewercker E, Bush JWM	Violent expiratory events: on coughing and sneezing	2014	Development of model with an health detection prober
17	Z. Mahmood, M. Ramachandran	Concepts, Principles and Related Paradigms.	2018	Development of model which stands the both the sections of pandemic
18	P. Viola, M. Jones	Rapid Object Detection using a Boosted Cascade of Simple Features.	2001	For using real time applications
19	M. Petkovic, W. Jonker	Content- Based Video Retrieval: A Database Perspective.	2004	Answer's user queries with a list of appropriate video content
20	Coia JE, Ritchie L, Adisesh A	Healthcare Infection Society Working Group on Respiratory and Facial Protection.	2013	To give a crucial platform for prevention of healthcare

21	Buonsenso D, Piano A, Raffaelli F	Point-of-Care Lung Ultrasound findings in novel coronavirus disease-19 pneumoniae.	2020	To develop the diagnostic tool
22	Gomathi M, Padmapriya S, Balachandar V	Drug studies on Rett syndrome: from bench to bedside.	2020	Development of a medicine suitable for the certain illness
23	Kurtz IS, Schiffman JD	Current and emerging approaches to engineer antibacterial and antifouling electrospun nanofibers.	2018	To coat the food substances packaging containing chitosan
24	Shankar S, Jeevan PR, Jong-Whan R	Preparation, characterization, and antimicrobial activity of chitin nanofibrils reinforced carrageenan nanocomposite films.	2015	To develop film for eatery packaging application with UV screening
25	Juan Mas, Teodoro Panadero, Guillermo Botella.	CNN Inference Acceleration Using Low- Power Devices for Human Monitoring and Security Scenarios.	2020	Develop the minimization of networks end to end response time

CHAPTER 3

RESEARCH DATABASE

In order to perform the research work, a set of 687 images are obtained from “[https:// www.kaggle.com/ shreyashwaghe /medical-mask-dataset/metadata](https://www.kaggle.com/shreyashwaghe/medical-mask-dataset/metadata)”. The database is in such a way that it contains 670 masked images (used for training) and 8 images used for testing. The dataset consists of true color images which are taken at different distances and in these images, a single face; a set of faces can be seen. Also the mask is of different sizes, different colors and different textures.



Figure 3.1 (a) gives the set of images used for testing.



Figure 3.1 (b) gives the set of images used for testing



Figure 3.1 (c) gives the set of images used for testing



Figure 3.1 (d) gives the set of images used for testing



Figure 3.1 (e) gives the set of images used for testing



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Figure 3.3 (i) gives the set of images used for testing



Figure 3.3 (j) gives the set of images used for testing



Figure 3.4 (a) gives the set of images used for testing



Figure 3.4 (b) gives the set of images used for testing

CHAPTER 4

DNN BASED MASK DETECTION

Conventional approaches for mask detection various methods cited in literature for mask detection is shown in tree diagram. In the first approach, the features are extracted and are then fed to the classifier features are extracted using Laplacian of Gaussian filter of the various filter. This filter is chosen because it performs image smoothing (to remove noise) and then extracts the useful information from the noiseless image.

These features are then fed to standard classifiers for determining the presence/absence of the mask.

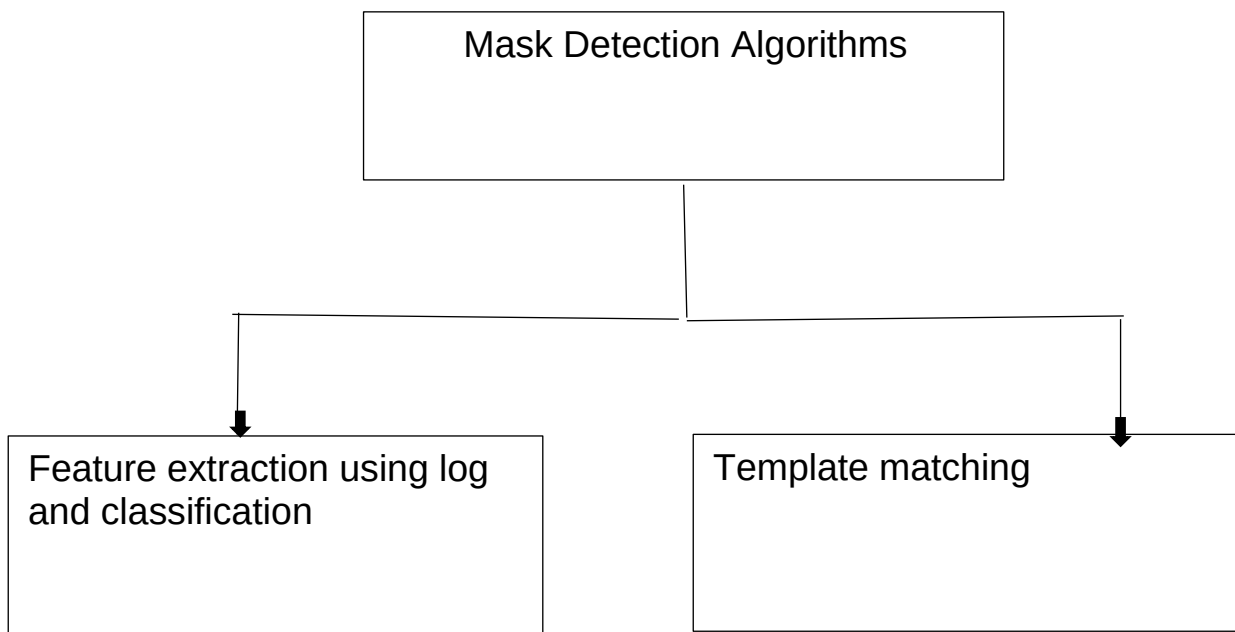


Figure 4.1 Model of Extraction

In the case of template matching only the edge information are obtained. The undesignable edges are removed by using an appropriate threshold. Having identify useful edges, the image is then compared with the template. First to final comparison between the two images is done and if there are more number of pixel matches with the mask image is declared as masked face and access is granted, else the access is denied.

However the performance of the above two techniques is strongly dependent on the features which are attracted from the image. Hence is necessary to have a technique becomes the extraction of features step. One such technique deep learning and hence deep is used in this project work.

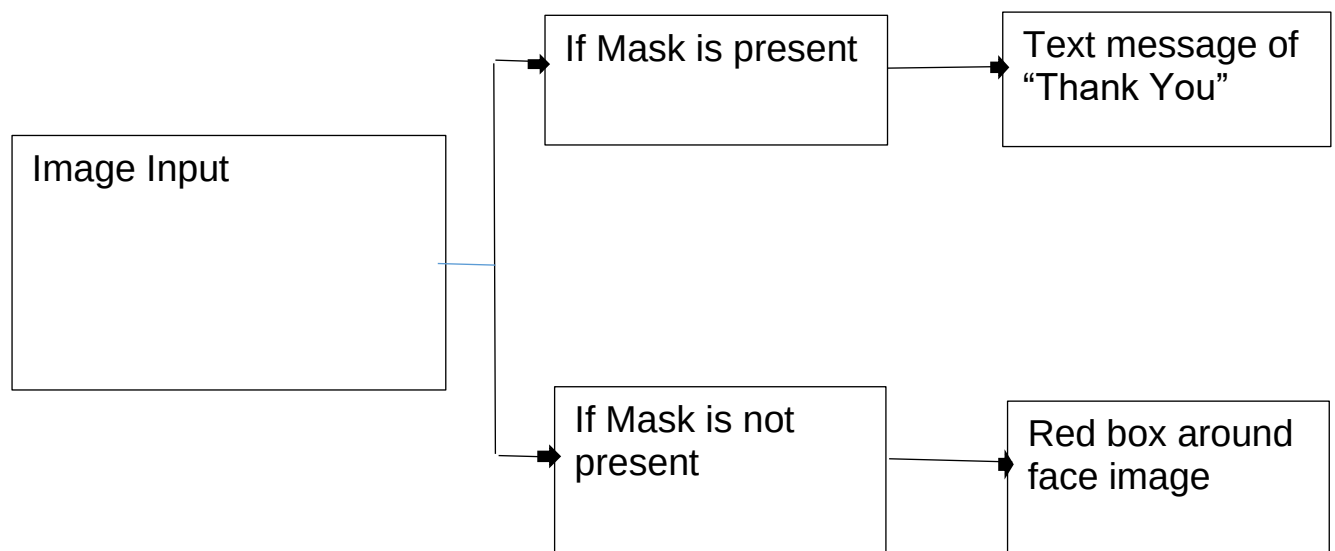


Figure 4.2 Expected outcome of the proposed work

4.1 Proposed Work

Steps involved in the proposed research and the steps involved in the project work are as follows Image acquisition from the standard database, image pre-processing (to remove noisy images) and image augmentation by image augmentation ,it means that all the images are converted into an predefined size in order to increase the accuracy. Having preprocessed the database, the images are to the separated for training in this Work, 80% of the images are used for training and 20% are to for testing.

of the various convolutional normal networks, RESNET10 is used in this work.

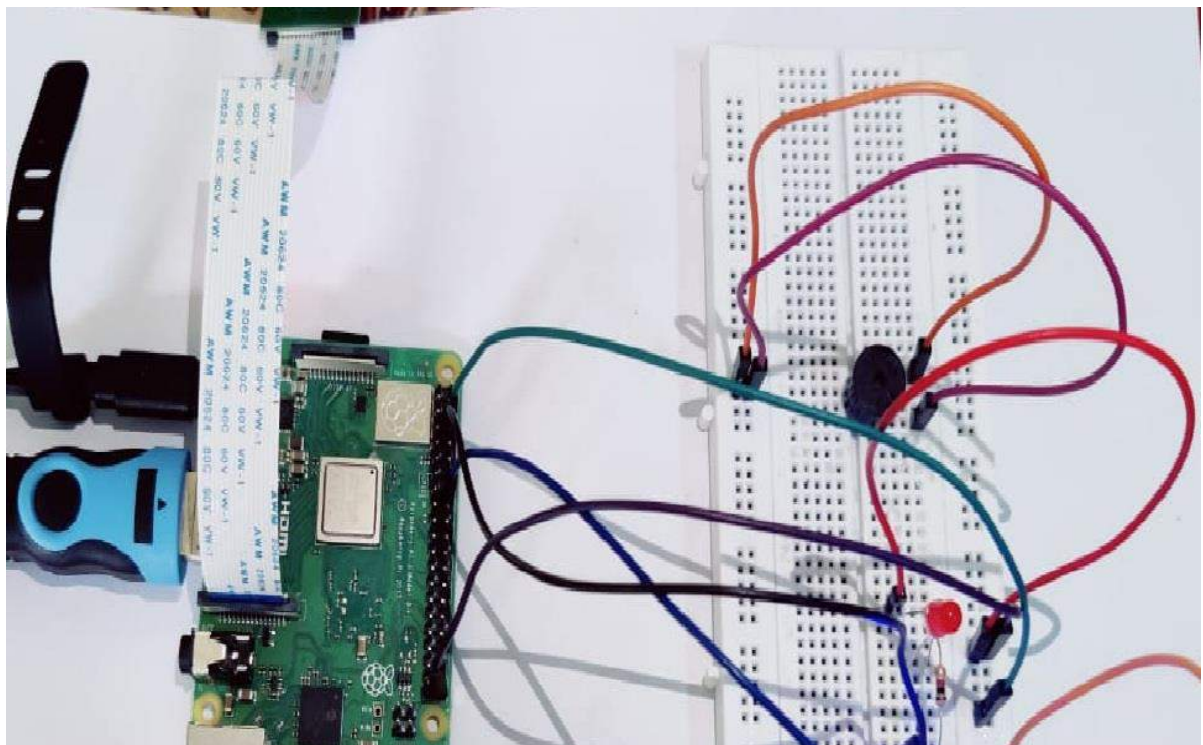


Figure 4.3 Proposed Hardware (Automated mask detection)

A 5 megapixel camera is connected to the camera port of Arduino. Also a HDMI cable is connected from HDMI port of Arduino to the desktop or television. The true color image obtained from the camera and the code are stored in external memory connected to Arduino. Initially LS command is executed and the image and the program executed using appropriate Python commands. Once the program is executed, the output is seen on the display device. Also corresponding LED glows and the buzzer may be turned ON or OFF. If the mask is present, then the blue LED glows and the buzzer is OFF. On the other hand, if the mask is not present then Red LED glows and the buzzer is ON.

In this work, RESNET10 is used as the CNN for detecting the mask. It consists of 8 convolutional layers. The mask size for first convolutional layer is 7x7 and the remaining masks are 3x3 and 1x1. These values are normalized using a batch normalization layer. These features are then converted to values greater than or equal to zero with rectified linear activation function.

These values are then fed to fully connected network which accepts 256 features and converts it into 1000 features which are used for mask detection. The input layer accepts a true colored image.

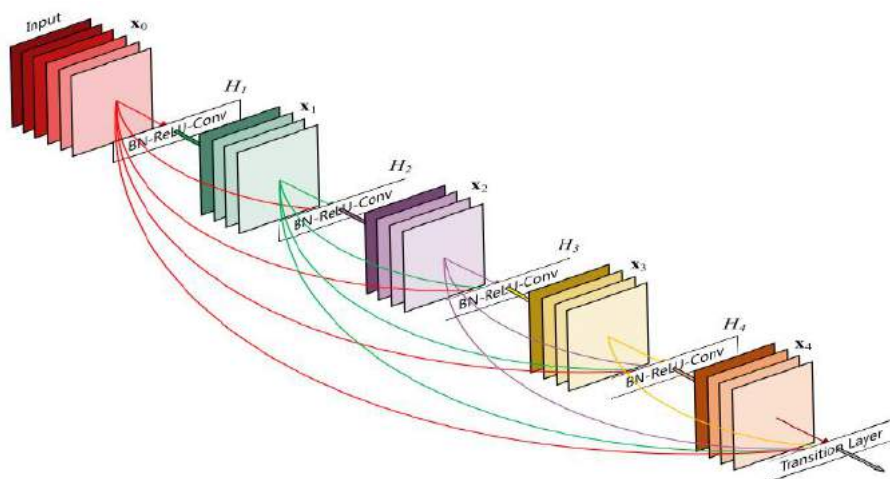


Figure 4.4 Resnet10

CHAPTER 5

Conclusion

The neural network is trained with 670 images and tested with 8 images. A set of 2209 images is used for validation. Sensitivity is 85.23% and specificity is 99.81%. Having pre-trained, tested and validated the network, the hardware is then developed. The hardware set up for the proposed work is shown in Figure 5.1

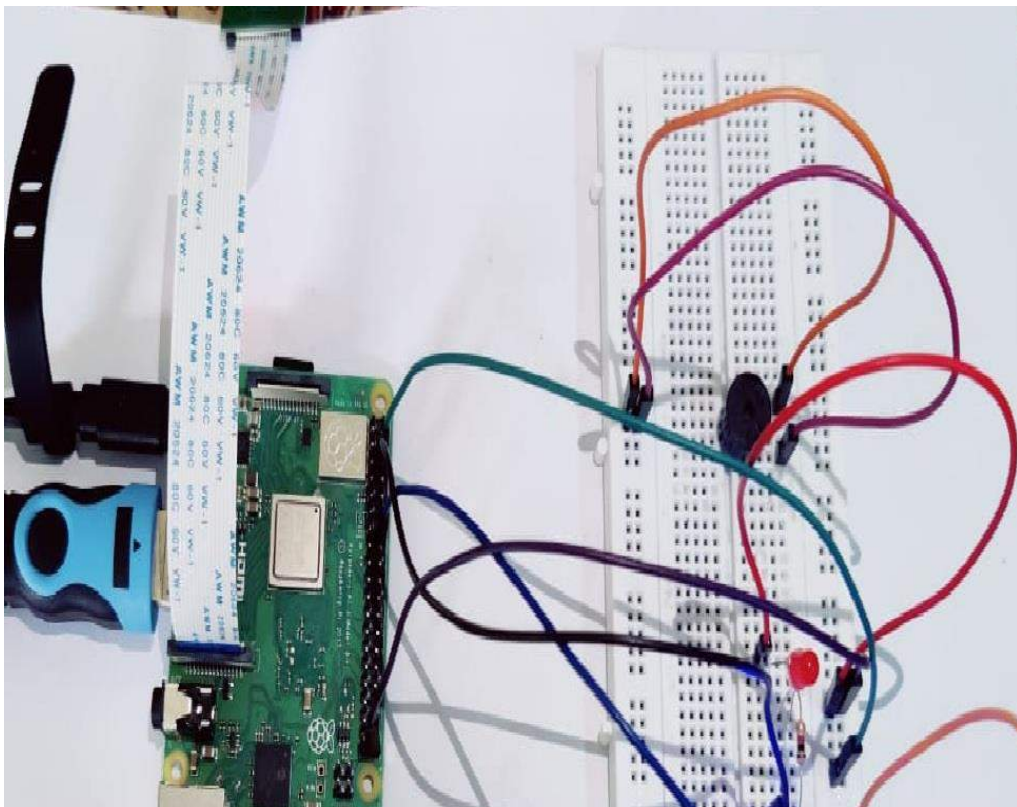


Figure 5.1 Proposed Hardware (Automated mask detection)

In this work, a hardware is developed for automated entry validation in public and private places. This hardware allows people only with mask to enter into a building and sends an alarm if anyone has appeared at the gates without wearing the mask. RESNET10 is used for mask detection. Having validated the software, it is downloaded in Arduino and is implemented in hardware. The network uses transfer learning where it is trained from Kaggle medical mask dataset. Though it is trained with synthetic dataset, it works well for the real time images acquired using a 5 Megapixel camera.

The subroutines are written in such a way that the buzzer goes on when a person without mask tries to enter. The algorithm written in the hardware is scalable. It means that it works well on a group of images, instead of single images. However, the sensitivity of the proposed algorithm is in 80% and hence it must be improved. So the feasibility of other deep learning techniques can be studied. Also, it involves an additional television screen or desktop which can be eliminated in future design.

The output of the hardware for the real time images is shown in Figure 5.2 (Red Rectangular box when the image is without mask).

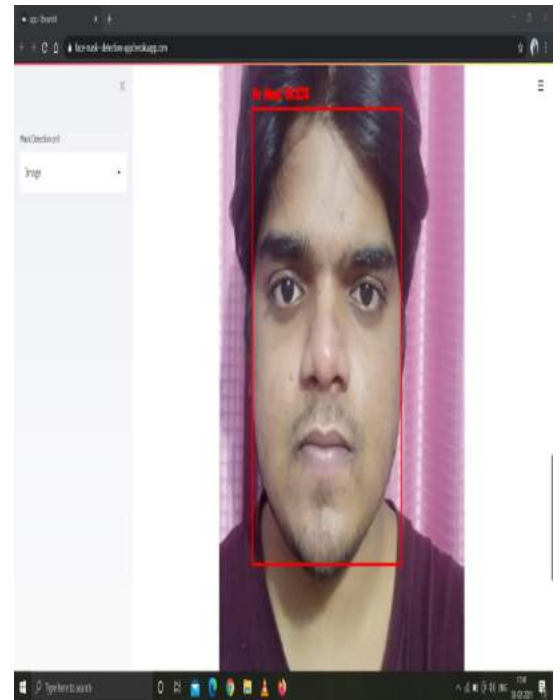
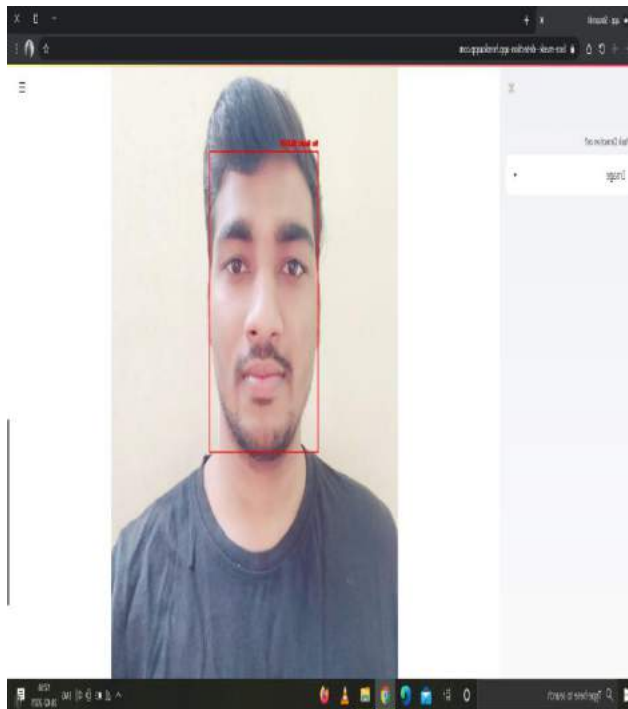


Figure 5.2 a (Detected images without mask)

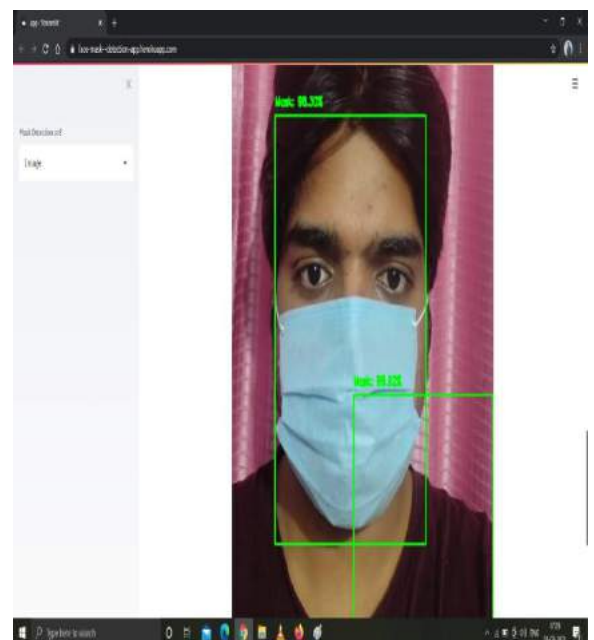
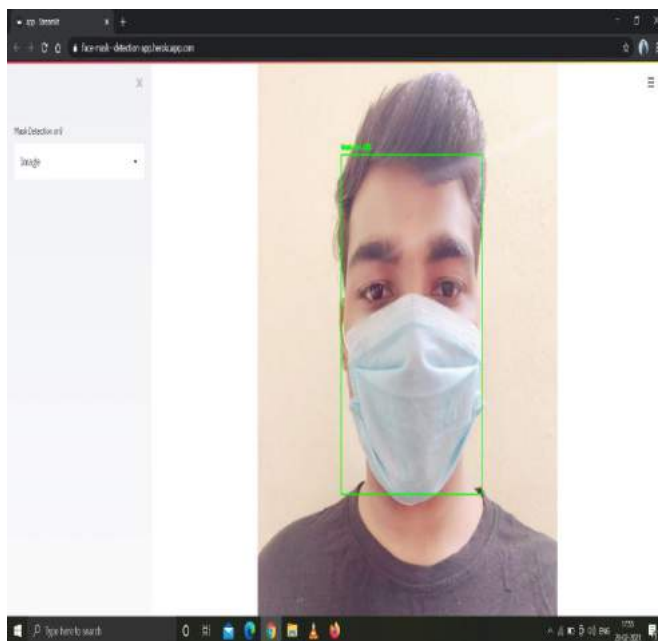


Figure 5.3 a (Detected images with mask)

PLAGIARISM REPORT

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CHAPTER 1

INTRODUCTION

Face masks have become the necessity of hour and it is advocated that it is the foremost necessity to stay safe. Hence it is important for the people to out only with masks. However due to year-long lethargy of not wearing masks, humans tend to step out without masks. As per Government norms, in public places, work places, industries, temples, etc, permission must be given only for the people with masks. Hence the security personnel at the entrance of the above mentioned places, has an additional task of prohibiting people without masks from entering into the places. However if the system is automated then it will be relief for the security personnel.

Automation of this has already been attempted and various techniques are in use. But these systems are semi automatic in nature and hence it requires a completely automated system. The proposed system must be capable of acquiring the face image of the person, detect for the presence of mask and accordingly allow or deny the person. Images can be acquired using a state of art camera and can be processed and stored. Major challenge in the above technique lies in developing techniques for mask detection.

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- To acquire the research database
- To preprocess the database to remove the noisy and corrupted images
- To identify an appropriate Convolutional Neural Network for classifying the images (with mask or without mask)
- To test and validate the network
- To download the validated version of the software into Raspberry Pi
- To connect a camera, buzzer and other sensoes to Rasspberry Pi (if needed)
- To test and implement the hardware

1.3 Organization of the report

Chapter 2 provides a detailed literature survey. Research database is provided in Chapter 3. Proposed methodology is explained in Chapter 4. Chapter 5 concludes the work and provides the future directions.

Chapter 2

LITERATURE SURVEY

Serial No	Author	Title	Year of Publishing	Objective
1	Hatchett RJ, Mecher CE, Lipsitich M	Public health interventions and epidemic intensity	2007	To improve the quality of life through prevention
2	Dick EC, Jennings LC, Mink KA	Aerosol transmission of rhinovirus colds	2005	To resolve limitations in conventional Airborne transmission
3	Wong TW, Lee CK, Tam W	Cluster of SARS among medical students exposed to single patient	2004	To review the severe acute respiratory syndrome infection control practices
4	Chen N, Zhou M, Dong X	Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus	2020	To identify factors related to the occurrence of diseases

11 5	Mizumoto K, Kagaya K, Zarebski A	Estimating the asymptomatic proportion of coronavirus disease 2019 (COVID-19)	2020	Using Covid-19 data from different countries to show the prediction are sensitive
10 6	Hoffmann M, Kleine-Weber H, Schroeder S	SARS-CoV-2 cell entry depends on ACE2 and TMPRSS2 Cell.	2020	It blocks by a proven protease inhibitor
8 7	Wrapp D, Wang N, Corbett KS	Cryo-EM structure of the 2019-nCoV spike in the prefusion conformation.	2020	To reveal conformations of dynamic molecular complexes
3 8	Seto WH, Tsang D, Yung RW	Effectiveness of precautions against droplets and contact in prevention of nosocomial transmission of severe acute respiratory syndrome (SARS)	2003	To control the pandemic without the vaccination
5 9	Duan SM, Zhao XS, Wen RF	Stability of SARS coronavirus in human specimens and environment and its sensitivity to heating and U.V.	2003	To increase the survival rate of humans by this environment

10	Otter JA, Donskey C, Yezli S	Transmission of SARS and MERS coronaviruses and influenza virus in healthcare settings: the possible role of dry surface contamination.	2016	To implement the testing strategies which can be rapidly adaptable
11	van Doremalen N, Bushmaker T, Morris DH	Aerosol and surface stability of SARS-CoV2 as compared with SARS-CoV-1.	2020	To contrast the set side by side for Effectiveness
13	Alford RH, Kasel JA, Gerone PJ	Human influenza resulting from aerosol inhalation.	2005	To check the credibility of precautions
14	Moser MR, Bender TR, Margolis HS	An outbreak of influenza aboard a commercial airliner	2007	To have a safety measures with necessary implements
15	Xie X, Li Y, Sun H	Exhaled droplets due to talking and coughing.	2009	To maintain a suitable space between the group

16	Bourouiba L, Dehandschoewercker E, Bush JWM	Violent expiratory events: on coughing and sneezing	2014	Development of model with an health detection prober
17	Z. Mahmood, M. Ramachandran	Concepts, Principles and Related Paradigms.	2018	Development of model which stands the both the sections of pandemic
¹³ 18	P. Viola, M. Jones	Rapid Object Detection using a Boosted Cascade of Simple Features.	2001	For using real time applications
⁴ 19	M. Petkovic, W. Jonker	Content- Based Video Retrieval: A Database Perspective.	2004	Answer's user queries with a list of appropriate video content
20	Coia JE, Ritchie L, Adisesh A	Healthcare Infection Society Working Group on Respiratory and Facial Protection.	2013	To give a crucial platform for prevention of healthcare

21	Buonsenso D, Piano A, Raffaelli F	Point-of-Care Lung Ultrasound findings in novel coronavirus disease-19 pneumoniae.	2020	To develop the diagnostic tool
22	¹² Gomathi M, Padmapriya S, Balachandar V	Drug studies on Rett syndrome: from bench to bedside.	2020	Development of a medicine suitable for the certain illness
23	Kurtz IS, Schiffman JD	Current and emerging approaches to engineer antibacterial and antifouling electrospun nanofibers.	2018	To coat the food substances packaging containing chitosan
24	Shankar S, Jeevan PR, Jong-Whan R	Preparation, characterization, and antimicrobial activity of chitin nanofibrils reinforced carrageenan nanocomposite films.	2015	To develop film for eatery packaging application with UV screening
25	Juan Mas, Teodoro Panadero, Guillermo Botella.	CNN Inference Acceleration Using Low- Power Devices for Human Monitoring and Security Scenarios.	2020	Develop the minimization of networks end to end response time

CHAPTER 3

RESEARCH DATABASE

In order to perform the research work, a set of 687 images are obtained from "https:// [www.kaggle.com/ shreyashwaghe /medical-mask-dataset/metadata](https://www.kaggle.com/shreyashwaghe/medical-mask-dataset/metadata)". The database is in such a way that it contains 670 masked images (used for training) and 8 images used for testing. The dataset consists of true color images which are taken at different distances and in these images, a single face; a set of faces can be seen. Also the mask is of different sizes, different colors and different textures.



Figure 3.1 (a) gives the set of images used for testing.



Figure 3.1 (b) gives the set of images used for testing



Figure 3.1 (c) gives the set of images used for testing



Figure 3.1 (d) gives the set of images used for testing



Figure 3.1 (e) gives the set of images used for testing



Figure 3.1 (f) gives the set of images used for testing



Figure 3.1 (g) gives the set of images used for testing



Figure 3.1 (h) gives the set of images used for testing



Figure 3.1 (i) gives the set of images used for testing



Figure 3.1 (j) gives the set of images used for testing



Figure 3.2 (a) gives the set of images used for testing



Figure 3.2 (b) gives the set of images used for testing



Figure 3.2 (c) gives the set of images used for testing



Figure 3.2 (d) gives the set of images used for testing



Figure 3.2 (e) gives the set of images used for testing



Figure 3.2 (f) gives the set of images used for testing



Figure 3.2 (g) gives the set of images used for testing



Figure 3.2 (h) gives the set of images used for testing



Figure 3.2 (i) gives the set of images used for testing



Figure 3.2 (j) gives the set of images used for testing



Figure 3.3 (a) gives the set of images used for testing



Figure 3.3 (b) gives the set of images used for testing



Figure 3.3 (c) gives the set of images used for testing



Figure 3.3 (d) gives the set of images used for testing



Figure 3.3 (e) gives the set of images used for testing



Figure 3.3 (f) gives the set of images used for testing



Figure 3.3 (g) gives the set of images used for testing



Figure 3.3 (h) gives the set of images used for testing



Figure 3.3 (i) gives the set of images used for testing



Figure 3.3 (j) gives the set of images used for testing



Figure 3.4 (a) gives the set of images used for testing

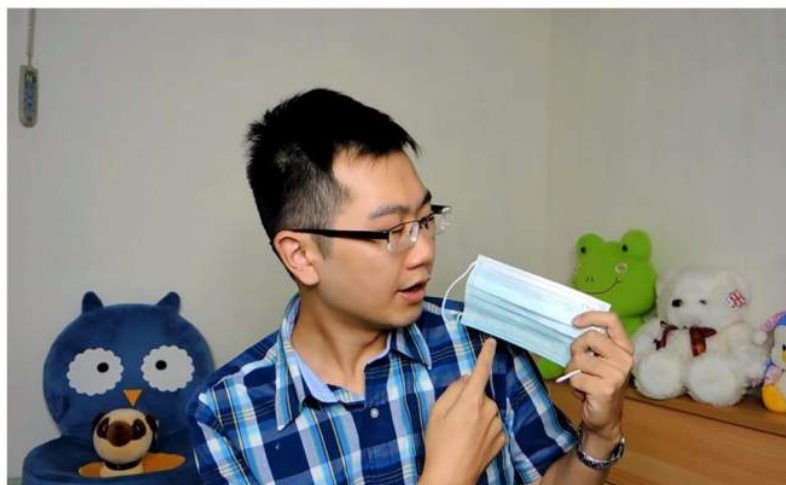


Figure 3.4 (b) gives the set of images used for testing

CHAPTER 4

DNN BASED MASK DETECTION

Conventional approaches for mask detection various methods cited in literature for mask detection is shown in tree diagram. In the first approach, the features are extracted and are then fed to the classifier features are extracted using Laplacian of Gaussian filter of the various filter. This filter is chosen because it performs image smoothening (to remove none) and then extracts the useful information from the noiseless image.

These features are then fed to standard classifiers for determining the presence/absence of the mask.

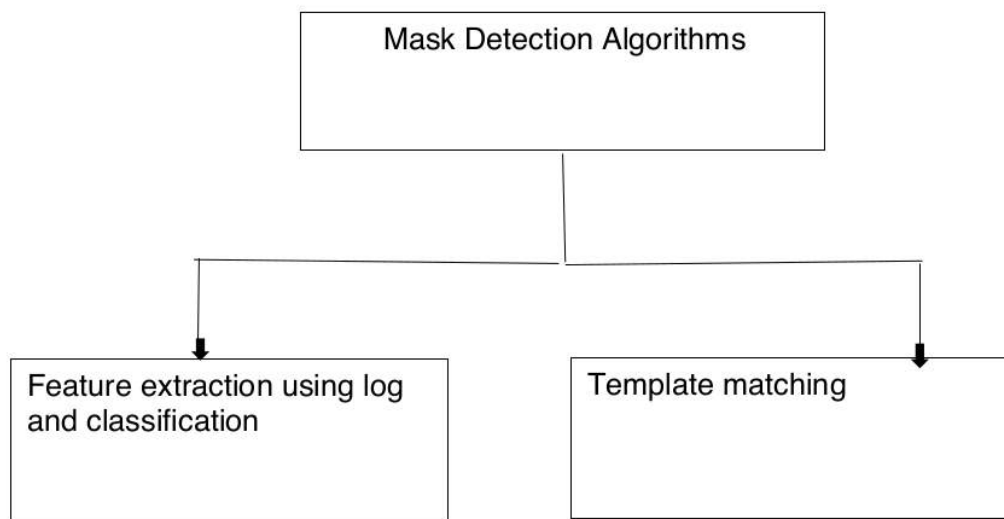


Figure 4.1 Model of Extraction

In the case of template matching only the edge information are obtained. The undesignable edges are removed by using an appropriate threshold. Having identify useful edges, the image is then compared with the template. First to final comparison between the two images is done and if there are more number of pixel matches with the mask image is declared as masked face and access is granted, else the access is denied.

However the performance of the above two techniques is strongly dependent on the features which are attracted from the image. Hence is necessary to have a technique becomes the extraction of features step. One such technique deep learning and hence deep is used in this project work.

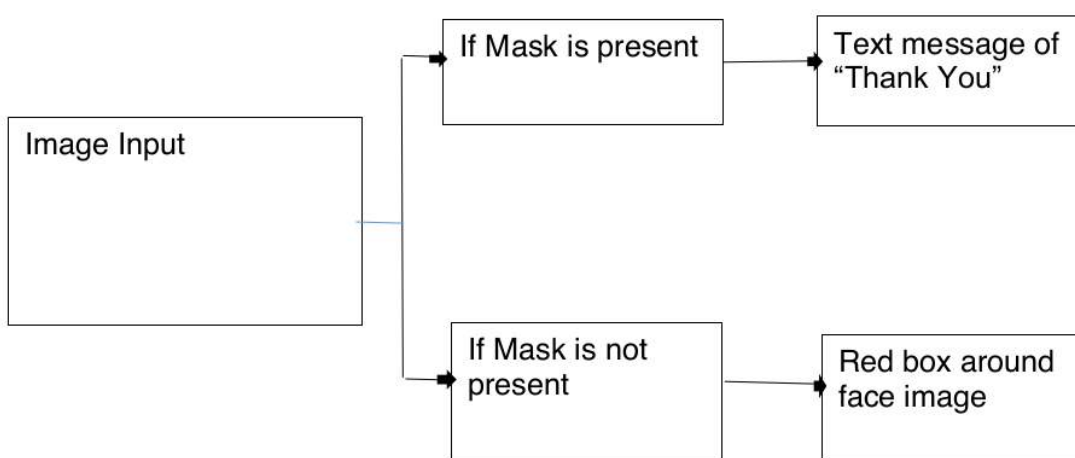


Figure 4.2 Expected outcome of the proposed work

4.1 Proposed Work

Steps involved in the proposed research and the steps involved in the project work are as follows Image acquisition from the standard database, image pre-processing (to remove noisy images) and image augmentation by image augmentation ,it means that all the images are converted into an predefined size in order to increase the accuracy. Having preprocessed the database, the images are to the separated for training in this Work, 80% of the images are used for training and 20% are to for testing.

of the various convolutional normal networks, RESNET10 is used in this work.

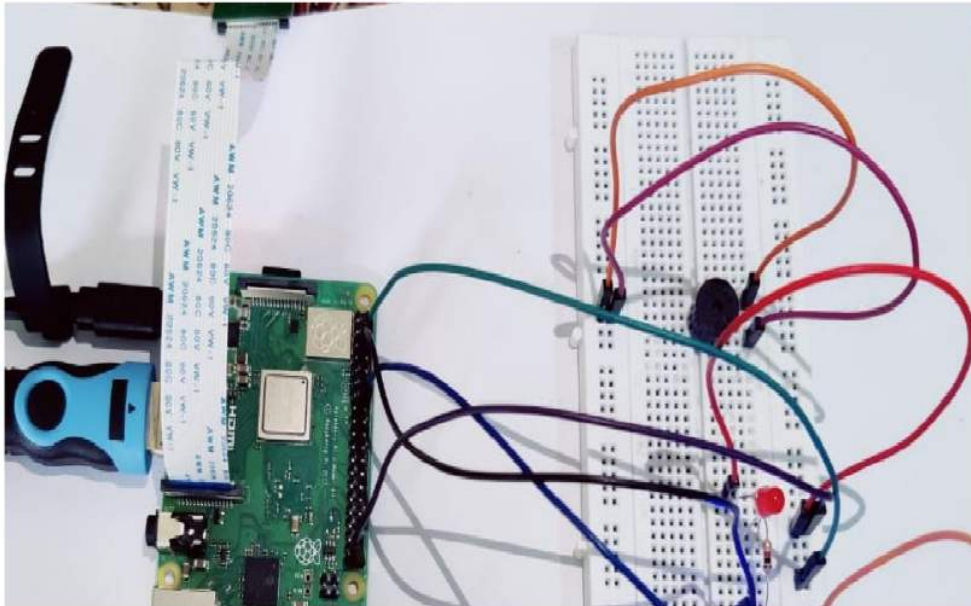


Figure 4.3 Proposed Hardware (Automated mask detection)

A 5 megapixel camera is connected to the camera port of Arduino. Also a HDMI cable is connected from HDMI port of Arduino to the desktop or television. The true color image obtained from the camera and the code are stored in external memory connected to Arduino. Initially LS command is executed and the image and the program executed using appropriate Python commands. Once the program is executed, the output is seen on the display device. Also corresponding LED glows and the buzzer may be turned ON or OFF. If the mask is present, then the blue LED glows and the buzzer is OFF. On the other hand, if the mask is not present then Red LED glows and the buzzer is ON.

In this work, RESNET10 is used as the CNN for detecting the mask. It consists of 8 convolutional layers. The mask size for first convolutional layer is 7x7 and the remaining masks are 3x3 and 1x1. These values are normalised using a batch normalization layer. These features are then converted to values greater than or equal to zero with rectified linear activation function.

These values are then fed to fully connected network which accepts 256 features and converts it into 1000 features which are used for mask detection. The input layer accepts a true colored image.

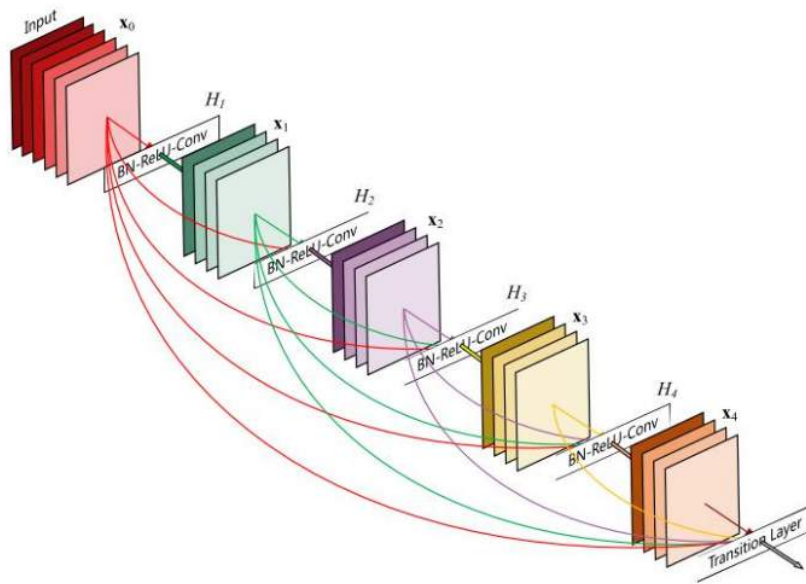


Figure 4.4 Resnet10

CHAPTER 5

RESULTS AND DISCUSSION

The neural network is trained with 670 images and tested with 8 images. A set of 2209 images is used for validation. Sensitivity is 85.23% and specificity is 99.81%. Having pre-trained, tested and validated the network, the hardware is then developed. The hardware set up for the proposed work is shown in Figure 5.1

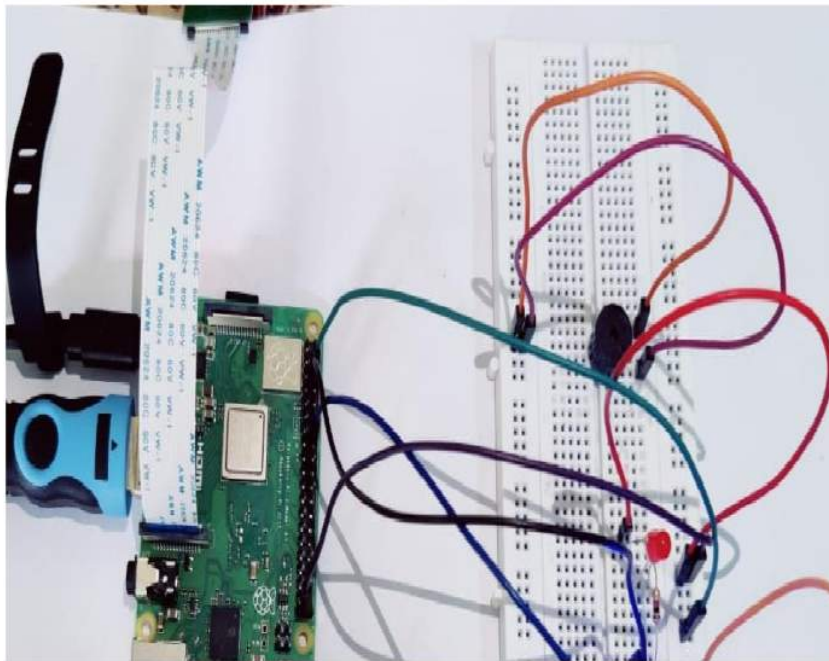


Figure 5.1 Proposed Hardware (Automated mask detection)

The output of the hardware for the real time images is shown in Figure 5.2 (Red Rectangular box when the image is without mask).

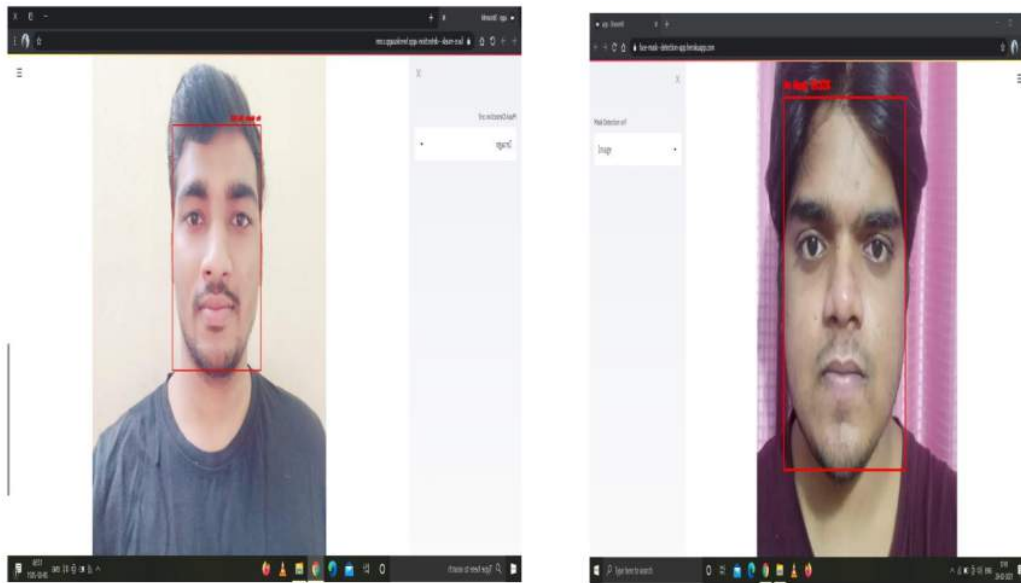


Figure 5.2 a (Detected images without mask)

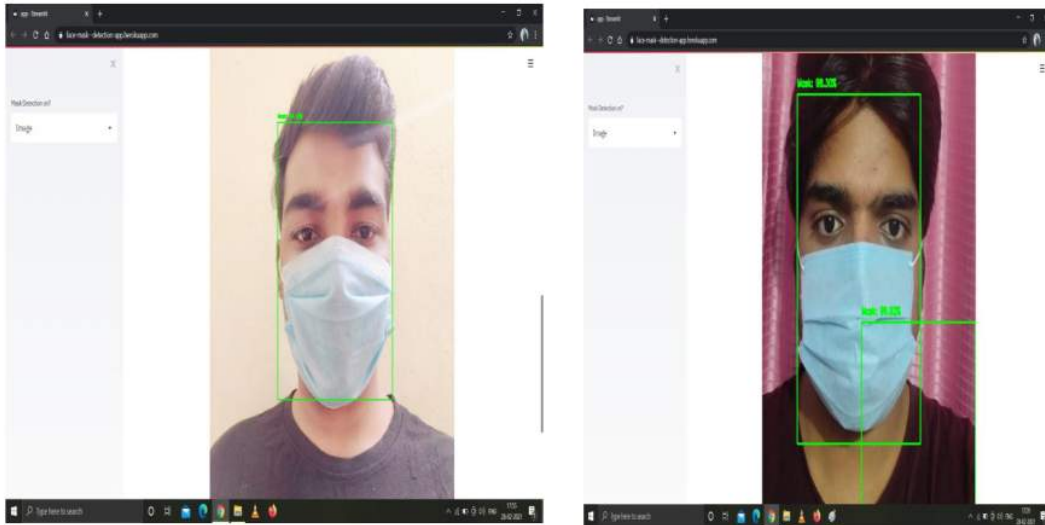


Figure 5.3 a (Detected images with mask)

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