OPTIMIZED FACE MASK RECOGNITION USING EDGE DEPLOYMENT FRAMEWORK IN GUARD BOT USING DEEP LEARNING

A PROJECT REPORT

Submitted By

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We express our gratitude and thanks to **Our parents** first for giving health and a sound mind for completing this project. We give all the glory and thanks to our almighty **GOD** for showering upon, the necessary wisdom and grace for accomplishing this project.

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ABSTRACT

Coronavirus disease is the latest epidemic that forced an international health emergency. It spreads mainly from person to person through airborne transmission. Community transmission has raised the number of cases over the world. Many countries have imposed compulsory face mask policies in public areas as a preventive action. Manual observation of the face mask in crowded places is a tedious task. However, some people still do not wear masks in public areas, which might lead to infection of themselves or others. Therefore, automatic detection of the wearing of face masks may help global society, but research related to this is limited. Various machine learning based methods have been applied in health care to assist the detection of COVID-19 cases from medical images. One issue that limits machine learning methods for detecting COVID-19 cases is the lack of data. In this paper, propose a Mask-RCNN which is able to detect face masks accurately and warn them to wear face mask. Mask-RCCN use two novel methods to achieve this. First, to detect mask region from the face using RPN and to extract rich context features and focus on crucial face mask related regions, propose a novel residual context attention module (RCAM). Second, to learn more discriminating features for faces with and without masks. This technique is capable of recognizing masked and unmasked faces to help monitor safety breaches, facilitate the use of face masks, and maintain a secure working atmosphere.

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LIST OF ABBREVIATIONS

CNN	Convolutional Neural Network
RNN	Recurrent Neural Networks
GAN	Generative Adversarial Networks
TNN	Transformer Neural Networks
CT	Computed Tomography
DL	Deep Learning
RPN	Region Proposal Network
GLCM	Gray Level Co-occurrence Matrix
VGG	Visual Geometry Group
MRCNN	Mask Region Convolutional Neural Network
VS Code	Visual Studio Code
TP	True Positive
TN	True Negative
FP	False Positive
FN	False Negative
RT-PCR	Reverse Transcription Polymerase Chain Reaction
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2

CHAPTER 1

INTRODUCTION

The outbreak of COVID-19 (Coronavirus) was declared a pandemic early March 2020, people across the globe have rushed to their local pharmacy to buy surgical masks. The novel coronavirus with pathogen name SARS-CoV-2 spreads through the mouth when an infected person coughs or sneezes. The World Health Organization (WHO) states that the new coronavirus spreads much faster than other coronaviruses such as SARS and MERS.

Fig.No: 1. Face Mask

Face masks can help to stop the spread of coronavirus (COVID-19), especially in places where it is difficult to socially distance. Face masks are one tool utilized for preventing the spread of disease. They may also be called dental, isolation, laser, medical, procedure, or surgical masks. Face masks are loose-fitting masks that cover the nose and mouth, and have ear loops or ties or bands at the back of the head.

Consider wearing a face mask when you are sick with a cough or sneezing illness (with or without fever) and you expect to be around other people. The face mask will help protect them from catching your illness. Healthcare settings have specific rules for when people should wear face masks. There are many different brands and they come in different colours. It is important to use a face mask approved by the FDA. When worn properly, all types of face masks help to reduce the spread of COVID-19 (coronavirus). If your face mask does not completely cover your nose and mouth, it will not protect you or anyone else.

1.1 Types of Face Mask

The WHO recommends the use of face masks in health care settings and in communities during home care in areas that have reported cases of the novel coronavirus. So, what are the primary types of face masks. Primarily, there are three types of face masks being talked about here:

Fig.No: 1.1 Types of face mask

Different types of face masks can provide different levels of protection, depending on the type of mask and how they are used.

1.1.1 Surgical Mask

Surgical masks are slightly loose-fitting and cover your mouth, nose and chin. They are disposable medical masks which are predominantly used by healthcare professionals. Surgical masks are quite popular among the people and they come in different shapes and sizes. However, they do not protect you against airborne infectious diseases. They are disposable in nature and cannot be reused.

1.1.2 N95 Respirator Mask

The N95 respirator mask is increasingly being used to contain the spread of COVID-19 across the world. The mask is a lot more tight-fitting compared to the disposable surgical masks. They can filter up to 95% of small particles including bacteria's and viruses.

1.1.3 Homemade Cloth Masks or Face Coverings

Homemade face masks are meant to protect you just like the surgical masks. These can be made of fabric. While they might protect you to a small degree, they may help contain the spread of the novel coronavirus. Disinfecting and sanitizing of cloth or sponge masks is crucial in containing the spread of viruses.

1.2 ABOUT THE PROJECT

This project is based on the Deep learning algorithm, which is now widely used in the various field to train the machine by using the datasets collected from the data from the previous years. In order to train the proposed model .

There are several types of neural networks.

1.2.1 CNN

The Convolutional Neural Networks or CNNs are primarily used for tasks related to computer vision or image processing.

CNNs are extremely good in modelling spatial data such as 2D or 3D images and videos. They can extract features and patterns within an image, enabling tasks such as image classification or object detection.

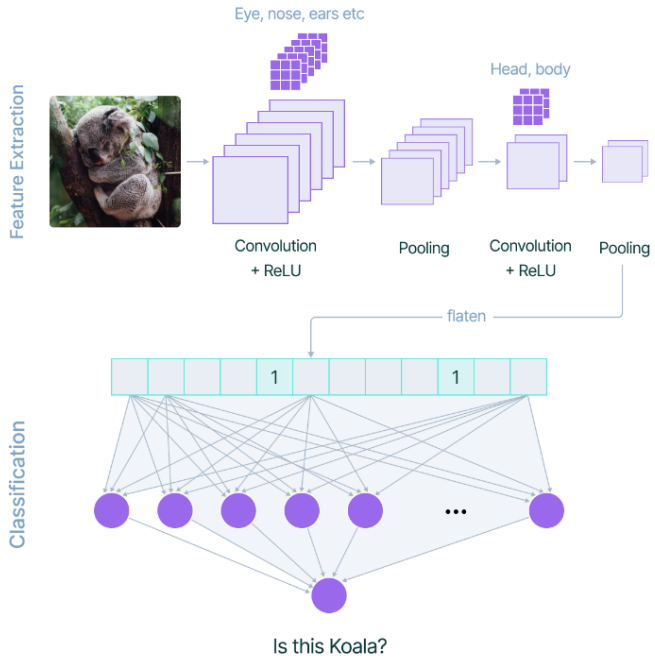


Fig.No: 1.2.1 Convolutional Neural Networks (CNN)

1.2.2 RNN

The Recurrent Neural Networks or RNN are primarily used to model sequential data, such as text, audio, or any type of data that represents sequence or time. They are often used in tasks related to natural language processing (NLP).

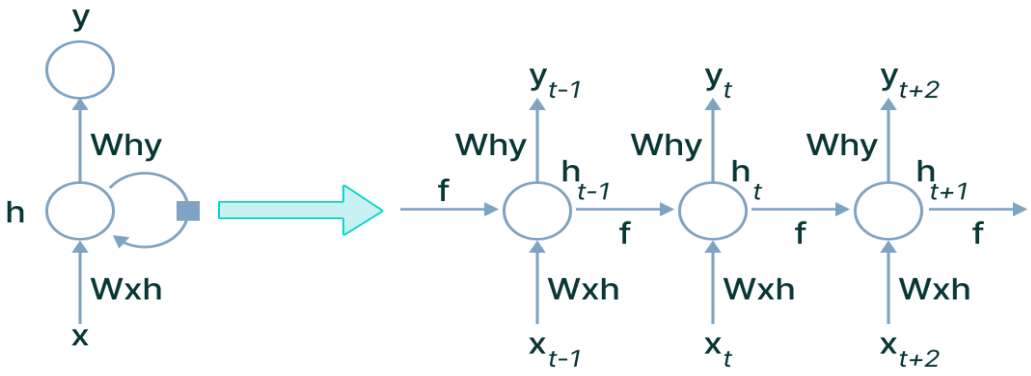


Fig.No: 1.2.2 Recurrent Neural Network (RNN)

1.2.3 GAN

Generative adversarial networks or GANs are frameworks that are used for the tasks related to unsupervised learning. This type of network essentially learns the structure of the data, and patterns in a way that it can be used to generate new examples, similar to that of the original dataset.

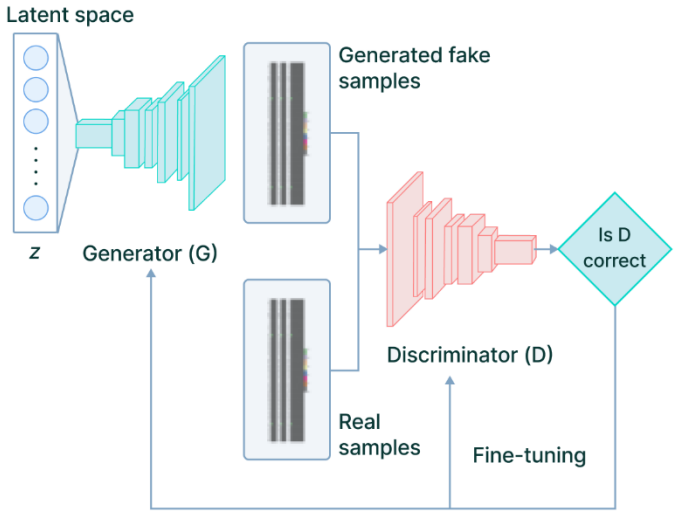


Fig.No: 1.2.3 Generative Adversarial Networks (GAN)

1.2.4 Transformers

Transformers are the new class deep learning model that is used mostly for the tasks related to modelling sequential data, like that in NLP. It is much more powerful than RNNs and they are replacing them in every task. Recently, transformers are also being applied in computer vision tasks and they are proving to be quite effective than the traditional CNNs.

Though self-driving cars is a risky field to automate, it has recently taken a turn towards becoming a reality. From recognizing a stop sign to seeing a pedestrian on the road, deep learning-based models are trained and tried under simulated environments to monitor progress. Product recommendations has been one of the most popular and profitable applications of deep learning. With more personalized and accurate recommendations, customers are able to easily shop for the items they are looking for and are able to view all of the options that they can choose from. This also accelerates sales and thus, benefits sellers.

Transformers were introduced in 2017 by a team at Google Brain and are increasingly becoming the model of choice for NLP problems, replacing RNN models such as long short-term memory (LSTM). Compared to RNN models, transformers are more amenable to parallelization, allowing training on larger datasets. This led to the development of pretrained systems such as BERT (Bidirectional Encoder Representations from Transformers)

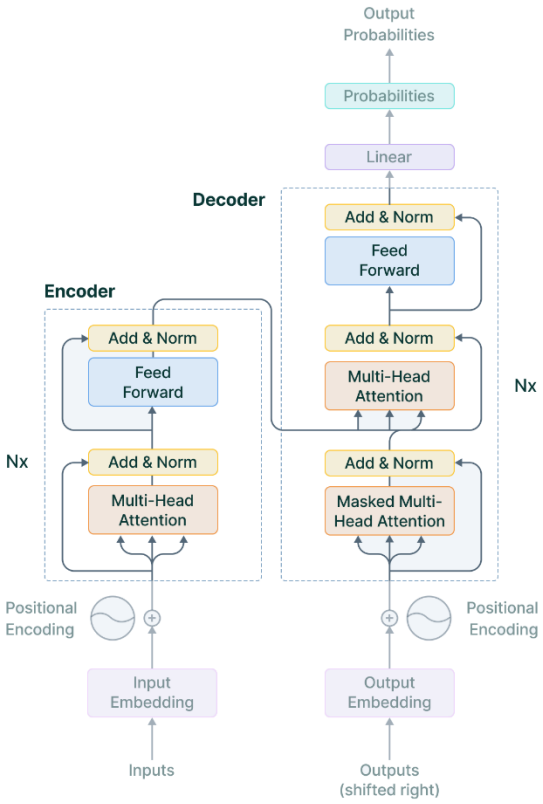


Fig.No: 1.2.4 Transformer Neural Network (TNN)

Normal and COVID-19 using the VGG16 and CNN deep learning techniques. The model had trained with 1600 pictures of two folders test and validation with 2 classes of each folder to test their realism in practical settings. The traditional CNN model has less accuracy in detecting COVID-19 cases, for the betterment of prediction it needs the improved CNN model. The proposed model has the highest accuracy of 94% when compared to the traditional CNN model.

1.3 GOAL OF THE PROJECT

Therefore, recognizing and authenticating people wearing masks will be a long-established research area, and more efficient methods are needed for real-time MFR.TMachine learning has made progress in MFR and has significantly facilitated the intelligent process of detecting and authenticating persons with occluded faces. The objective of the project is to propose, a deep learning approach to obtain highly discriminative features for face recognition with masked face. To extract deep features from the informative regions, employed CNN as feature extractors.

This project works developed for MFR based on deep learning techniques, providing insights and thorough discussion on the development pipeline of MFR systems. State-of-the-art techniques are introduced according to the characteristics of deep network architectures and deep feature extraction strategies.

1.4 APPLICATION

Deep learning has a plethora of applications in almost every field such as health care, finance, and image recognition. In this section, let's go over a few applications.

Health care: With easier access to accelerated GPU and the availability of huge amounts of data, health care use cases have been a perfect fit for applying deep learning. Using image recognition, cancer detection from MRI imaging and x-rays has been surpassing human levels of accuracy. Drug discovery, clinical trial matching, and genomics have been other popular health care-based applications.

Autonomous vehicles: Though self-driving cars is a risky field to automate, it has recently taken a turn towards becoming a reality. From recognizing a stop sign to seeing a pedestrian on the road, deep learning-based models are trained and tried under simulated environments to monitor progress.

E-commerce: Product recommendations has been one of the most popular and profitable applications of deep learning. With more personalized and accurate recommendations, customers are able to easily shop for the items they are looking for and are able to view all of the options that they can choose from. This also accelerates sales and thus, benefits sellers.

Personal assistant: Thanks to advancements in the field of deep learning, having a personal assistant is as simple as buying a device like Alexa or Google Assistant. These smart assistants use deep learning in various aspects such as personalized voice and accent recognition, personalized recommendations, and text generation.

CHAPTER 2

LITERATURE SURVEY

2.1 TITLE: A Survey on Masked Facial Detection Methods and Datasets for Fighting Against COVID-19

AUTHOR: Bing Shu Wang, Jianbing Zheng, and C.L. Philip Chen

YEAR: 2021

Coronavirus disease 2019 (COVID-19) continues to pose a great challenge to the world since its outbreak. To fight against the disease, a series of artificial intelligence (AI) techniques are developed and applied to real-world scenarios such as safety monitoring, disease diagnosis, infection risk assessment, lesion segmentation of COVID-19 CT scans, etc. The coronavirus epidemics have forced people wear masks to counteract the transmission of virus,which also brings difficulties to monitor large groups of people wearing masks. In this paper, primarily focus on the AI techniques of masked facial detectionand related datasets and the recent advances, beginning with the descriptions of masked facial detection datasets has been proposed. Thirteen available datasets are described and discussed in details. Then, the methods are roughly categorized into two classes: conventional methods and neural network-based methods. Conventional methods are usually trained by boosting algorithms with handcrafted features, which accounts for a small proportion. Neural network- based methods are further classified as three parts according to the number of processing stages. Representative algorithms are described in detail, coupled with some typical techniques that are described briefly. Finally, summarize the recent benchmarking results, give the discussions on the limitations of datasets and methods, and expand future research directions.

2.1.1 ALGORITHM:

YOLOv3, Faster R-CNN, InceptionV3.

2.1.2 ADVANTAGES:

Identify the conditions of wearing masks.

2.1.3 DISADVANTAGES:

Limitations for current masked facial wearing condition.

2.2 TITLE: Face mask detection using deep learning: An approach to reduce risk of Coronavirus spread

AUTHOR: Shilpa Sethi , Mamata Katharina , Trilok Kaushik

YEAR: 2021

Effective strategies to restrain COVID-19 pandemic need highattention to mitigate negatively impacted communal health and global economy,with the brim-full horizon yet to unfold. In the absence of effective antiviral and limited medical resources, many measures are recommended by WHO to controlthe infection rate and avoid exhausting the limited medical resources. Wearing amask is among the non-pharmaceutical intervention measures that can be used tocut the primary source of SARS-CoV2 droplets expelled by an infected individual. Regardless of discourse on medical resources and diversities in masks, all countries are mandating coverings over the nose and mouth in public. To contribute towards communal health, this paper aims to devise a highly accurate and real-time technique that can efficiently detect non-mask faces in public and thus, enforcing to wear mask. This technique is ensemble of one-stage and two-stage detectors to achieve low inference time and high accuracy has been proposed. start with ResNet50 as a baseline and applied the concept of transfer learning to fuse high-level semantic information in multiple feature maps. In addition, also propose a bounding box transformation to improve localization performance during mask detection. The experimental results show that the algorithm proposed in this paper can effectively recognize face masks and realize the effective monitoring of personnel.

2.2.1 ALGORITHM:

Fine-tuning of pre-trained model , Image complexity predictor for facedetection.

2.2.2 ADVANTAGES:

Facemask Violation person has been identified by their Name and Person- ID.

2.2.3 DISADVANTAGES:

This approach not achieving high accuracy in the detection.

2.3 TITILE: SSDMNV2: A real time DNN-based face mask detection system using single shot multi box detector and MobileNetV2

AUTHOR: Preethi Nagrath, Rachna Jain, Agam Madan, Rohan Arora, Piyush Kataria

YEAR: 2021

Face mask detection had seen significant progress in the domains of Image processing and Computer vision, since the rise of the Covid- 19 pandemic. Many face detection models have been created using several algorithms and techniques. They proposed in this paper uses deep learning, TensorFlow, Keras, and OpenCV to detect face masks. This model canbe used for safety purposes since it is very resource efficient to deploy. The SSDMNV2 approach uses Single Shot Multibox Detector as a face detector and MobilenetV2 architecture as a framework for the classifier, which is very lightweight and can even be used in embedded devices (like NVIDIA Jetson Nano, Raspberry pi) to perform real-time mask detection. The technique deployed in this paper gives us an accuracy score of 0.9264 and an F1 score of 0.93. The dataset provided in this paper, was collected from various sources, canbe used by other researchers for further advanced models such as those of face recognition, facial landmarks, and facial part detection process.

2.3.1 ALGORITHM:

SSDMNV2 Model, OPEN-CV DNN, MobileNetV2.

2.3.2 ADVANTAGES:

This model can be used for safety purposes since it is very resource efficient to deploy.

2.3.3 DISADVANTAGES:

Real-world applications are a much more challenging issue for theupcoming future.

2.4 TITILE: Face mask recognition system using CNN model

AUTHOR: Ritesh Sinha, Puneet Kumar Tiwari, Srijan Kumar Yadav, Prabhash Pandey

YEAR: 2022

COVID-19 epidemic has swiftly disrupted our day-to-day lives affecting the international trade and movements. Wearing a face mask to protect one's face has become the new normal. In the near future, many public service providers will expect the clients to wear masks appropriately to partake of their services. Therefore, face mask detection has become a critical duty to aidworldwide civilization. This paper provides a simple way to achieve this objective utilising some fundamental Machine Learning tools as TensorFlow, Keras, OpenCV and Scikit-Learn by using this model the project will be proposed. The suggested technique successfully recognises the face in the image or video and then determines whether or not it has a mask on it. As a surveillance job performer, it can also recognise a face together with a mask in motion as well as in a video. The technique attains excellent accuracy. investigate optimal parameter values for the Convolutional Neural Network model (CNN) in order to identify the existence ofmasks accurately without generating over-fitting.

2.4.1 ALGORITHM:

CNN model, TensorFlow, keras, Numpy, OpenCV-python.

2.4.2 ADVANTAGES:

To identify the existence of masks accurately without generating over-fitting.

2.4.3 DISADVANTAGES:

Effectively decreases the requirements of the model on training cost andmodel complexity.

2.5 TITILE: Face Mask Recognition System with YOLOV5 Based on ImageRecognition

AUTHOR: Guanhao Yang , Wei Feng , Jintao Jin , Qujiang Lei , Xiuhao Li , Guangzhou Gui

YEAR: 2020

The rapid development of computer vision makes human- computer interaction possible and has a wide application prospect. Since the discovery of the first case of COVID-19, the global fight against the epidemic hasbegun. In addition to various studies and findings by medical and health care experts, people's daily behaviors have also become key to combating the epidemic. In China, the government has taken active and effective measures of isolation and closure, as well as the active cooperation of the general public, suchas it is unnecessary to stay indoors and wear masks. China, as the country with the first outbreak of the epidemic, has now become the benchmark country of epidemic prevention in the world. Of course, it is not enough for people to wear masks consciously. Wearing masks in all kinds of public places still needs supervision. In this paper they proposes to replace manual inspection with a deep learning method and use YOLOV5, the most powerful objection detectionalgorithm at present, to better apply it in the actual environment, especially in thesupervision of wearing masks in public places. The experimental results show that the algorithm proposed in this paper can effectively recognize face masks and realize the effective monitoring of personnel.

2.5.1 ALGORITHM:

YOLOV5, Center Loss, Faster-RCNN.

2.5.2 ADVANTAGES:

Effectively recognize face masks and realize the effective monitoring of personnel.

2.5.3 DISADVANTAGES:

In this project the person in the picture wearing a mask has been detected ,but not covering the nose of the person

2.6 TITILE: A novel machine learning scheme for face mask detection using pretrained convolutional neural network

AUTHOR: T.M. Saravanan , K. Karthiha, R. Kavinkumar, S. Gokul, JayPrakash Mishra

YEAR: 2022

Corona virus 2019 (COVID-19) erupted toward the end of 2019, and it has continued to be a source of concern for a large number of peopleand organizations well into 2020. Wearing a face cover has been shown in studiesto reduce the risk of viral transmission while also providing a sense of security. Be that as it may, it isn't attainable to physically follow the execution of this strategy. They proposed in this system is to built pretrained deep learning model, Vgg16. The proposed scheme is easy to implement and use all the layers in vgg16 modeland train only the last layer called fully connected layer, which reduce the training time and effort. The proposed scheme is trained and evaluated using two Face mask datasets, one having 1484 pictures and the other with 7200. For a smaller dataset, augmented pictures were utilized to enhance accuracy. The suggested model is tested on unknown pictures, and it correctly predicts whether the imageis wearing a mask or not. The proposed scheme gives accuracy 96.50% during testing in small dataset. The model gives accuracy in medium dataset is 91% during testing. The experimental results show that the algorithm proposed in this paper can effectively recognize face masks and realize the effective monitoring of personnel.

2.6.1 ALGORITHM:

CNN algorithm, Conv2D, KNN algorithm.

2.6.2 ADVANTAGES:

The proposed scheme gives accuracy 96.50% during testing in smalldataset.

2.6.3 DISADVANTAGES:

Less computation than any other Trained Deep Learning algorithms.

2.7 TITILE: A novel DeepMaskNet model for face mask detection and maskedfacial recognition

AUTHOR: Naeem Ullah , Ali Javed , Mustansar Ali Ghazanfar , AbdulmajeedAlsufyani

YEAR: 2022

Coronavirus disease (COVID-19) has significantly affected the daily life activities of people globally. To prevent the spread of COVID-19, the World Health Organization has recommended the people to wear face mask in public places. Manual inspection of people for wearing face masks in public places is a challenging task. Moreover, the use of face masks makes the traditional face recognition techniques ineffective, which are typically designed for unveiledfaces. Thus, introduces an urgent need to develop a robust system capable of detecting the people not wearing the face masks and recognizing different persons while wearing the face mask. In this novel DeepMasknet framework capable of both the face mask detection and masked facial recognition has been proposed. Moreover, presently there is an absence of a unified and diverse dataset that can be used to evaluate both the face mask detection and masked facial recognition. For this purpose, also developed a largescale and diverse unified mask detection and masked facial recognition (MDMFR) dataset to measure the performance of both the face mask detection and masked facial recognition methods.

2.7.1 ALGORITHM:

VGGFace2, CASIA-Webface, Center Loss-based CNN.

2.7.2 ADVANTAGES:

It will detect both the face mask detection and masked facial recognition.

2.7.3 DISADVANTAGES:

The accuracy is 100% for face mask detection and 93.33% for masked facial recognition have confirmed the superiority of our Deep masknet model over the contemporary techniques.

2.8 TITILE: A novel algorithm for mask detection and recognizing actions of human

AUTHOR: Puja Gupta , Varsha Sharma , Sunita Varma

YEAR: 2022

Face recognition has become a significant challenge today since an increasing number of individuals wear masks to avoid infection with thenovel coronavirus or Covid-19. Due to its rapid proliferation, it has garnered growing attention. The technique proposed in this chapter seeks to produce unconstrained generic actions in the video. Conventional anomaly detection is difficult because computationally expensive characteristics cannot be employed directly, owing to the necessity for real-time processing. Even before activities are completely seen, they must be located and classified. This systemexpanded Mask R-CNN (Ex-Mask R-CNN) architecture that overcomes these issues has been Proposed. High accuracy is achieved by using robust convolutional neural network (CNN)-based features. The technique consists of two steps. First, a video surveillance algorithm is employed to determine whether or not a human is wearing a mask. Second, Multi-CNN forecasts the frame's suspicious conventional abnormality of people. Experiments on tough datasets indicate thatour approach outperforms state-of-the-art online traditional detection of anomalysystems while maintaining the real-time efficiency of existing classifiers.

2.8.1 ALGORITHM:

Mask R-CNN, Optical-flow stacked difference image (OFSDI).

2.8.2 ADVANTAGES:

High accuracy is achieved by using robust convolutionalneural network (CNN) based algorithm.

2.8.3 DISADVANTAGES:

Less computation than any other Trained Deep Learning algorithms.

2.9 TITILE: MaskedFace-Net – A dataset of correctly/incorrectly masked faceimages in the context of COVID-19

AUTHOR: Adnane Cabani , Karim Hammoudi , Halim Benhabiles , Mahmoud Melkemi

YEAR: 2021

Wearing face masks appears as a solution for limiting the spread of COVID-19. In this context, efficient recognition systems are expected for checking that people faces are masked in regulated areas. Hence, a large dataset of masked faces is necessary for training deep learning models towards detecting people wearing masks and those not wearing masks. Currently, there are no available large dataset of masked face images that permits to check if facesare correctly masked or not. Indeed, many people are not correctly wearing theirmasks due to bad practices, bad behaviors or vulnerability of individuals (e.g., children, old people). For these reasons, several mask wearing campaigns intendto sensitize people about this problem and good practices. In this sense, this workproposes an image editing approach and three types of masked face detection dataset; namely, the Correctly Masked Face Dataset (CMFD), the Incorrectly Masked Face Dataset (IMFD) and their combination for the global masked face detection (MaskedFace-Net). Realistic masked face datasets are proposed with atwofold objective: i) detecting people having their faces masked or not masked, ii) detecting faces having their masks correctly worn or incorrectly worn (e.g.; atairport portals or in crowds). To the best of our knowledge, no large dataset of masked faces provides such a granularity of classification towards mask wearinganalysis.

2.9.1 ALGORITHM:

Flickr-Faces-HQ*3(FFHQ), Real-World Maked Face Dataset (RMFD*2).

2.9.2 ADVANTAGES:

Image editing, Realistic image synthesis.

2.9.3 DISADVANTAGES:

This approach not achieving high accuracy in the detection.

2.10 TITILE: Real masks and spoof faces: On the masked face presentation attack detection

AUTHOR: Meiling Fanga , Naser Damer , Florian Kirchbuchner , Arjan Kuijper

YEAR: 2022

Face masks have become one of the main methods for reducing the transmission of COVID-19. This makes face recognition (FR) a challenging task because masks hide several discriminative features of faces. Moreover, face presentation attack detection (PAD) is crucial to ensure the security of FR systems. In contrast to the growing number of masked FR studies,the impact of face masked attacks on PAD has not been explored. Therefore, in this novel attacks with real face masks placed on presentations and attacks with subjects wearing masks to reflect the current real-world situation. Furthermore, this study investigates the effect of masked attacks on PAD performance by using seven state-of-the-art PAD algorithms under different experimental settings. also evaluate the vulnerability of FR systems to masked attacks. The experiments show that real masked attacks pose a serious threat to the operation and security of FR systems. The experimental results show that the algorithm proposed in this paper can effectively recognize face masks and realize the effective monitoring of personnel.

2.10.1 ALGORITHM:

Face PAD-algorithm Multitask cascaded convolutional networks (MTCNN).

2.10.2 ADVANTAGES:

It evaluate the vulnerability of FR systems to masked attacks.

2.10.3 DISADVANTAGES:

Processing time is more in the detection because of more limitations.

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

A large number of intelligent models for masked face recognition (MFR) has been recently presented and applied in various fields, such as masked face tracking for people safety or secure authentication. Exceptional hazards such as pandemics and frauds have noticeably accelerated the abundance of relevant algorithm creation and sharing, which has introduced new challenges. Therefore, recognizing and authenticating people wearing masks will be a long-established research area, and more efficient methods are needed for real-time MFR.

3.1.1 Support Vector Machine (SVM)

Support Vector Machines (SVM) are a popular training tool which can be used to generate a model based on several classes of data, and then distinguish between them. For the basic two-class classification problem, the goal of an SVM is to separate the two classes by a function induced from available examples. In the case of facial recognition, a class represents a unique face, and the SVM attempts to find what best separates the multiple feature vectors of one unique face from those of another unique face.

3.1.2 Principal Component Analysis (PCA)

One of the most used and cited statistical method is the Principal Component Analysis. A mathematical procedure performs a dimensionality reduction by extracting the principal component of multi-dimensional data. Principal component analysis id reducing the Eigen value and Eigen vectors problem in a matrix. Simply Principal component analysis is used for a wide range of variety indifferent applications such as Digital image processing, Computer vision and Pattern recognition. The main principal of principal component analysis is reducing the dimensionality of a database. In the communication of large number of interrelated features and those retaining as much as possible of the variation in the database

3.1.3 Linear Discriminant Analysis (LDA)

LDA is widely used to find the linear combination of features while preserving class separability. Unlike PCA, the LDA tries to model to the difference between levels. For each level the LDA obtains differenced in multiple projection vectors. Linear discriminant analysis method is related to fisher discriminant analysis. Linear discriminant analysis is using to describing the local features of the images. Features are extracting the form of pixels in images; these features are known as shape feature, color feature and texture feature. The linear

discriminant analysis is using for identifying the linear separating vectors between features of the pattern in the images. This procedure is using maximization between class scatter, when minimizing the intra class variance in face identification.

3.1.4 Neural Network (NN)

Neural Network has continued to use pattern recognition and classification. Kohonen was the first to show that a neuron network could be used to recognize aligned and normalized faces. There are methods, which perform feature extraction using neural networks. There are many methods, which combined with tools like PCA or LCA and make a hybrid classifier for face recognition. These are like Feed Forward Neural Network with additional bias, Self-Organizing Maps with PCA, and Convolutional Neural Networks with multi-layer perception, etc. These can increase the efficiency of the models.

3.1.5 K-Nearest Neighbors

One of the basic classification algorithms in machine learning is known to be the k-NN algorithm. In machine learning, the k-NN algorithm is considered a well monitored type of learning. It is commonly used in the sorting of related elements in searching apps. By constructing a vector representation of objects and then measuring them using appropriate distance metrics, the similarities between the items are determined.

Face Recognition Applications Are Attendance System, Security System and Smart Home Automation System.

Face recognition based voting system are proposed

3.2 Disadvantages

- The accuracy of the system is not 100%.
- Face and mask detection and loading training data processes just a little bit slow.
- It can only detect face from a limited distance.
- The instructor and training set manager still have to do some work manually.
- Handcrafted feature
- High Computational Complexity

3.3 PROPOSED SYSTEM

Recently, face masks have become one of the common objects that occlude the facial parts, coming in different styles, sizes, textures, and colors. This strengthens the requirement of training the deep learning models to accurately detect the masks. Most of the existing detection methods, usually introduced for object detection, are tuned and investigated in the task of mask detection.

3.3.1 Region Proposal Network

This region proposal network takes convolution feature map that is generated by the backbone layer as input and outputs the anchors generated by sliding window convolution applied on the input feature map.

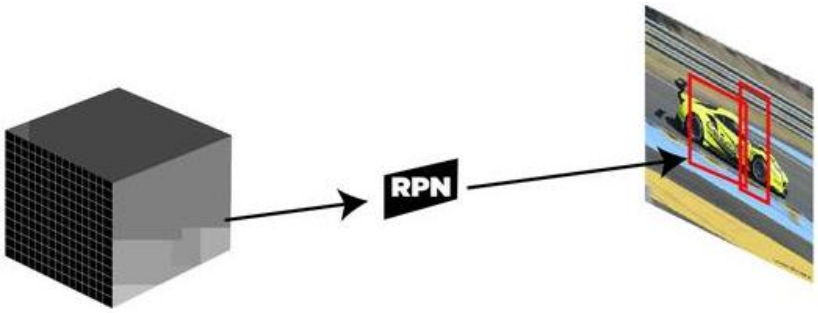


Fig.No 3.3.1 Region Proposal Network(RPN)

3.3.2 Gray Level Co-occurrence Matrix

Gray Level Co-occurrence Matrix (GLCM) based texture analysis of kidney diseases for parametric variations. The investigations were carried out using three Pyoderma variants (Boil, Carbuncle, and Impetigo Contagiosa) using GLCM. GLCM parameters (Energy, Correlation, Contrast, and Homogeneity) were extracted for each colour component of the images taken for the investigation. Contrast, correlation, energy, and homogeneity represent the coarseness, linear dependency, textural uniformity, and pixel distribution of the texture, respectively. The analysis of the GLCM parameters and their histograms showed that the said textural features are disease dependent. The approach may be used for the identification of Masked Face Recognition with satisfactory accuracy by employing a suitable deep learning algorithm.

3.3.3 Mask R-CNN

Mask R-CNN, or Mask RCNN, is a Convolutional Neural Network (CNN) and state-of-the-art in terms of image segmentation and instance segmentation. Mask R-CNN was developed on top of Faster R-CNN, a Region-Based Convolutional Neural Network.Mask R-

CNN was built using Faster R-CNN. While Faster R-CNN has 2 outputs for each candidate object, a class label and a bounding-box offset, Mask R-CNN is the addition of a third branch that outputs the object mask. The additional mask output is distinct from the class and box outputs, requiring the extraction of a much finer spatial layout of an object. Mask R-CNN is an extension of Faster R-CNN and works by adding a branch for predicting an object mask (Region of Interest) in parallel with the existing branch for bounding box recognition.

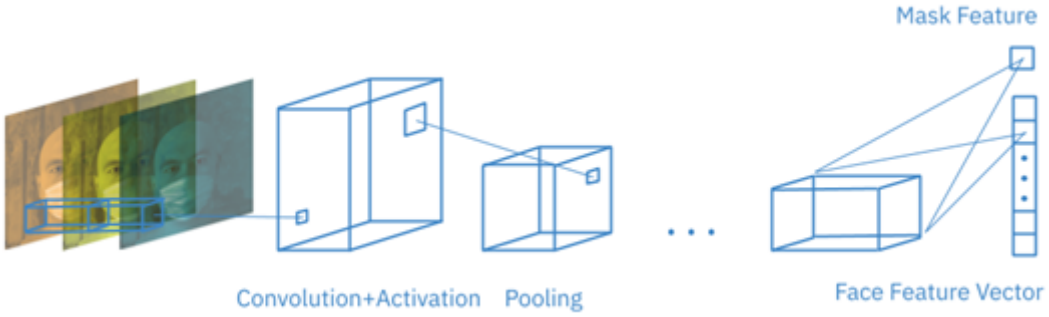


Fig No : 3.3.2 Mask R-CNN(MRCNN)

As shown in Fig.3.2. the mask R-CNN is modified based on the faster R-CNN. Specifically, the mask R-CNN replaces the region of interest pooling layer with the region of interest (RoI) alignment layer. This region of interest alignment layer uses bilinear interpolation to preserve the spatial information on the feature maps, which is more suitable for pixel-level prediction. They are used to predict not only the class and bounding box for each region of interest, but also the pixel-level position of the object through an additional fully convolutional network.

3.3.4 Futures of Mask R-CNN

Mask RCNN is a deep neural network aimed to solve the instance segmentation problems in machine learning or computer vision. Mask R-CNN is a conceptually simple, flexible, and general framework for object instance segmentation. It can efficiently detect objects in an image while simultaneously generating a high-quality segmentation mask for each instance. It extends Faster R-CNN by adding a branch for predicting an object mask in parallel with the existing branch for bounding box recognition. Mask R-CNN is simple to train and adds only a small overhead to Faster R-CNN, running at 5 fps.

3.4 Advantage

- The detection speed and accuracy have been greatly improved.
- Greatly reduced the computational complexity.
- Accurately predict the Face and Face mask
- Attendance System

CHAPTER 4

SYSTEM REQUIRMENTS

4.1 HARDWARE REQUIRMENTS

- Processors : Intel® Core™ i5 processor 4300M at 2.60 GHz or 2.59 GHz
- Disk space : 320 GB
- Operating systems : Windows® 10

4.2 SOFTWARE REQUIRMENTS

- Server Side : Python 3.7.4(64-bit) or (32-bit)
- Client Side : HTML, CSS, Bootstrap
- IDE : Flask 1.1.1
- Back end : MySQL 5.
- Server : Wamp server 2i
- DL Packages : TensorFlow, Pandas, NumPy

CHAPTER 5

SOFTWARE DESCRIPTION

5.1 PYTHON

Python is an interpreted, high-level, general-purpose programming language. Python is dynamically typed and garbage-collected. It supports multiple programming paradigms, including procedural, object-oriented, and functional programming. Python is often described as a "batteries included" language due to its comprehensive standard library.

Python was conceived in the late 1980s as a successor to the ABC language. Python 2.0, released in 2000, introduced features like list comprehensions and a garbage collection system capable of collecting reference cycles. Python 3.0, released in 2008, was a major revision of the language that is not completely backward-compatible, and much Python 2 code does not run unmodified on Python 3.

The Python 2 language, i.e., Python 2.7.x, was officially discontinued on 1 January 2020 (first planned for 2015) after which security patches and other improvements will not be released for it. With Python 2's end-of-life, only Python 3.5.x and later are supported.

Python interpreters are available for many operating systems. A global community of programmers develops and maintains C Python, an open-source reference implementation. A non-profit organization, the Python Software Foundation, manages and directs resources for Python and C Python development.

5.1.1 Libraries

Python’s large standard library, commonly cited as one of its greatest strength, provides tools suited too many tasks/ For Internet-facing applications, many standards formats and protocols a+ such as MIME and HTTP are supported. It includes modules for creating graphical user interfaces, connecting to relational databases, generating pseudorandom numbers, arithmetic with arbitrary-precision decimals, manipulating regular expressions, and unit testing.

Some parts of the standard library are covered by specifications (for example, the Web Server Gateway Interface (WSGI) implementation WSGI ref follows PEP 333), but most modules are not. They are specified by their code, internal documentation, and test suites (if

supplied). However, because most of the standard library is cross-platform Python code, only a few modules need altering or rewriting for variant implementations.

- Graphical user interfaces
- Web frameworks
- Multimedia
- Databases
- Networking
- Test frameworks
- Automation
- Web scraping
- Documentation
- Scientific computing
- Text processing
- Image processing
- Machine learning
- Data analytics

5.2 Visual Studio Code

Visual Studio Code, also commonly referred to as **VS Code**, is source code editor made by Microsoft with the Electron Framework, for Windows, Linux and macOS. Features include support for debugging, syntax highlighting, intelligent code completion, snippets, code refactoring, and embedded Git. Users can change the theme, keyboard shortcuts, preferences, and install extensions that add functionality. In the Stack Overflow 2022 Developer Survey, Visual Studio Code was ranked the most popular developer environment tool among 71,010 respondents, with 74.48% reporting that they use it.

Visual Studio Code was first announced on April 29, 2015, by Microsoft at the 2015 Build conference. A preview build was released shortly thereafter. On November 18, 2015, the source of Visual Studio Code was released under the MIT License, and made available on GitHub. Extension support was also announced. On April 14, 2016, Visual Studio Code graduated from the public preview stage and was released to the Web. Microsoft has released most of Visual Studio Code's source code on GitHub under the permissive MIT License, while the releases by Microsoft are proprietary freeware.

Visual Studio Code is a source-code editor that can be used with a variety of languages, including C, C#, C++, Fortran, Go, Java, JavaScript, Node.js, Python, Rust. It is based on the Electron framework, which is used to develop Node.js web applications that run on the Blink layout engine. Visual Studio Code employs the same editor component (codenamed "Monaco") used in Azure DevOps (formerly called Visual Studio Online and Visual Studio Team Services).

Out of the box, Visual Studio Code includes basic support for most common programming languages. This basic support includes syntax highlighting, bracket matching, code folding, and configurable snippets. Visual Studio Code also ships with IntelliSense for JavaScript, TypeScript, JSON, CSS, and HTML, as well as debugging support for Node.js. Support for additional languages can be provided by freely available extensions on the VS Code Marketplace.

Instead of a project system, it allows users to open one or more directories, which can then be saved in workspaces for future reuse. This allows it to operate as a language-agnostic code editor for any language. It supports many programming languages and a set of features that differs per language. Unwanted files and folders can be excluded from the project tree via the settings. Many Visual Studio Code features are not exposed through menus or the user interface but can be accessed via the command palette.

Visual Studio Code can be extended via extensions, available through a central repository. This includes additions to the editor and language support. A notable feature is the ability to create extensions that add support for new languages, themes, debuggers, time travel debuggers, perform static code analysis, and add code linters using the Language Server Protocol.

CHAPTER 6

SYSTEM DESIGN

6.1 SYSTEM ARCHITECTURE

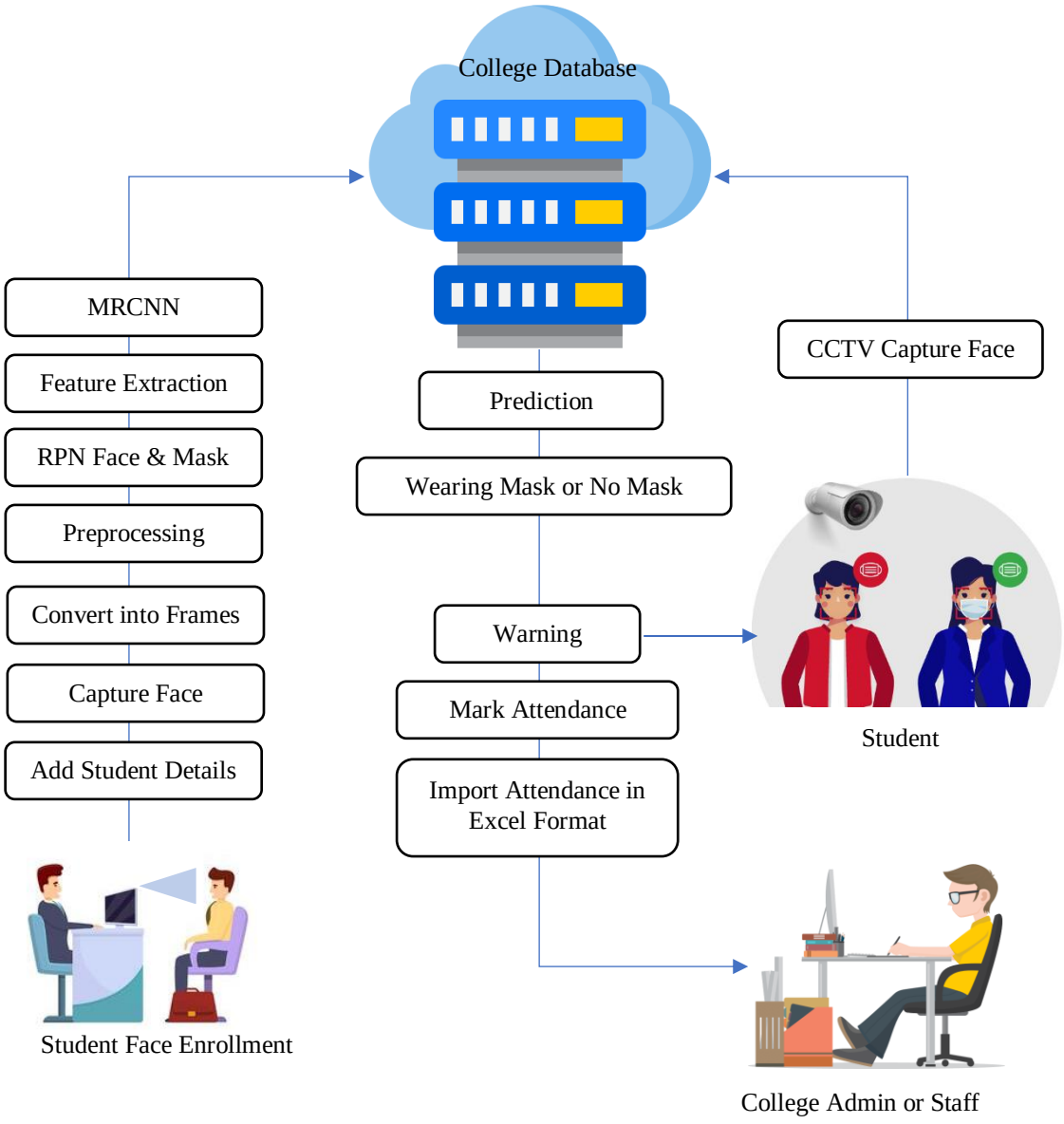


Fig. No: 6.1 System Architecture

The Architecture of College Database is know as a web-based dashboard to display the real-time information about the face mask compliance in the college. The dashboard can be built using a web development framework such as Flask, Django, or Node.js. You can use cameras that are installed at various locations in the college to capture images of students and staff members.To process the images and run the face mask detection algorithm.

6.2 DATA FLOW DIAGRAM

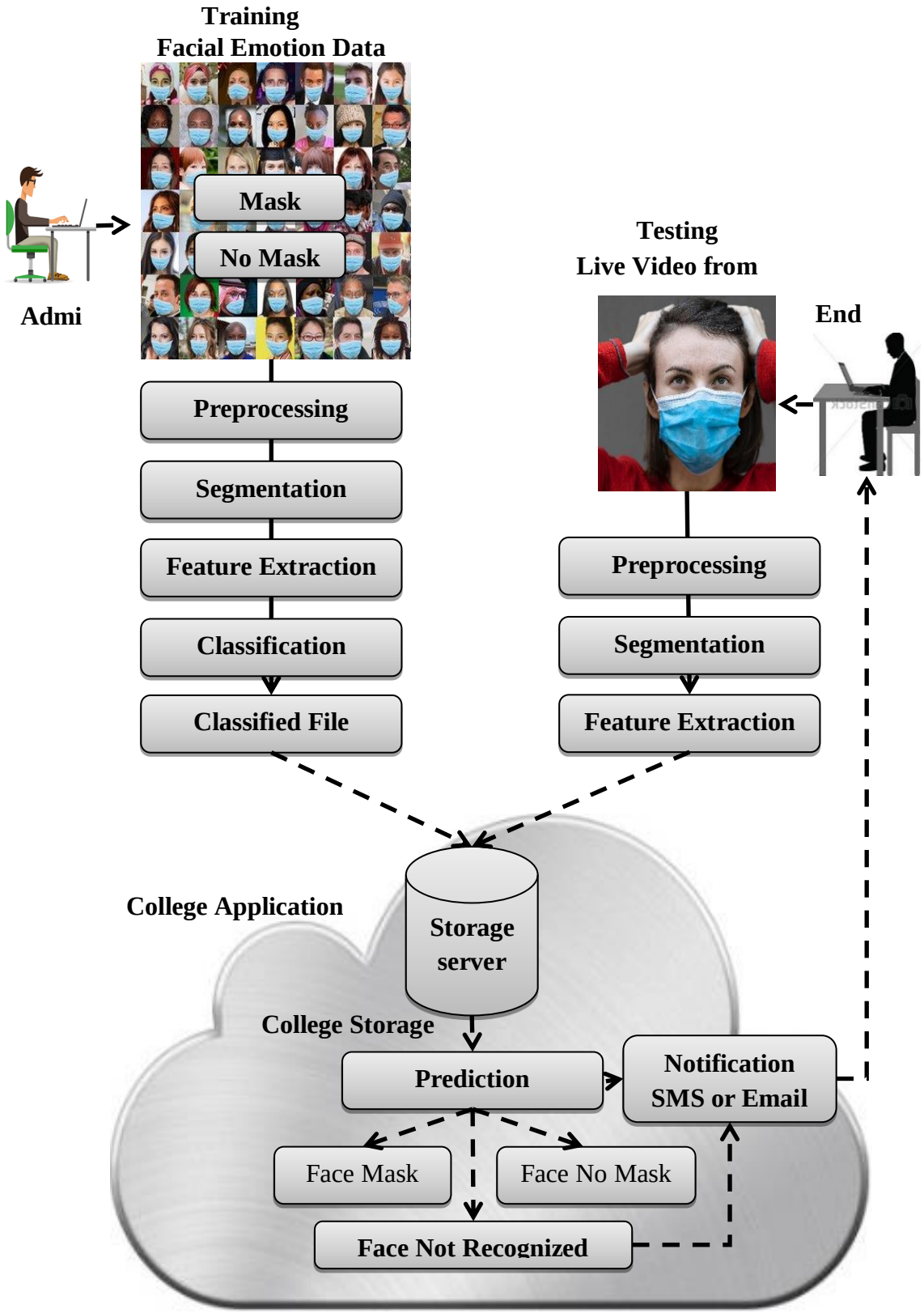


Fig.No: 6.2.1 Flow Diagram

DATA FLOW DIAGRAM

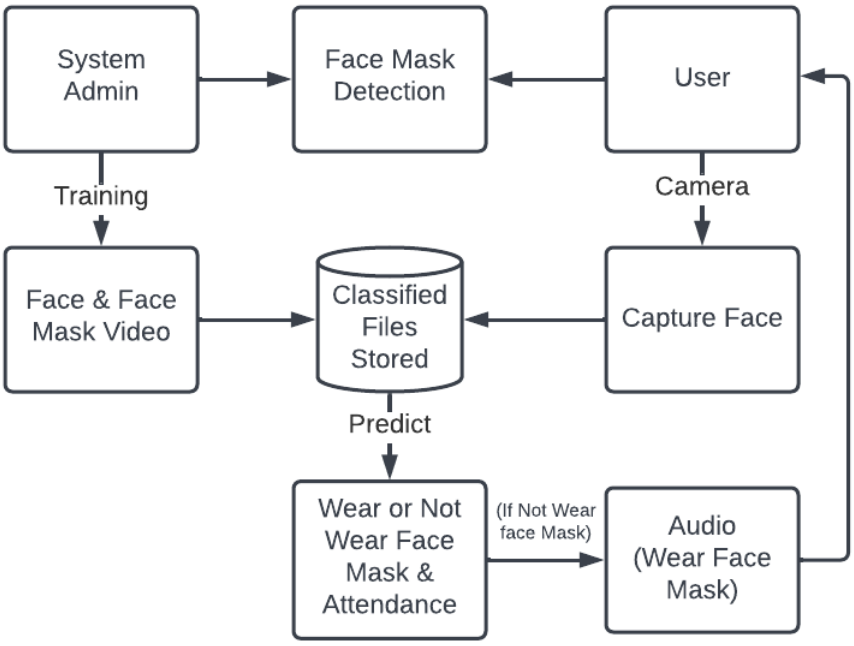


Fig.No: 6.2.2 Level – 0 Data Flow Diagram

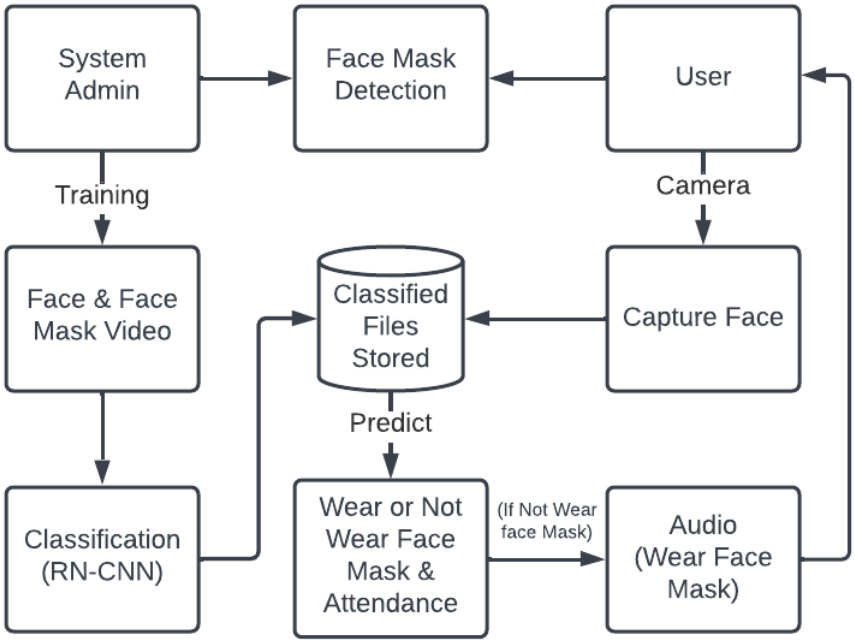


Fig.No: 6.2.3 Level – 1 Data Flow Diagram

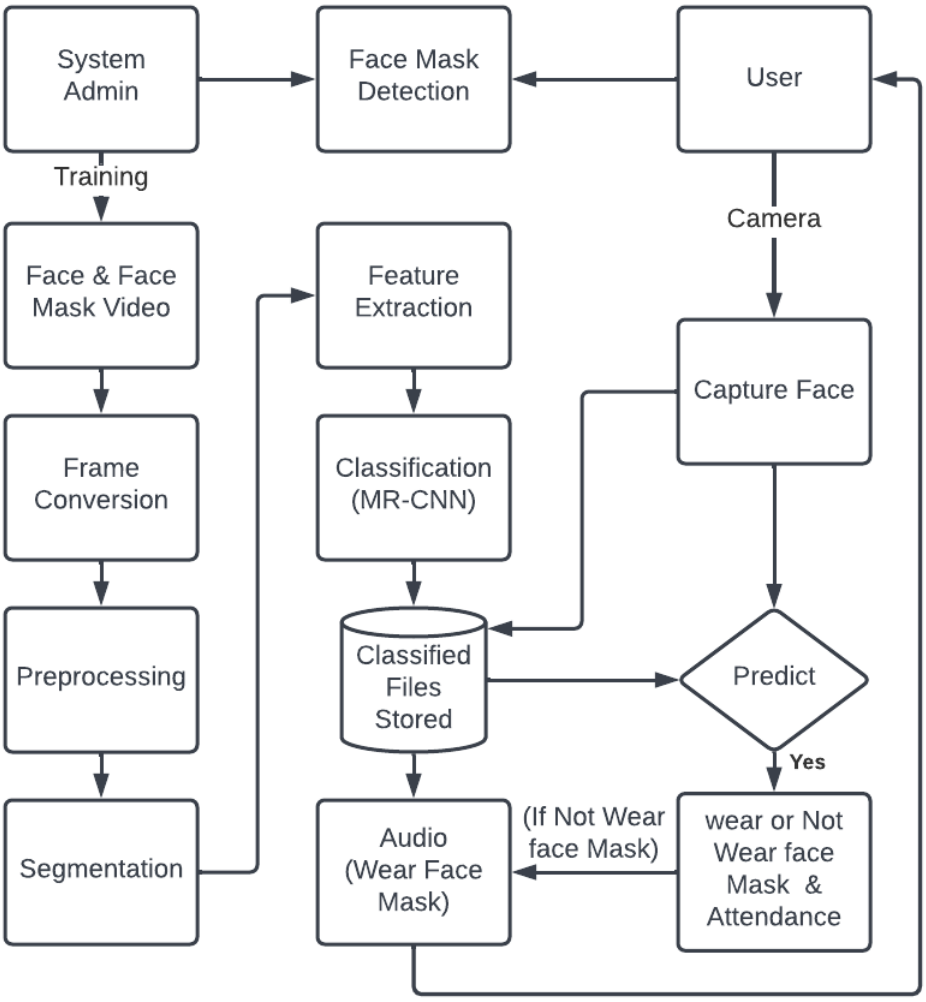


Fig.No: 6.2.4 Level – 2 Data Flow Diagram

6.3. UML DIAGRAM

UML stands for Unified Modelling Language. UML is a standardized general-purpose modelling language in the field of object-oriented software engineering. The standard is managed, and was created by, the object management group.

The goal is for UML. to become a common language for creating models of object-oriented computer software. In its current form UML is comprised of two major components: a Meta-model and a notation. In the future, some form of method or process may also be added to; or associated with, UML.

The Unified Modeling Language is a standard language for specifying, Visualization, Constructing and documenting the artifacts of software system, a well as for business modeling and other non-software systems. The UML represents a collection of best engineering practices that have proven successful in the modeling of large and complex systems.

The UML is a very important part of developing objects-oriented software and the software development process. The UMI. uses mostly graphical notations to express the design of software projects.

6.3.1. USE CASE DIAGRAM

A use case diagram in the Unified Modeling Language (UML) is a type of behavioural diagram defined by and created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. The main purpose of a use case diagram is to show what system functions are performed for which actor. Roles of the actors in the system can be depicted.

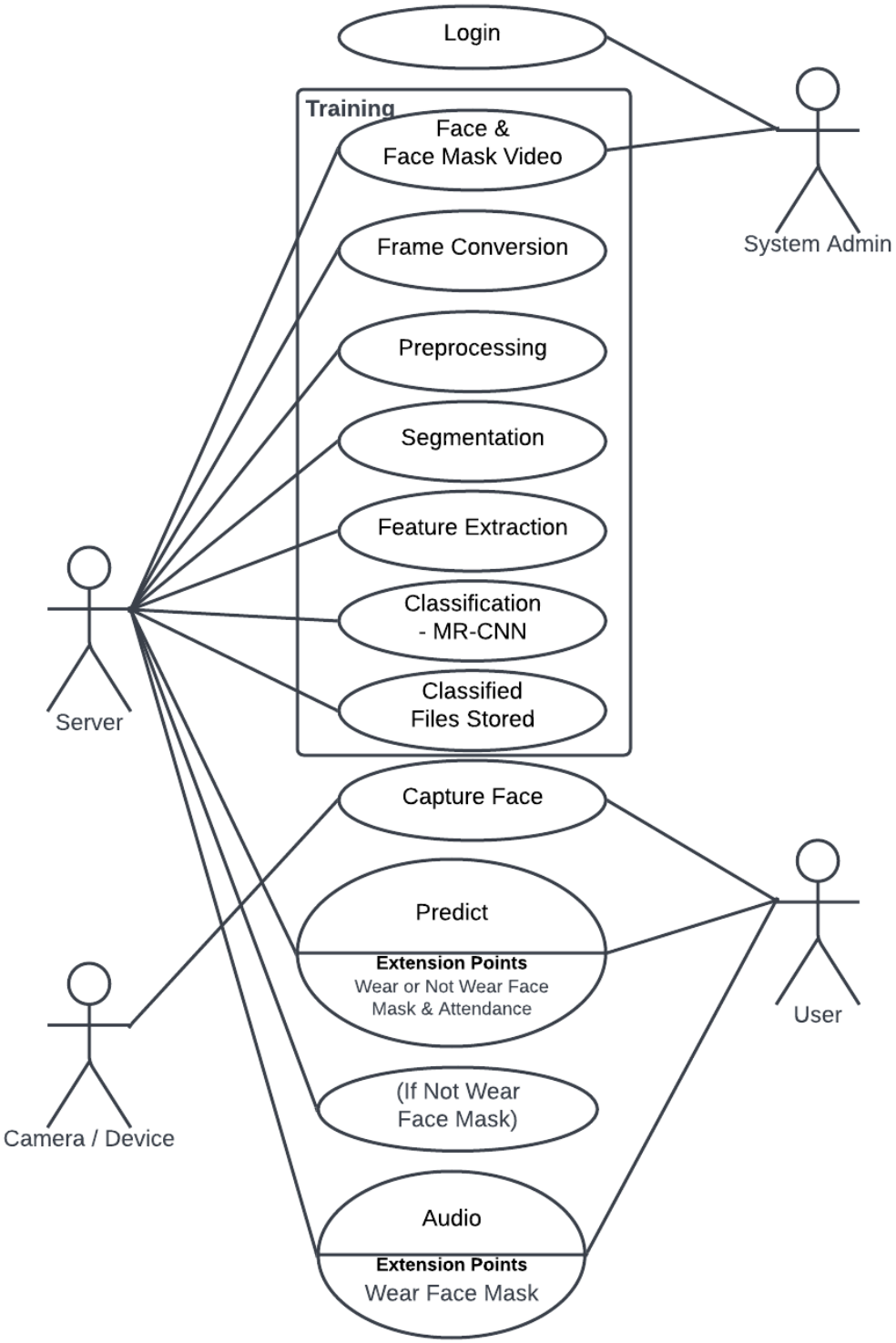


Fig. No: 6.3.1 Use Case Diagram

6.3.2 CLASS DIAGRAM

In software engineering, a class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attribute, operations (or methods), and the by showing the system's classes, their attributes, operations (or methods), and the relationship among the classes. It explains which class contains information.

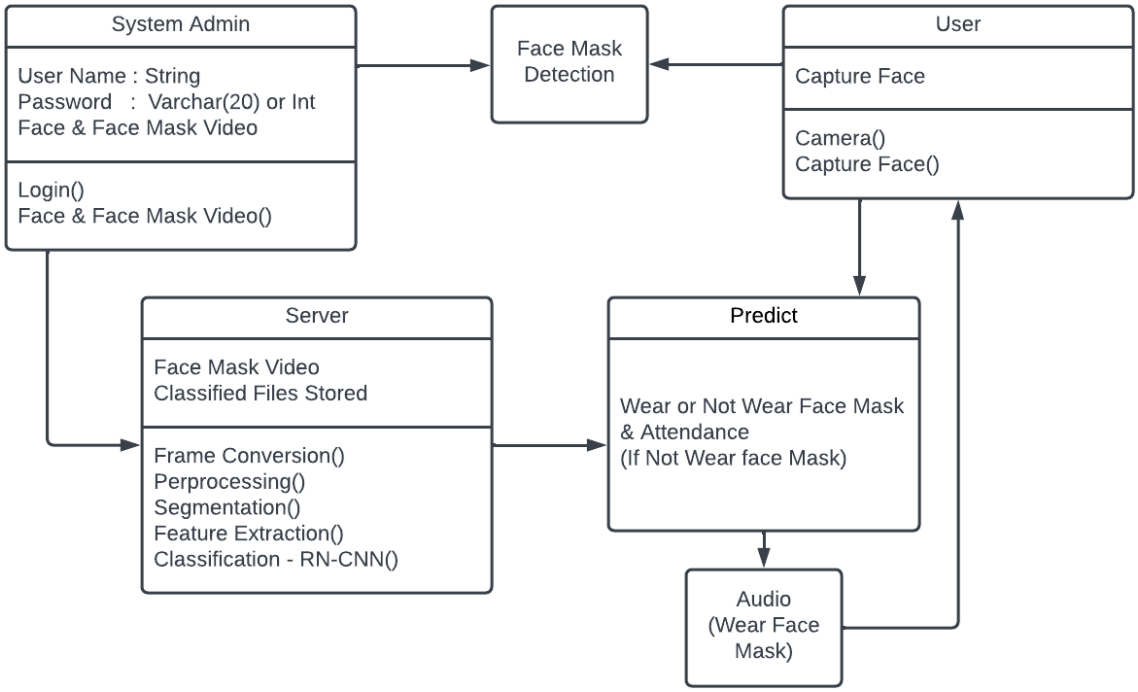


Fig. No: 6.3.2 Class Diagram

6.3.3 SEQUENCE DIAGRAM

A Sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. Sequence diagram are sometimes called event diagrams, event scenarios and timing diagrams.

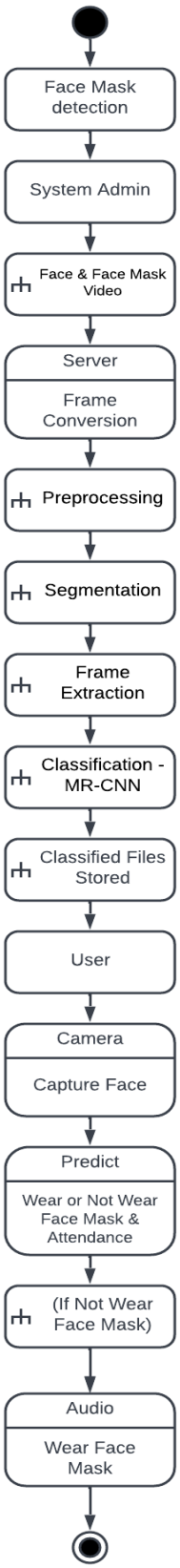


Fig. No: 6.3.3 Sequence Diagram

6.3.4 DEPLOYMENT DIAGRAM

Component diagrams are used to describe the components and deployment diagrams shows how they are deployed in hardware. UML is mainly designed to focus on the software artifacts of a system. However, these two diagrams are special diagrams used to focus software and hardware components.

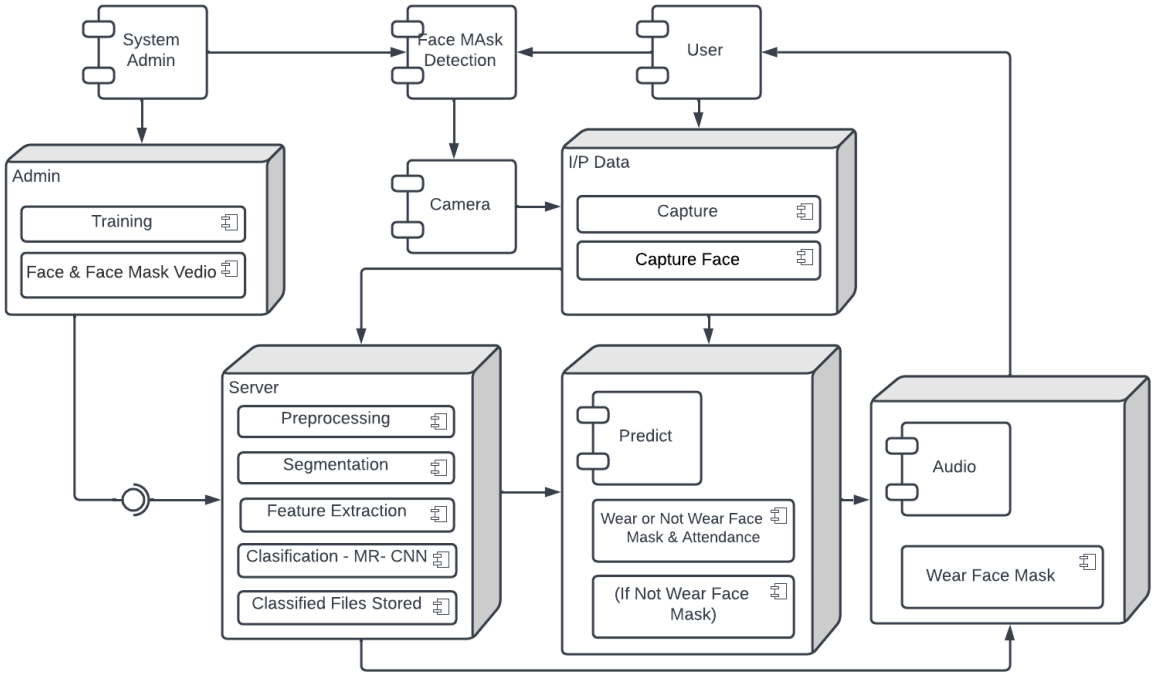


Fig. No: 6.3.4 Deployment diagram

CHAPTER 7

SYSTEM IMPLEMENTATION

7.1 MODULE SPECIFICATION

- College Dashboard
- Pre Porcessing
- Face Detection Segmentation
- Face Mask Detector
- Door Open

7.2 MODULE DESCRIPTION

7.2.1 College Dashboard

In this module developed web browser-based interface designed to be used by college admin, Teaching Staff and Student– untrained in data science – to predict and detect face with mask and no mask for attendance System.It is a cloud based educational ERP software that enables higher education institutions & colleges to manage online admission, student enrolment, students' attendance, online fees, grades, assignments, library books, etc. such as biometrics, business intelligence tools & analytics dashboard that generates precise reports on college admission, enrolment, scholarship, previous academic record, domicile, fees, alerts, attendance and compliance management.

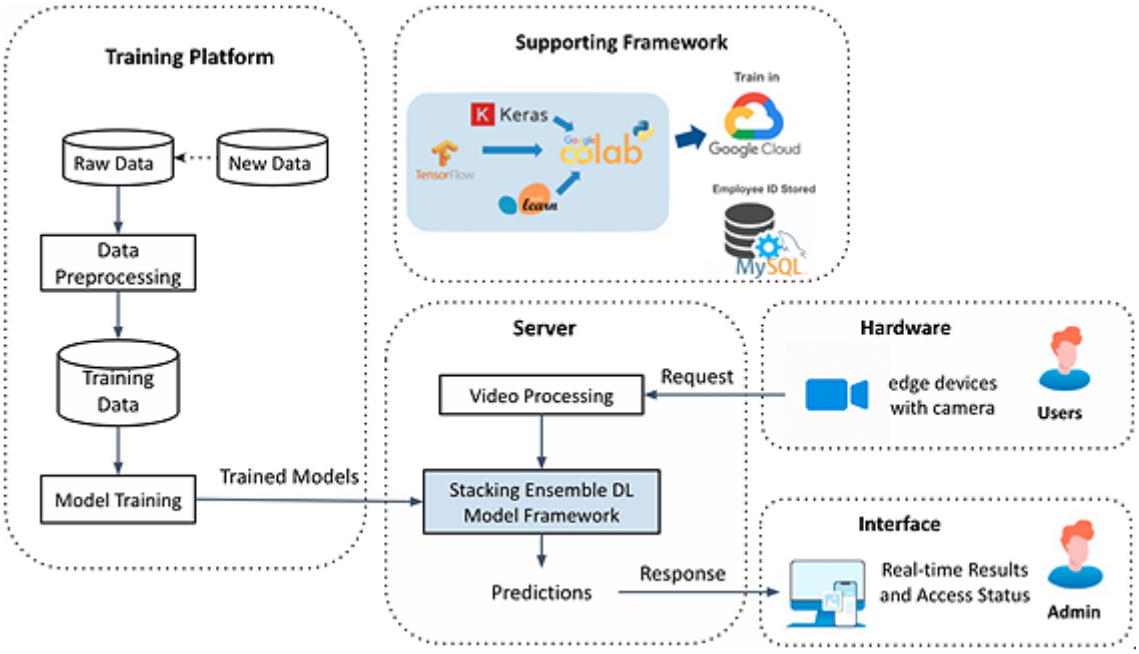


Fig.No: 7.2.1 Analytics dashboard

7.2.2 Pre-Processing

Face Image pre-processing are the steps taken to format images before they are used by model training and inference. The steps to be taken are:

- Read image
- RGB to Grey Scale conversion
- Resize image

Original size (360, 480, 3) — (width, height, no. RGB channels)

Resized (220, 220, 3)

- Remove noise (Denoise)

smooth our image to remove unwanted noise. do this using gaussian blur.

- Binarization

Image binarization is the process of taking a grayscale image and converting it to black-and-white, essentially reducing the information contained within the image from 256 shades of grey to 2: black and white, a binary image.

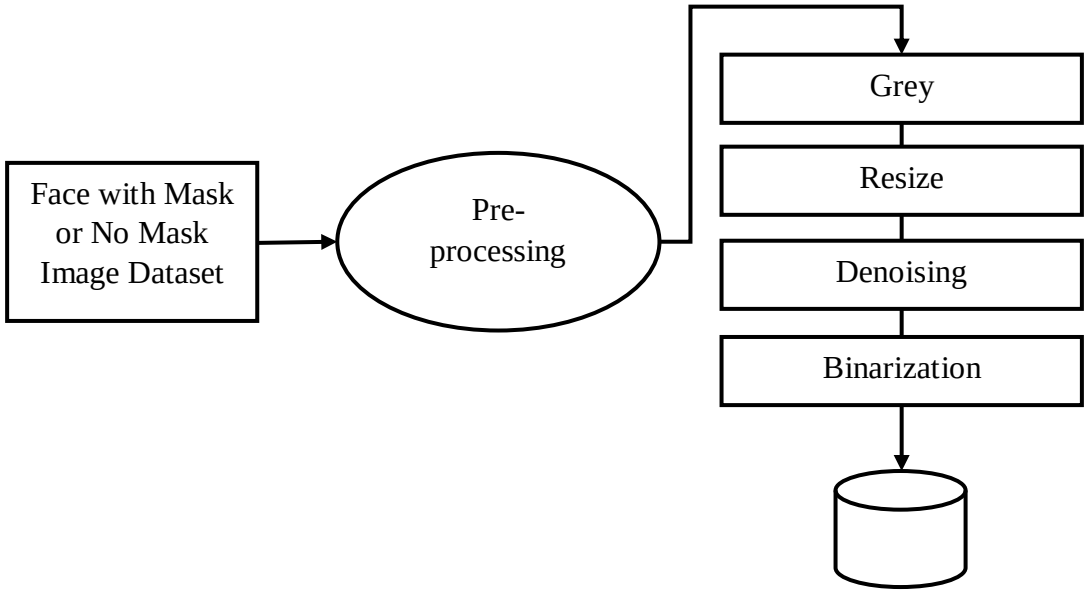


Fig.No: 7.2.2 Pre-Processing

7.2.3 Face Detection Segmentation

Therefore, in this module, Region Proposal Network (RPN) generates RoIs by sliding windows on the feature map through anchors with different scales and different aspect ratios. Face and Mask detection and segmentation method based on improved RPN. RPN is used to generate RoIs, and RoI Align faithfully preserves the exact spatial locations. These are

responsible for providing a predefined set of bounding boxes of different sizes and ratios that are going to be used for reference when first predicting object locations for the RPN.

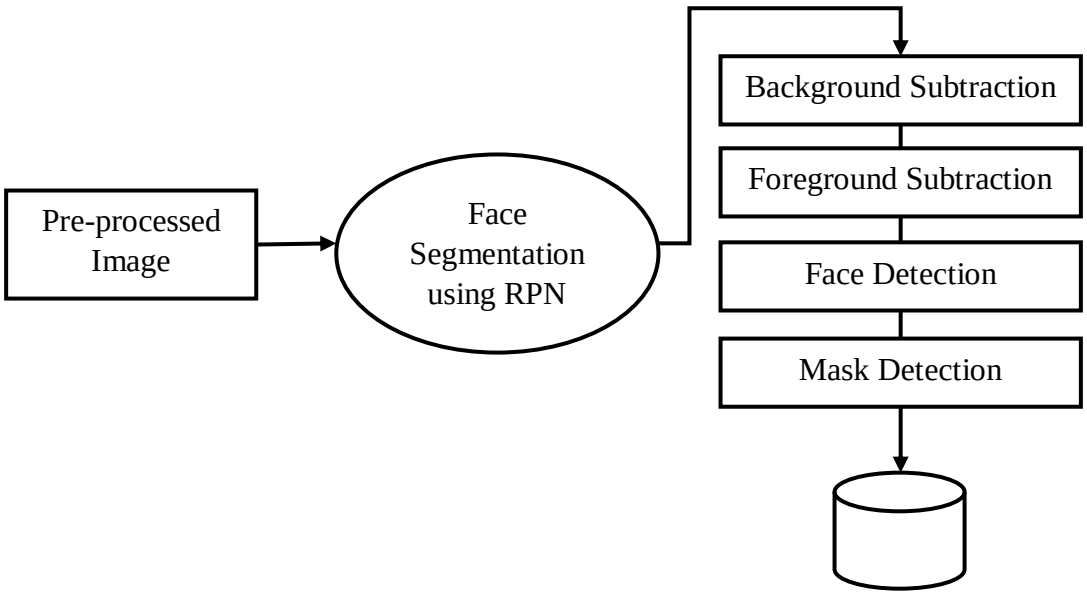


Fig.No: 7.2.3 Face Segmentation Process

- **Face Image segmentation using region growing (RG) method**

The region growing methodology and recent related work of region growing are described here.

RG is a simple image segmentation method based on the seeds of region. It is also classified as a pixel-based image segmentation method since it involves the selection of initial seed points. This approach to segmentation examines the neighbouring pixels of initial "seed points" and determines whether the pixel neighbours should be added to the region or not based on certain conditions. In a normal region growing technique, the neighbour pixels are examined by using only the "intensity" constraint. A threshold level for intensity value is set and those neighbour pixels that satisfy this threshold is selected for the region growing.

- **RPN**

A **Region Proposal Network**, or **RPN**, is a fully convolutional network that simultaneously predicts object bounds and objectless scores at each position. The RPN is trained end-to-end to generate high-quality region proposals. It works on the feature map (output of CNN), and each feature (point) of this map is called Anchor Point. For each anchor point, place 9 anchor boxes (the combinations of different sizes and ratios) over the image. These anchor boxes are cantered at the point in the image which is corresponding to the anchor point of the feature map.

- **Training of RPN**

To know that for each location of the feature map have 9 anchor boxes, so the total number is very big, but not all of them are relevant. If an anchor box having an object or part of the object within it then can refer it as a **foreground**, and if the anchor box doesn't have an object within it then can refer it as **background**.

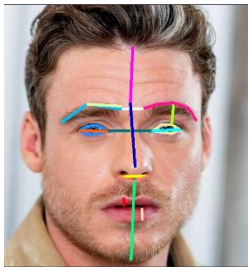
So, for training, assign a label to each anchor box, based on its Intersection over Union (IoU) with given ground truth. basically assign either of the three (1, -1, 0) labels to each anchor box.

The processing steps are

- Select the initial seed point
- Append the neighbouring pixels—intensity threshold
- Check threshold of the neighbouring pixel
- Thresholds satisfy-selected for growing the region.
- Process is iterated to end of all regions.

7.2.3.1 Feature Extraction

After the face detection, face image is given as input to the feature extraction module to find the key features that will be used for classification. With each pose, the facial information including eyes, nose and mouth is automatically extracted and is then used to calculate the effects of the variation using its relation to the frontal face templates.



Face Features

- **Forehead Height:** distance between the top edge of eyebrows and the top edge of forehead.
- **Middle Face Height**: distance between the top edge of eyebrows and nose tip.
- **Lower Face Height**: distance between nose tip and the baseline of chin.
- **Jaw Shape**: A number to differentiate between jaw shapes. this number can be replaced if you use Face Shape Recognition, see (this) notebook.
- **Left Eye Area**
- **Right Eye Area**

- **Eye to Eye Distance**: distance between eyes (closest edges)
- **Eye to Eyebrow Distance**: distance between eye and eyebrow (left or right is determined by which side of the face is more directed to the -screen-)
- **Eyebrows Distance:** horizontal distance between eyebrows
- **Eyebrow Shape Detector 1:** The angle between 3 points (eyebrow left edge, eyebrow center, eyebrow right edge), to differentiate between (Straight | non-straight) eyebrow shapes
- **Eyebrow Shape Detector 2:** A number to differentiate between (Curved | Angled) eyebrow shapes.
- **Eyebrow Slope**
- **Eye Slope Detector 1:** A method to calculate the slope of the eye. it's the slope of the line between eye's center point and eye's edge point. this detector is used to represent 3 types of eye slope (Upward, Downward, Straight).
- **Eye Slope Detector 2:** Another method to calculate the slope of the eye. it's the difference on Y-axis between eye's center point and eye's edge point. this detector isn't a 'mathematical' slope, but a number that can be clustered into 3 types of eye slope (Upward, Downward, Straight).
- **Nose Length**
- **Nose Width:** width of the lower part of the nose
- **Nose Arch:** Angle of the curve of the lower edge of the nose (longer nose = larger curve = smaller angle)
- **Upper Lip Height**
- **Lower Lip Height**
- **Mask**

7.2.3.2. Masked Face Classification

MRCNN

The proposed G-Mask model consists of two stages, which are the same as the general region-based model. In the first stage, RPN proposes the candidate bounding boxes of the object face. The second stage, follow the Fast R-CNN architecture, extracts features from each candidate box and then performs classification and bounding box location. In addition, like the Mask R-CNN, added a mask branch parallel to the classification branch and the bounding box location branch.

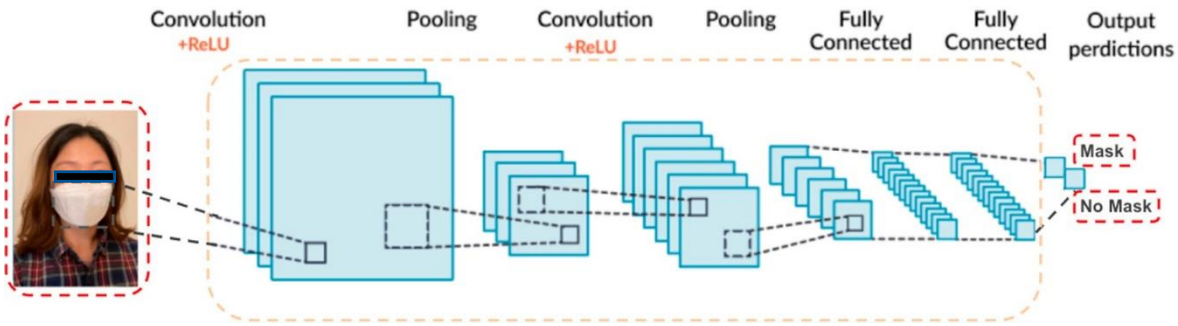


Fig.No: 7.2.3.2 Mask – RCNN(MRCNN)

7.2.4 Face Mask Detector

In this module the matching process is done with trained classified result and test Live Camera Captured Classified file. The Euclidean distance is calculated between 2 ROI points and hence the centre coordinates are transformed into rectangular coordinates to make the bounding box.

7.2.4.1 Attendance System

After the verification of faces and successful recognition is done, the attendance of the student is marked in front of his/her roll number. If the face is not recognized, an error page is displayed. It involves the attendance report generation. The attendance is calculated as per requirement.

7.2.4.2 Warning System

A warning system that utilizes face detection technology could be used to alert individuals or authorities of potential security threats or safety concerns in a particular area. These images or video would then be analysed by software that is trained to detect faces and analyse certain characteristics of those faces, such as the presence of specific facial features or expressions.

7.2.5 Door Open

The door can be opened by face recognition, password. And it can also be equipped with IC/ID card induction to open the door. Built-in dual infrared high-power fill light, no fear of night, dark light or night can be identified.3 attendance output modes, 2000 face capacity, 200,000 attendance record. An automatic door opening and closing system opens a door by **driving means when a person approaches the door.**

CHAPTER 8

SYSTEM TESTING

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub-assemblies, assemblies and/or a finished product It is the process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of tests. Each test type addresses a specific testing requirement.

8.1. TYPES OF TESTS

8.1.1 Unit testing

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

8.1.2 Integration testing

Integration tests are designed to test integrated software components to determine if they actually run as one program. Testing is event driven and is more I concerned with the basic outcome of screens or fields. Integration tests demonstrate that although the components were individually satisfaction, as shown by successfully unit testing, the combination of components is correct and consistent. Integration testing is specifically aimed at exposing the problems that arise from the combination of components.

8.1.3 Functional testing

Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals.

Functional testing is cantered on the following items:

Valid Input: identified classes of valid input must be accepted.

Invalid Input: identified classes of invalid input must be rejected.

Functions: identified functions must be exercised.

Output: identified classes of application outputs must be exercised.

Procedure: interfacing systems or procedures must be invoked.

Organization and preparation of functional tests is focused on requirements, key functions, or special test cases. In addition, systematic coverage pertaining to identify Business process flows; data fields, predefined processes, and successive processes must be considered for testing. Before functional testing is complete. additional tests are identified and the effective value of current tests is determined.

8.1.4 System Testing

System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration-oriented system integration test. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.

8.1.5 White Box Testing

White Box Testing is a testing in which in which the software tester has knowledge of the inner workings, structure and language of the software, or at least as purpose. It is purpose. It is used to test areas that cannot be reached from a black box level.

8.1.6 Black Box Testing

Black Box Testing is testing the software without any knowledge of the inner workings, structure or language of the module being, tested. Black box tests, as most other kinds of tests, must be written from a definitive source document, such as specification or requirements document, such as specification or requirements document. It is a testing in which the software under test is treated, as a black box you cannot "see" into it. The test provides inputs and responds to outputs without considering how the software works:

8.2 UNIT TESTING

Unit testing is usually conducted as part of a combined code and unit test phase of the software lifecycle, although it is not uncommon for coding and unit testing to be conducted as two distinct phases.

8.2.1 Test strategy and approach

Field testing will be performed manually and functional tests will be written in detail.

8.2.2 Test objectives

- All field entries must work properly.

- Pages must be activated from the identified link.
- The entry screen, messages and responses must not be delayed.

8.2.3 Features to be tested

- Verify that the entries are of the correct format
- No duplicate entries should be allowed
- All links should take the user to the correct page.

8.3 INTEGRATION TESTING

Software integration testing is the incremental integration testing of two of more integrated software components on a single platform to produce failures caused by interface defects.

The task of the integration test is to check that components or software applications, e.g. components in a software system or - one step up – software applications at the company level - interact without error.

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

8.4 ACCEPTANCE TESTING

User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that the system meets the functional requirements. Test Results: All the test cases mentioned above passed successfully. No defects encountered.

CHAPTER 9

CONCLUSION AND FUTURE WORK

9.1 CONCLUSION

Under the spread of COVID-19 pandemic, wearing a protective face mask has become a normal and requirement for many public services, colleges and essential business providers. Both WHO and CDC also stress on the importance and effectiveness of wearing correct masks for personal and public health. Therefore, face mask detection and facial recognition with a mask are essential for our society. To serve the above purpose, this paper proposed a Face Mask Detection and Facial Recogni0tion with Mask System for access, attendance and health check under the pandemic. In this project, a Mask Region Convolutional Neural Network method was proposed for face detection and recognition with mask or no masked face. The approach can extract features by GLCM, generate RoIs by RPN, preserve the precise spatial position by RoIAlign, and generate binary masks through the full convolutional network (FCN). In doing so, the proposed framework is able to detect faces correctly while also precisely segmenting and predict each face and mask or no mask in an image. Based on the testing results, each model performed relatively well and were able to accurately detect their classes for each feature. An average of 97% accuracy is achieved with proposed models and it indicates that the models can be integrated together and tested on real-time videos. The results show the balance of limited computing resources and high performance. Along with this project, an end-to-end solution is provided with video acquisition, database design and high-level data analytics. The system and the solution can be easily used by small businesses, organizations and universities with minimum cost under the COVID-19 and help to practice social distancing.

9.2 FUTURE ENHANCEMENT

- In future work, would like to build face mask detection datasets with no, correct and incorrect mask wearing states, or use a zero-shot learning approach to make the model able to detect incorrect mask wearing states.
- New deep learning detectors may be used to further improve the performance.
- Future enhancements could include measures to ensure that facial data is protected and that the technology is not misused.
- Future enhancements could focus on ensuring that the technology can be easily integrated with a variety of systems and platforms.

APPENDICES

APPENDIX I

SOURCE CODE

main.py

```
from flask import Flask

from flask import Flask, render_template, Response, redirect, request, session, abort, url_for

from camera import VideoCamera

from detect_mask_video import VideoCamera3

from datetime import datetime

from datetime import date

import datetime

import random

from random import seed

from random import randint

from flask import send_file

import csv

import cv2

import numpy as np

import threading

import os

import time

import shutil

import imagehash

import PIL.Image

from PIL import Image
```

```
from PIL import ImageTk
import urllib.request
import urllib.parse
from urllib.request import urlopen
import webbrowser
import mysql.connector
mydb = mysql.connector.connect(
  host="localhost",
  user="root",
  passwd="",
  charset="utf8",
  database="face_mask_door"
)
# import the necessary packages
from tensorflow.keras.applications.mobilenet_v2 import preprocess_input
from tensorflow.keras.preprocessing.image import img_to_array
from tensorflow.keras.models import load_model
from imutils.video import VideoStream
import numpy as np
import argparse
import imutils
import time
import cv2
import os
app = Flask(__name__)
```

```
##session key

app.secret_key = 'abcdef'

@app.route('/',methods=['POST','GET'])

def index():

    cnt=0

    act=""

    msg=""

    ff=open("det.txt","w")

    ff.write("1")

    ff.close()

    ff1=open("photo.txt","w")

    ff1.write("1")

    ff1.close()

    ff11=open("img.txt","w")

    ff11.write("1")

    ff11.close()

   if request.method == 'POST':

        username1 = request.form['uname']

        password1 = request.form['pass']

        mycursor = mydb.cursor()

        mycursor.execute("SELECT count(*) FROM admin where username=%s &&
password=%s",(username1,password1))

        myresult = mycursor.fetchone()[0]

        if myresult>0:

            result=" Your Logged in sucessfully**"

            return redirect(url_for('admin'))
```

```
        else:
            result="Your logged in fail!!!"
    return render_template('index.html',msg=msg,act=act)
@app.route('/login_admin', methods=['POST','GET'])
def login_admin():
    result=""
    ff1=open("photo.txt","w")
    ff1.write("1")
    ff1.close()
    if request.method == 'POST':
        username1 = request.form['uname']
        password1 = request.form['pass']
        mycursor = mydb.cursor()
        mycursor.execute("SELECT count(*) FROM admin where username=%s &&
password=%s",(username1,password1))
        myresult = mycursor.fetchone()[0]
        if myresult>0:
            result=" Your Logged in sucessfully**"
            return redirect(url_for('admin'))
        else:
            result="Your logged in fail!!!"
  return render_template('login_admin.html',result=result)
@app.route('/admin',methods=['POST','GET'])
def admin():
    msg=""
    ff1=open("photo.txt","w")
```

```
    ff1.write("2")
    ff1.close()
    mycursor = mydb.cursor()
    if request.method=='POST':
        regno=request.form['regno']
        name=request.form['name']
        mobile=request.form['mobile']
        email=request.form['email']
        address=request.form['address']
        aadhar=request.form['aadhar']
        dept=request.form['dept']
        year=request.form['year']
        now = datetime.datetime.now()
        rdate=now.strftime("%d-%m-%Y")
        mycursor.execute("SELECT count(*) FROM register where aadhar=%s",(aadhar, ))
        cnt = mycursor.fetchone()[0]
        if cnt==0:
            mycursor.execute("SELECT max(id)+1 FROM register")
            maxid = mycursor.fetchone()[0]
            if maxid is None:
                maxid=1
            xn3=randint(1000, 9999)
            pinno=str(xn3)
            sql = "INSERT INTO register(id, regno, name, mobile, email, address,  aadhar, dept,
year, rdate) VALUES (%s, %s, %s, %s, %s, %s, %s, %s, %s, %s)"
            val = (maxid, regno, name, mobile, email, address, aadhar, dept, year, rdate)
```

```
            print(sql)
            mycursor.execute(sql, val)
            mydb.commit()
            message="Dear "+name

#url="http://iotcloud.co.in/testmail/sendmail.php?email="+email+"&message="+message
            #webbrowser.open_new(url)
           return redirect(url_for('add_photo',vid=maxid))
        else:
            msg="Already Exist!"
    return render_template('admin.html',msg=msg)
@app.route('/add_photo',methods=['POST','GET'])
def add_photo():
    vid=""
    ff1=open("photo.txt","w")
    ff1.write("2")
    ff1.close()
   ff2=open("mask.txt","w")
    ff2.write("face")
    ff2.close()
   if request.method=='GET':
        vid = request.args.get('vid')
        ff=open("user.txt","w")
        ff.write(vid)
        ff.close()
  if request.method=='POST':
```

```
vid=request.form['vid']
fimg="v"+vid+".jpg"
cursor = mydb.cursor()
cursor.execute('delete from vt_face WHERE vid = %s && mask_st=0', (vid, ))
mydb.commit()
ff=open("det.txt","r")
v=ff.read()
ff.close()
vv=int(v)
v1=vv-1
vface1=vid+"_"+str(v1)+".jpg"
i=2
while i<vv:
    cursor.execute("SELECT max(id)+1 FROM vt_face")
    maxid = cursor.fetchone()[0]
    if maxid is None:
        maxid=1
    vface=vid+"_"+str(i)+".jpg"
    sql = "INSERT INTO vt_face(id, vid, vface, mask_st) VALUES (%s, %s, %s, %s)"
    val = (maxid, vid, vface, '0')
    print(val)
    cursor.execute(sql,val)
    mydb.commit()
    i+=1
cursor.execute('update register set fimg=%s WHERE id = %s', (vface1, vid))
```

```
        mydb.commit()
        shutil.copy('faces/f1.jpg', 'static/photo/'+vface1)
        return redirect(url_for('view_cus',vid=vid,act='success')
    cursor = mydb.cursor()
    cursor.execute("SELECT * FROM register")
    data = cursor.fetchall()
    return render_template('add_photo.html',data=data, vid=vid
@app.route('/add_photo1',methods=['POST','GET'])
def add_photo1():
    vid=""
    ff1=open("photo.txt","w")
    ff1.write("2")
    ff1.close()
    ff2=open("mask.txt","w")
    ff2.write("mask")
    ff2.close()

    if request.method=='GET':
        vid = request.args.get('vid')
        ff=open("user.txt","w")
        ff.write(vid)
        ff.close()

    if request.method=='POST':
        vid=request.form['vid']
```

```
fimg="v"+vid+".jpg"
cursor = mydb.cursor()

cursor.execute('delete from vt_face WHERE vid = %s && mask_st=1', (vid, ))
mydb.commit()

ff=open("det.txt","r")
v=ff.read()
ff.close()
vv=int(v)
v1=vv-1
vface1="m"+vid+"_"+str(v1)+".jpg"
i=2
while i<vv:

    cursor.execute("SELECT max(id)+1 FROM vt_face")
    maxid = cursor.fetchone()[0]
    if maxid is None:
        maxid=1
    vface="m"+vid+"_"+str(i)+".jpg"
    sql = "INSERT INTO vt_face(id, vid, vface, mask_st) VALUES (%s, %s, %s, %s)"
    val = (maxid, vid, vface, '1')
    print(val)
    cursor.execute(sql,val)
    mydb.commit()
```

```
            i+=1
        cursor.execute('update register set fimg=%s WHERE id = %s', (vface1, vid))
        mydb.commit()
        shutil.copy('faces/f1.jpg', 'static/photo/'+vface1)
        return redirect(url_for('view_cus',vid=vid,act='success'))

    cursor = mydb.cursor()
    cursor.execute("SELECT * FROM register")
    data = cursor.fetchall()
    return render_template('add_photo1.html',data=data, vid=vid)

@app.route('/view_cus',methods=['POST','GET'])
def view_cus():
    mycursor = mydb.cursor()
    mycursor.execute("SELECT * FROM register")
    value = mycursor.fetchall()
    return render_template('view_cus.html', result=value)
```

APPENDIX II

SCREEN SHOTS

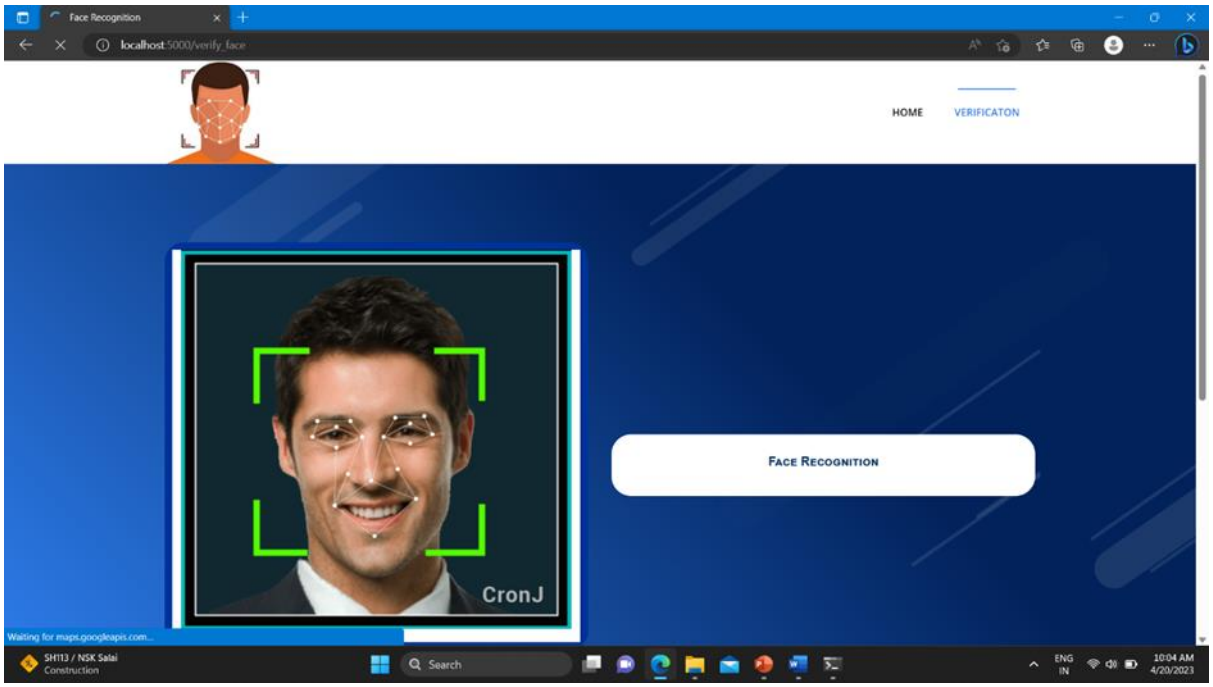


Fig.No: A.1 HOME PAGE

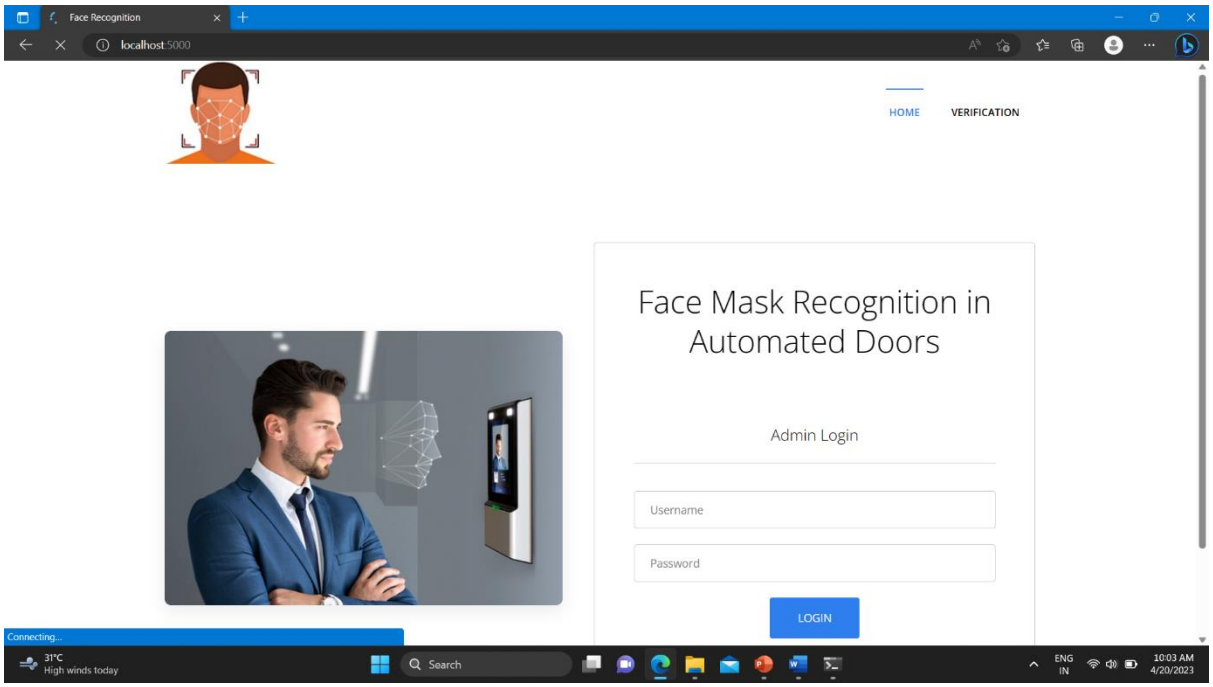


Fig.No: A.2 ADMIN LOGIN

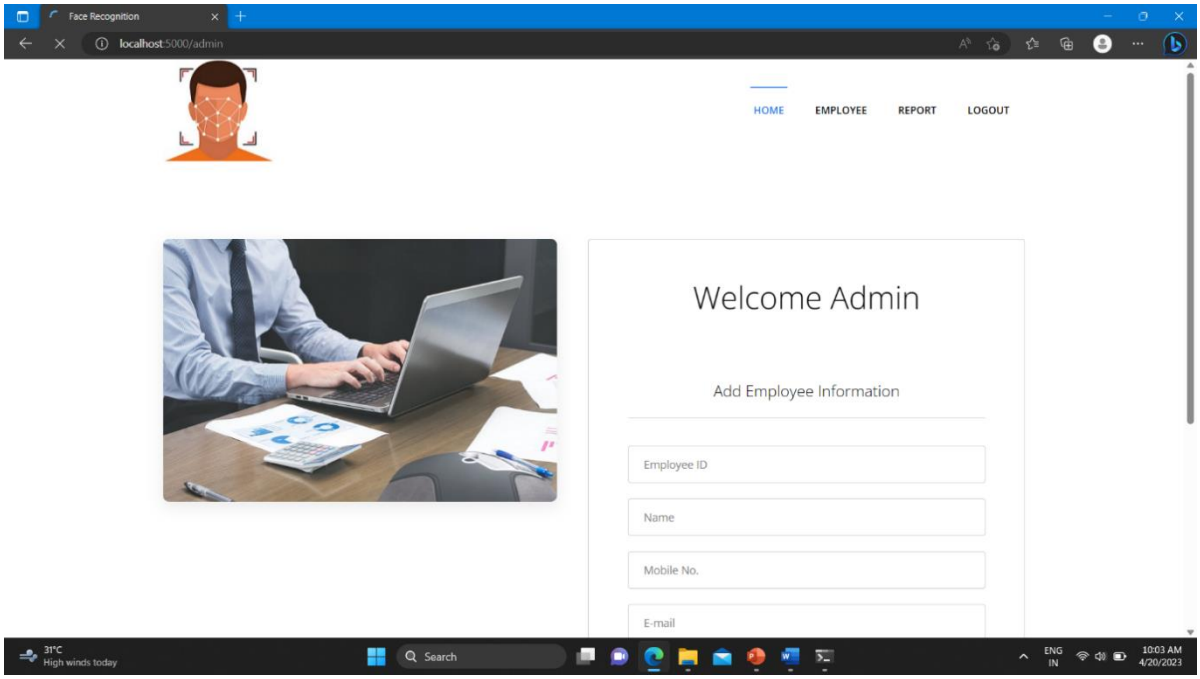
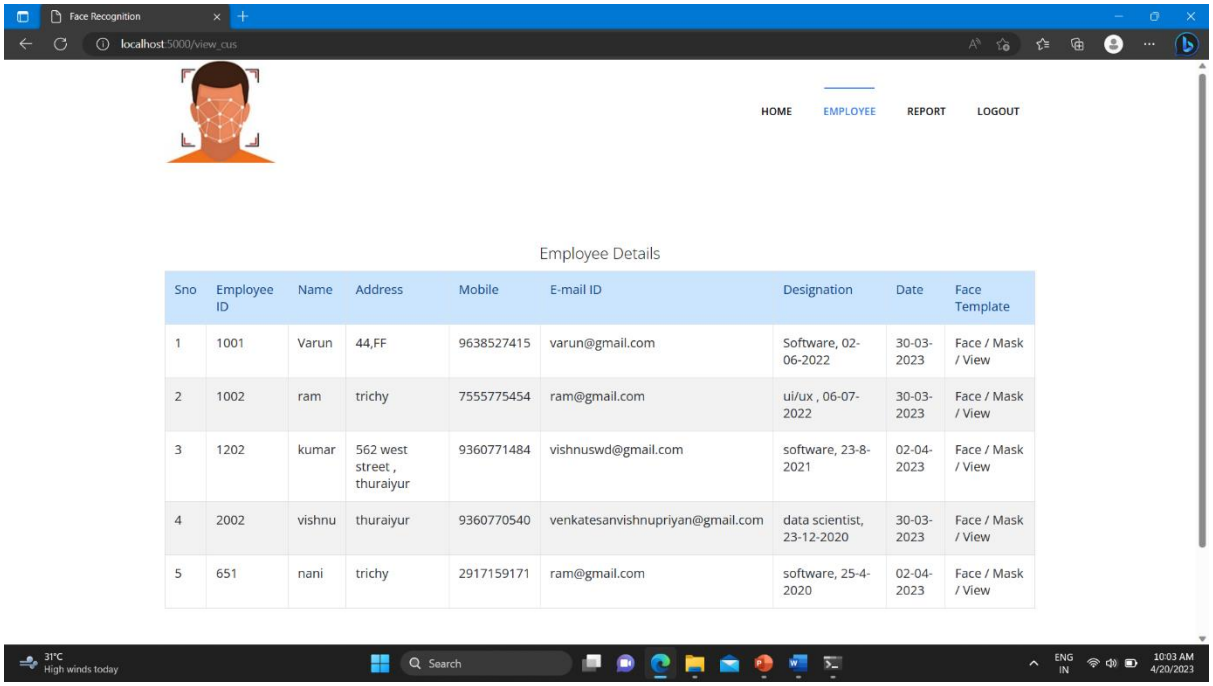


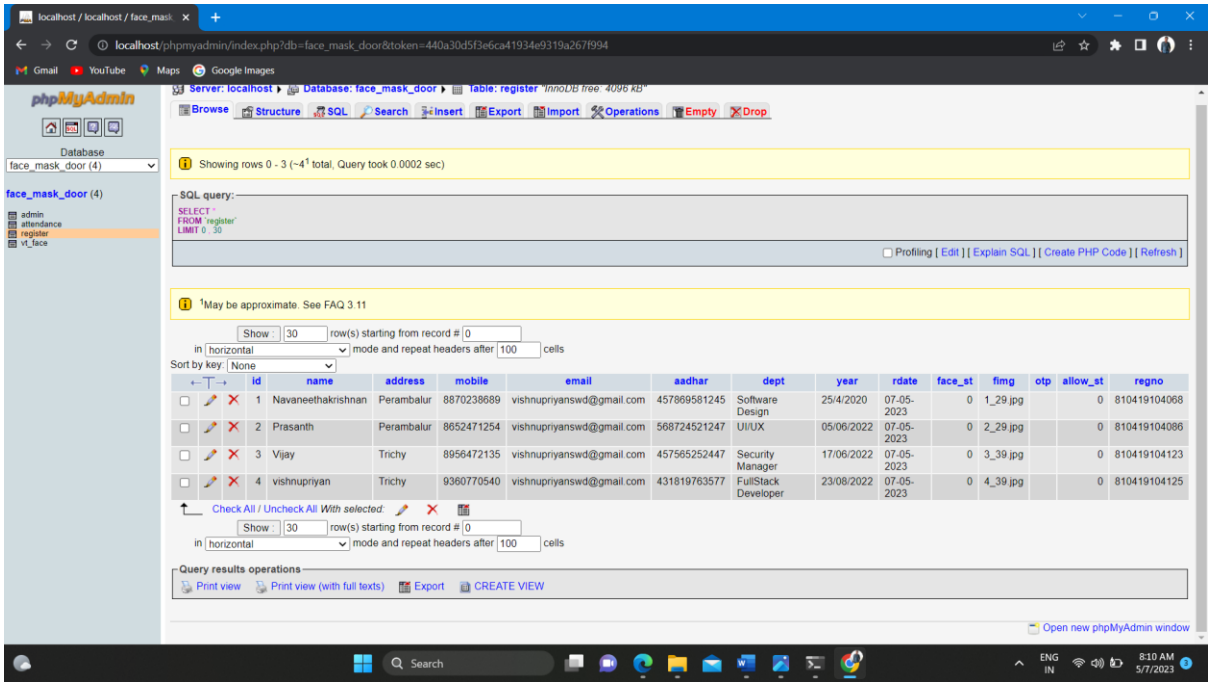
Fig. No: A.3 ADD EMPLOYEE DETAILS



Employee Details

Sno	Employee ID	Name	Address	Mobile	E-mail ID	Designation	Date	Face Template
1	1001	Varun	44,FF	9638527415	varun@gmail.com	Software, 02-06-2022	30-03-2023	Face / Mask / View
2	1002	ram	trichy	7555775454	ram@gmail.com	ui/ux , 06-07-2022	30-03-2023	Face / Mask / View
3	1202	kumar	562 west street , thuraiyur	9360771484	vishnuswd@gmail.com	software, 23-8-2021	02-04-2023	Face / Mask / View
4	2002	vishnu	thuraiyur	9360770540	venkatesanvishnupriyan@gmail.com	data scientist, 23-12-2020	30-03-2023	Face / Mask / View
5	651	nani	trichy	2917159171	ram@gmail.com	software, 25-4-2020	02-04-2023	Face / Mask / View

Fig.No: A.4 EMPLOYEE DETAILS



id	name	address	mobile	email	aadhar	dept	year	rdate	face_st	fimg	otp	allow_st	regno
1	Navaneethakrishnan	Perambalur	8870238689	vishnupriyanswd@gmail.com	457869581245	Software Design	25/4/2020	07-05-2023	0	1_29.jpg		0	810419104068
2	Prasanth	Perambalur	8652471254	vishnupriyanswd@gmail.com	568724521247	UI/UX	05/06/2022	07-05-2023	0	2_29.jpg		0	810419104086
3	Vijay	Trichy	8956472135	vishnupriyanswd@gmail.com	457565252447	Security Manager	17/06/2022	07-05-2023	0	3_39.jpg		0	810419104123
4	vishnupriyan	Trichy	9360770540	vishnupriyanswd@gmail.com	431819763577	FullStack Developer	23/08/2022	07-05-2023	0	4_39.jpg		0	810419104125

Fig. No: A.5 ADMIN PAGE

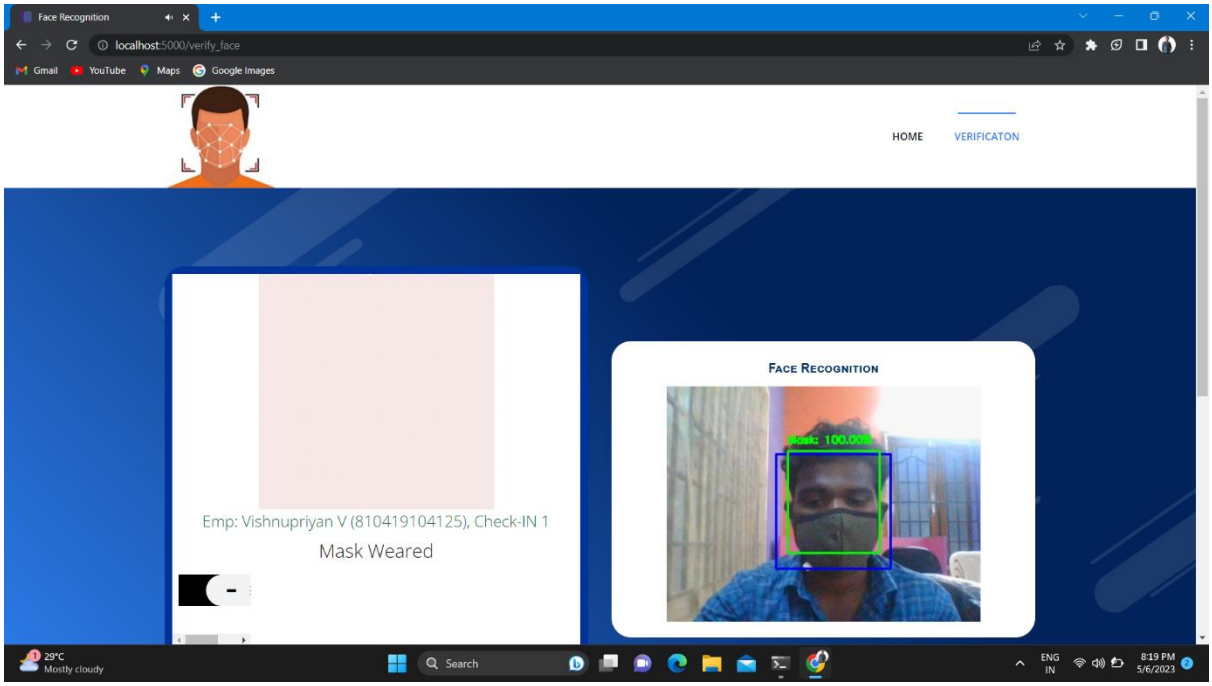


Fig.No: A.6 OUTPUT FACE MASK WEARED

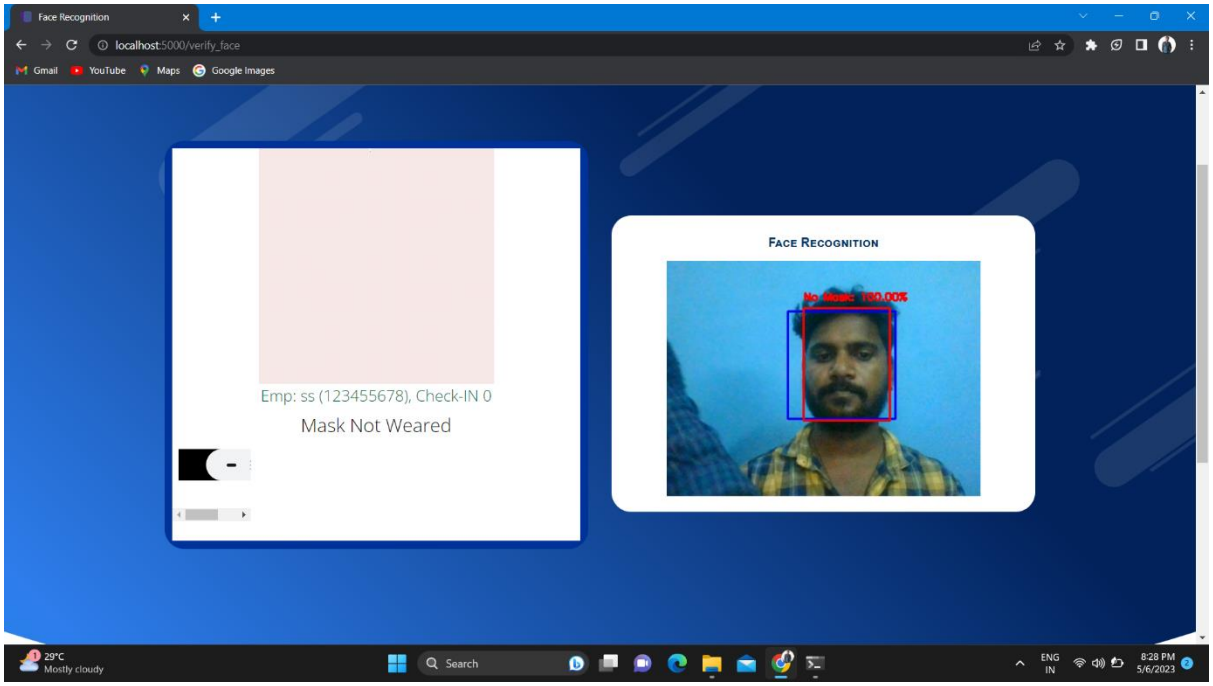


Fig. No: A.7 OUTPUT FACE MASK NOT WEAR

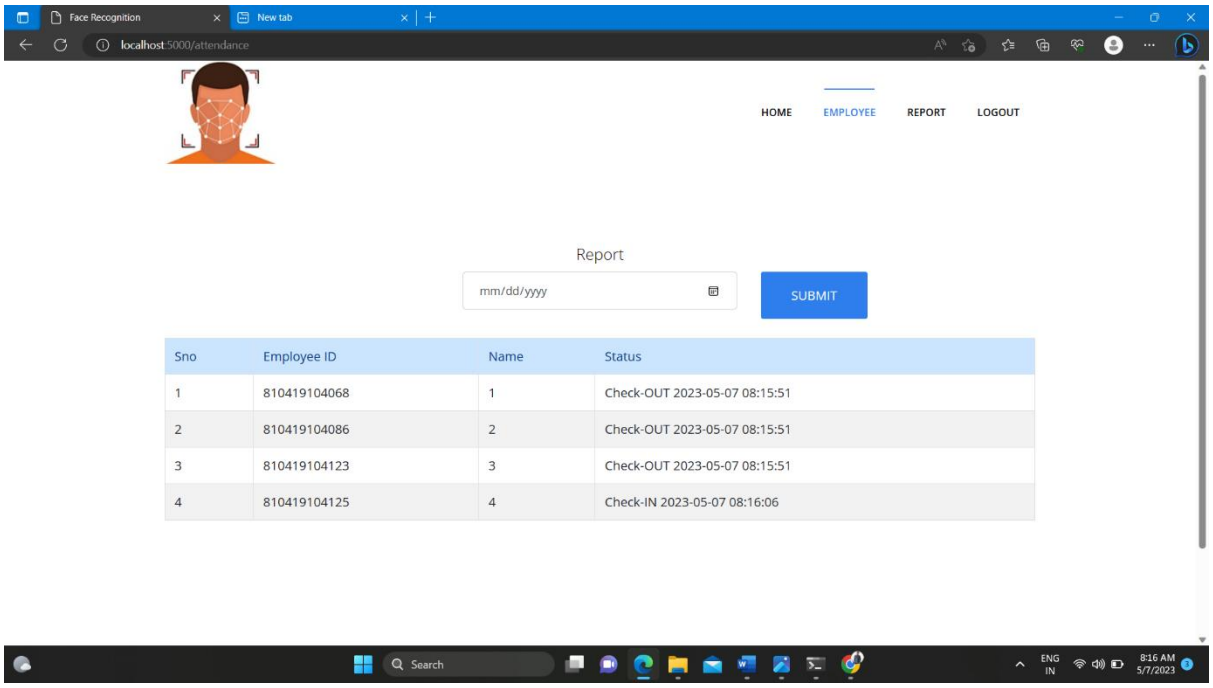


Fig.No: A.8 EMPLOYEE ATTENDANCE

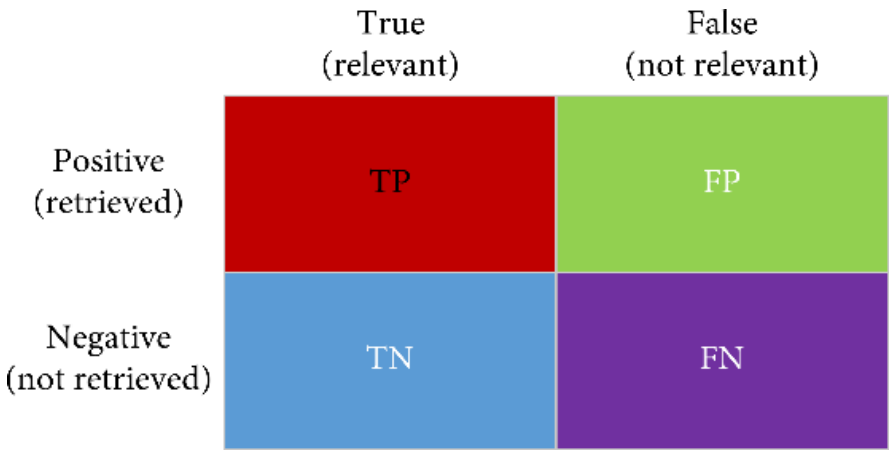


Fig. No: A.9 PARAMETER DEFINITION

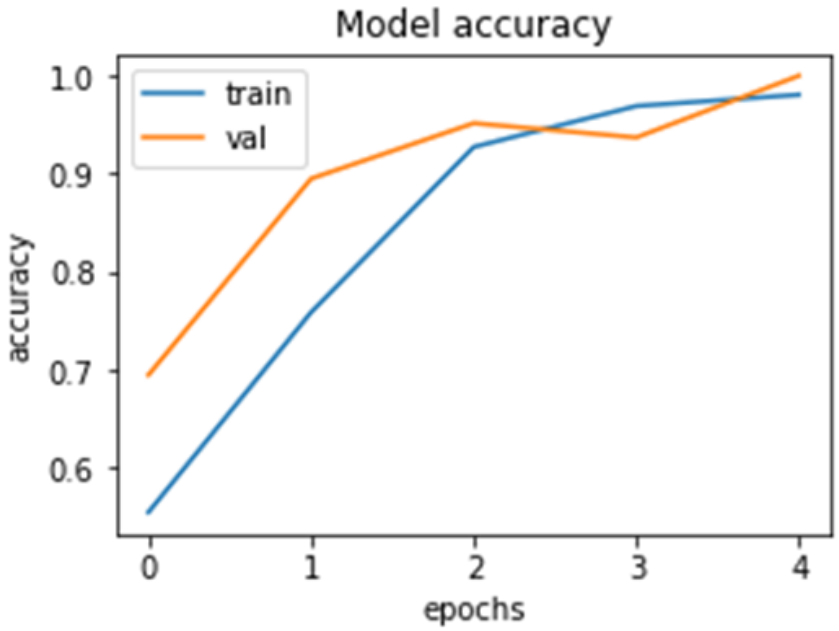


Fig. No: A.10 MODEL ACCURACY

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