DEEP FACE RECOGNITION FOR SURVEILLANCE AND ACCESS CONTROL

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Submitted to the department of computer engineering in the partial fulfillment of the requirements for the degree of Bachelor's in Computer Engineering.

Department of Computer Engineering
Bahria University Islamabad.

2021

UNDERTAKING

I certify that research work titled "*Deep Face Recognition for Surveillance and Access Control*" is my own work. The work has not been presented elsewhere for assessment. Where material has been used from other sources it has been properly acknowledged / referred.

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DEDICATION

"We dedicate,

this work to our beloved **parents and teachers**

Who have been great supporters?throughout our career,

with them

in valuable guidance

love

and

devotion."

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All praise to the almighty ALLAH, who deserves all praises alone. It is only His blessing, which enable us to reach this level of knowledge in our field. We are grateful to most competent, knowledgeable, and cooperative supervisor, Engr. Waqar Tanveer for his willingness to give considerable time, dedication, and supervision.

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ABSTRACT

The most important domain of research field in biometric technology is facial recognition and its applications are widely utilized for security purposes to consumer applications, monitoring solutions to industrial efficiency, access control and surveillance etc. Most of the existing facial recognition systems are based on old techniques which give poor accuracy and vulnerable to lightning and other environmental conditions. To address these problems, we propose a **Deep Face Recognition** system for surveillance, access control and other security purposes. We also focus to make a smart attendance system in which attendance can be marked by the faces of people appearing in the camera. In this project, we prepare custom dataset for facial recognition. We perform data augmentation to increase the variation and size of custom dataset. We utilize pre-trained VGG-16 model for deep face recognition. We fine-tune the VGG-16 model with our custom dataset and trained it. We implement our project for access control, surveillance, and facial attendance. In access control setup, if the person is not recognized by our system, the access to the gate will be denied. We also maintain a database of people appearing in front of the camera during access control setup. We record the time of entry, name of person and the image of the person in our database for surveillance and record purpose. In facial attendance setup, our system provides the ease to mark the attendance of all the registered persons appearing in front of the camera and their names and time of attendance will be stored in the database. Our system also provides the facility of registration of new person in the existing record. We made an efficient graphical user interface to provide all the above-mentioned facilities. We also implement our complete project on an embedded platform raspberry pi 4 to shape our project in form of a portable product.

Keywords: DCNN, DNN, AI, CV, DB, FR, VGG-16, ID, DAT.

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CHAPTER 1

Introduction

1.1 Introduction

A Face Recognition method which is used to identify the faces of each person whose face images are already saved in the informational index. Even though there are many other techniques of identification that can give more accurate results, face identification has always become most important research because of it denationalize nature and because it's people's facile technique of personal identification.

A Facial Recognition is defined as, "a biometric software application competent of specifically recognizing or confirming an individual by comparing and analyzing facial patterns based on the person's facial contours." As we know that each person had different face metrics. By using the above technique, we can examine persons facial landmarks, after this comparing this dataset of a person by set of data, which is already present in a database, and.

In 2018 the market of face recognition technique up to 3.98 billion US Dollars and is anticipate developing almost 10.18 US Dollars by 2025. Whereas a few companies are working to increase in this ratio while some Authors highlighted the agenda regarding the security and precisions.

According to this thesis we are not as it were making an effective facial identification technique, but we are also working on the preciseness by utilizing profound deep learning models VGG16 and ResNet50 Convolutional Neural Networks (CNN) architectures our anticipated precision will be around 94%.

1.2 Problem Statement

For security we [humans] identify persons through their ID card but what if someone lost it or ID is compromised.

This problem can be solved by Computer vision (Facial Recognition technique). A facial identification method is used for recognizing face as well as identity of each person by facial landmarks. People can be identified by using the photos, videos, and by using the real time cameras by the using the facial recognition techniques. The conventional authorities might utilize versatile devices to distinguish each person when a person is check for his identification by the Police.

1.3 Background

A facial identification method is used for recognizing face as well as identity of each person by facial landmarks. People can be identified by using the photos, videos, and by using the real time cameras by the using the facial recognition techniques. The conventional authorities might utilize versatile devices to distinguish each person when a person is check for his identification by the Police.

A face recognition method may give undesired results such as, due to some error in dataset can cause a person a committed criminal as he has not committed this crime.

Additionally, facial recognition technique can be used to targeting each person that are involving in threatened conversation. Soon, face identification technology will likely become more universal. We can use this technology as a tracking system to track down the persons' activities by using the automatic licensed car number plates, tracking automobiles by their number plates. A real time facial identification currently used by the different nations such as in United States.

In this project, we are using deep machine learning structures for dealing with real-time facial recognition problem.

1.4 Objectives

Not like other recognition techniques as we know that like unique PINs, Email authorization, taking real time photos or videos or generating the finger-patterns for the recognition. A technique which is used now a days called as biometric face identification mostly uses exclusive numerical and active shapes for this System to make it more precise, accurate and secure.

An important goal of facial identification technique is to take the real time images which is coming from the active camera for making the sequence of face features so that the current face of a person will be used in the training for making the training data set later on which will stored in the database. This whole process will be based on the real time taking the images from the camera that will be not available somehow in the Biometric face identification systems may not provide by the software companies.

A face identification process is divided into two processes, for what purpose it will be completed:

In the beginning, the first step is to find the face of a particular person by the facial recognition system, after this when a face is recognized, it will be adding as a registration that will be used to recognize a specific person, this whole process will be recorded by the face recognition system.

The second step is that when a particular person is identified by the system. Once it done, when a new facial data set of a person comes by the CCTV cam it will be checked by using the facial data of person that is already present in the database. By now when a current data set of face matched with the existing data set of the user, the user will be allowed to access to this framework with his credentials.

CHAPTER 2

Literature Review

An important aspect about literature review will be finding the best methods or techniques that is provided by the other authors as they proposed their system, by considering their deficiencies in their Models, we can manage to find the advanced methods to over-come these problems.

A new method of lecture attendance system also known as real time monitoring of the students and marked their attendance automatically by the source camera, which capture the images of the students those who are present in the class. This system had two cameras which are attached on the wall of the class. In this system, one camera is used to capturing the images of the students while the other camera in which sensor is involved, this camera is used to getting the seat images of the students which are present inside the class, after this whole process all the captured images will be send to the database for the comparison analysis of the students, if student is matched with their database image, his/her attendance will be marked as Present. But this system takes too much time to making the attendance accurate.

In 2010, the automatic surveillance system which capture the images in real-time by using the computer vision algorithms. In this system a camera is used to take the images those who are in present the class, after this extracting the face features, they will be compared with the images capturing by the source camera with the faces which are recorded in the system. In this system deep machine learning models and algorithms are used which is the requirement of the computer vision. The images which are taken by the source capturing camera will be trained by using the Haar Classifiers Algorithms. Also, the images taken by the source camera will be converted into grayscale and will perform some subtraction techniques on the images, after this all the dataset of the pictures will be referred to the database for further processing.

In the year 2012, the new technique of facial recognition which uses the Principle Component Analysis for the application of the system, this system uses two type of libraries which are named as OpenCV, a library of the computer vision that supports computer vison algorithms and the other library named as FLTK used to designing the interface of the system. In this system, first images are taken by the camera for extracting the human face features. After this next step is training of these faces, once the features of the face are extracted, they will be passed into the Principal Component Analysis. The very next step is to be finding and displaying the closest face which will be required. Now the final step is storing the images in the database and learning the features of each face, after that Principal Component Analysis Algorithm will be used for further processing. Once the features of the faces are recorded, their face information will be stored in the XML file. The main goal of this system is to improve the face detection algorithm for the acquisition of the images or videos.

In the year of 2014, the new model which is called as Vgg-16. In this architecture, the size of input is fixed up to 224x224. In this model a set of images are passed through the deep convolutional layers of the model, in which there is a flexible filter whose size is 3x3. There is another filter of size 1x1 which is created for the input channels of linear transformation. After the deep convolution, the spatial resolution will be reserved. The padding technique will be used for this purpose such as for a single pixel of 3x3, convolution layer will be used, in this way all the 5 max-pooling layers will be executed one by one. A 2x2 window with the step size of 2 is used for the max-pooling layers. These layers are further connected with three more FC layers, later on which will be used as the first two fully connected layers having 4096 channels and the next layer which will be considered as third layer of FC will have 1000 channels. The final and the last layer of this Model is called SoftMax layer.

In the year of 2014, a model which is called as Residual Network or ResNet 50 having a layer of 50. Just like the Vgg-16, ResNet 50 also had a deep convolutional layer of 3x3 filters, having the fixed size of input such as 224x224. This model follows some patterns such as a layer having an input of numbers of filter will have a same number of outputs. If the number of filters is doubled having the convolution size which will

be shared so that the complexity issues regarding time will be reserved. This architecture also had fully connected layers up to 1000 ways having the average pooling ratio with SoftMax. In this architecture, a very few filters are available, and complications are very minors, than the other models of Vgg-16. There are also other models available like Resnet 101 & Resnet 152.

2.1 COMPARISON OF FACE RECOGNITION TECHNIQUES:

Several research studies showed the best algorithms regarding deep face recognition. Below table will covers the best five papers that we had chosen and relevant to our field. A complete summary of these papers is given below. We highlighted their problems and their restrictions with comparison table:

Table 1 Comparison Analysis

Author	Algorithm	Problems/Issues	Techniques/Methods
Kawaguchi	Principal Component Analysis (PCA)	The accuracy rate is just 56%, and do not recognize the students of 3 to 4 years.	Face recognition algorithms like Haar Classifier and OpenCV is used [1] Y. Kawaguchi, 3rd AEARU no. October,2005
A. Dika	Haar-Classifier	The accuracy rate is very low while training the large size of images using the PCA algorithms.	PCA algorithm is used for the training, reducing the dimensions and for classification ANN technique is used to find the patterns. [2] A. Dika, 10th IEEE no. Decemberr,2006
N. Kar	Open-Cv/PCA	Repeat image capturing	Using Eigenvectorand Eigenvalue forface recognition.

			[3] N. Kari, 5th AEARU no. March,2008
Simonyi & Zisser-man	VGG-16	Slower in Training/overfitting	Using the high processing CPU &GPU required. [4] Simonyi, 8th AEARU no. October,2003
He etal	ResNet 50	Overfitting	Using High Computational Power. [5] He, 3rd IEEE no. Feburary,2009

Chapter 3

Design & Methodology

A computer vision algorithm is used for the face recognition. These algorithms are also used to find out the inner details of the human face. The details include, shape of eyes including colors, shape of the person's chin, after this, these minor details are used as dataset of the face. This face information is converted into the mathematics such as in the form of metrices and then these details are used for the comparison purposes with the other face data which is collected in the face identification database. The data set of each face is also called face features which are different from the photographs, it is because only the face features is required for finding the specific face from other face.

3.1 Face Detection:

The facial detection system sometimes fluctuates, but its overall working is very effective which is as follows:

The First step is detecting and recognizing the face whether the person is in crowd or alone. If a person stands in front of the camera, the detection and recognition will be very accurate. With the advancement in the technology now we can also overcome this issue, by using the Haar Cascade Frontal Face Detection Algorithm.

Figure 3.1.1 shows the face detection. This is the most important step for the face recognition and verification. Now a days, this technology is used as an applications like tracking of face for surveillance purposes, recognition of human face expressions or emotions, on social media platforms it is used as digital tagging, and in many other consumer digital applications, such as in mobile cameras as an auto-focusing ability. Below figure will shows the full facial detection methods as applied for the verification of a particular face:

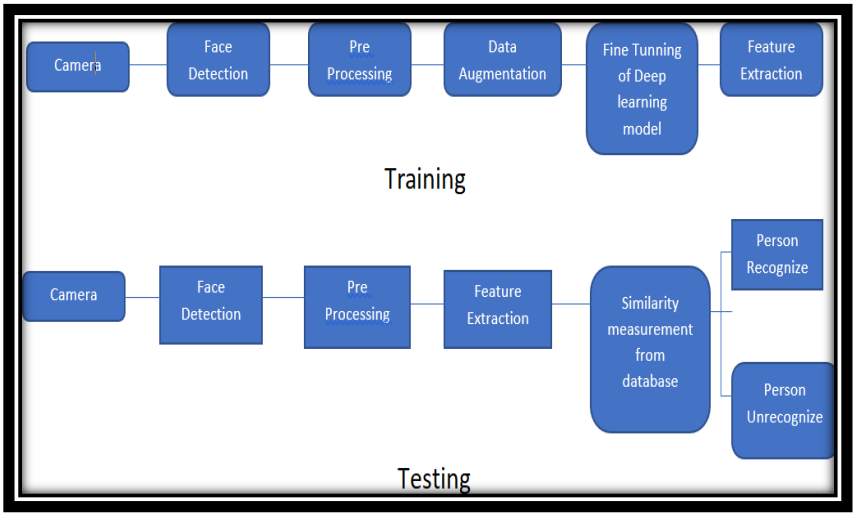


Fig 3.1 Training & Testing Block Diagram

In face detection algorithms, the biggest problem is ability to gaining the highest accuracy in an unconditional environment. Therefore, the use of this technology in real life conditions is very limited. Due to the development of the famous algorithms named as Viola & Jones for the face detection method improving its quality, in real life conditions face detection technique became very common now. Many famous researchers have made research specially in this field, it is all because of the improving techniques of the facial extraction.

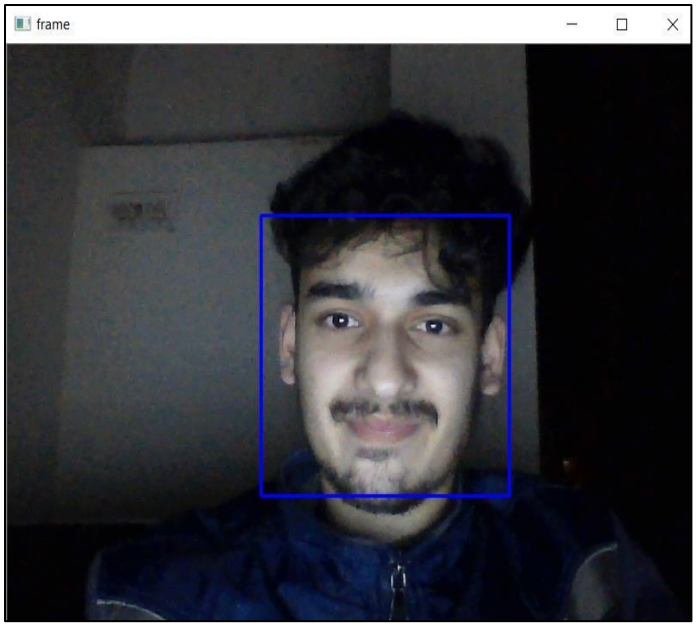


Fig 3.1 Face Detection

3.2 Augmentation

Face can be detected and can be stored in a dataset for feature extraction but to acquire best accuracy we must prepare our dataset most efficient one of the methods to do this is image augmentation. By using the image augmentation technique, we can increase the size of our current training dataset by making the different modifications/versions of the images in the dataset.

By training the more data on the deep neural network models, we can create a highly efficient models, and also due to the augmentation techniques we can generate the most improved fit model for the learning of the new images.

The most efficient and famous Deep learning neural network library which is called as Keras has an ability to fit the most efficient models using the image data augmentation technique by means of the image data generator class.

In our report, we will discuss and discover how we can use image data augmentation technique by training the deep learning neural networks.

3.3 Image Data Augmentation

Data is like a food for a deep learning neural network. More data, strong the neural network will be. But question is how to generate more and more data? Well answer is data augmentation.

Data augmentation is a technique for creating artificial data from existing data for our neural network to train.

Most well-known data augmentation is for image data augmentation. It transforms image data into range of operations from image manipulation like flip, rotate, flip, zooms and much more.

Our goal is to expand the training dataset with new, possible examples. As shown below in figure2. This makes our training data set very variable. For example, a horizontal flip of a picture may make sense, because the photo could have been taken from the left or right.

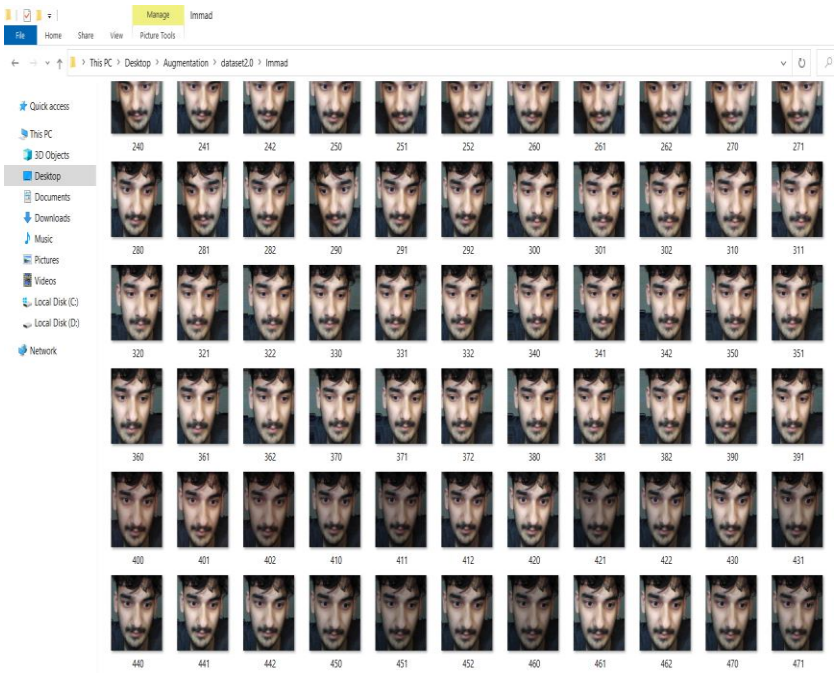


Fig 3.3 Data Augmentation

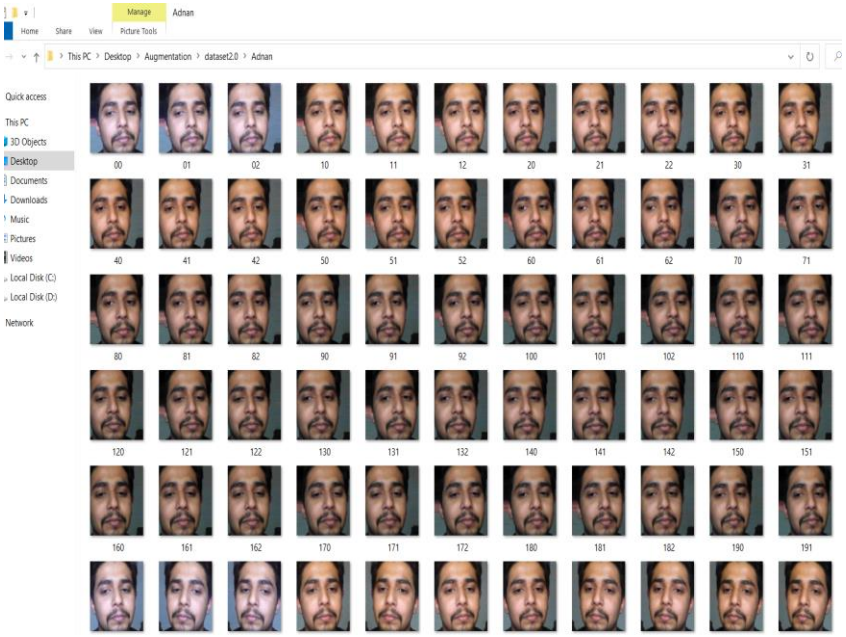


Fig 3.3 Data Augmentation

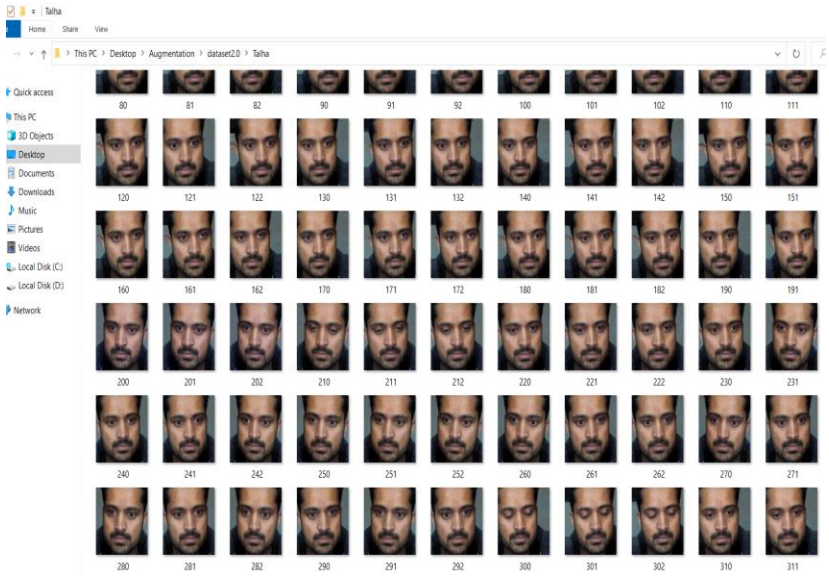


Fig 3.4 Data Augmentation

It is clear that the choice for data augmentation must be choose very carefully for example I we are augmenting human faces data augmentation we can't just rotate the image by upside down it makes no sense.

Image data augmentation is typically only applied to the training dataset, and not to the validation or test dataset. This is different from data preparation such as image resizing and pixel scaling; they must be performed consistently across all datasets that interact with the model.

Fig 3.5 Data Augmentation

3.1 Feature Extraction and Training dataset

For Training purpose, we are planning to use Transfer learning approach especially fine tuning to train our model using VGG16 from Keras.

3.1.1 Transfer Learning:

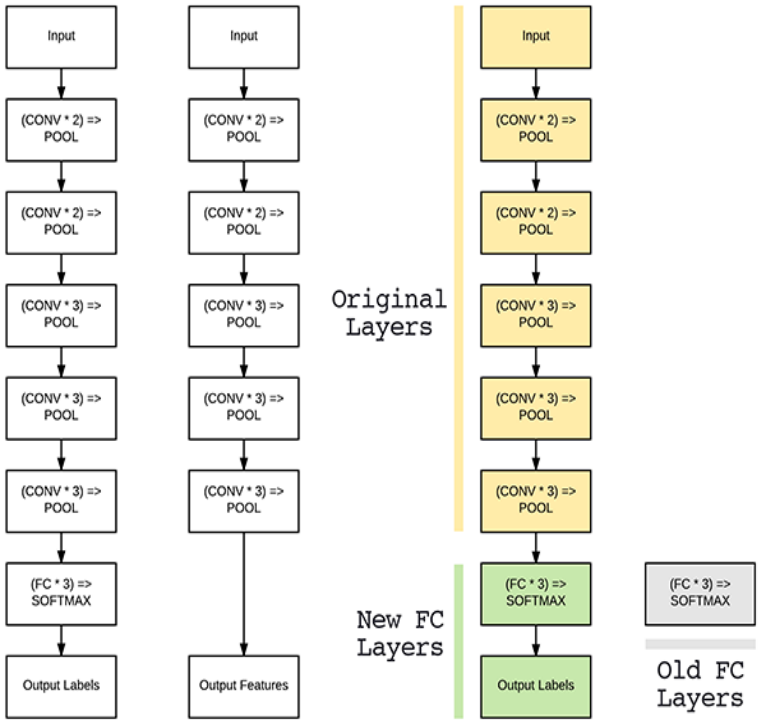
Transfer learning is a machine learning technique in which we perform a network surgery on a pre trained network and make it useful for solving new problem. It is a very famous concept in deep learning because it required very little data, as we all know data is a food for machine to learn.

In transfer learning we use already trained machine learning model and apply transfer learning techniques to use it against related machine learning problem. One type of transfer learning is called Fine tuning.

3.1.2 Fine Tuning:

In fine tuning we not only update the architecture of CN but also, we retrain the updated trained model for new object classes.

To understand how fine-tuning works, consider the following figure:



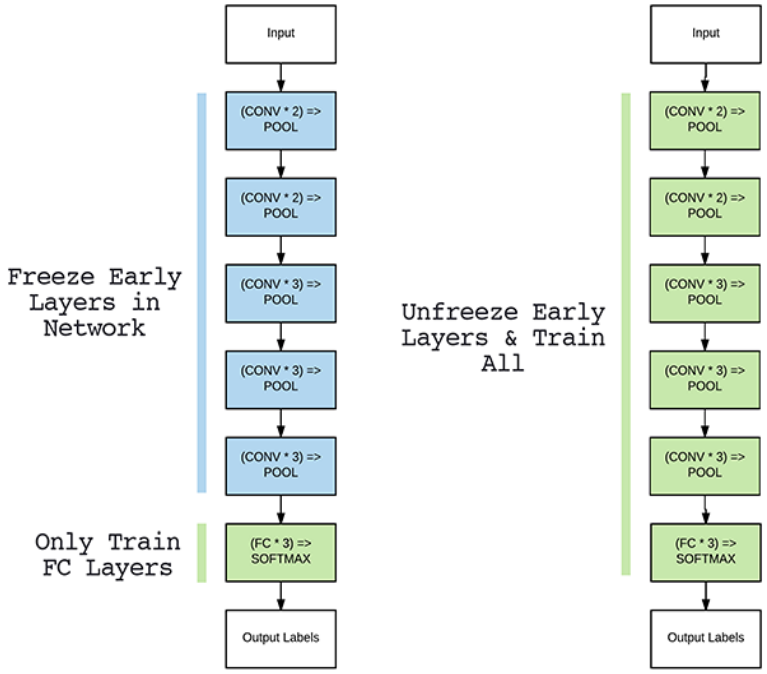


Fig 3.6 Fine Tuning Model

As seen in the figure top layer of the pre trained model is removed and new head layer is added with extra features.

3.1.3 How to fine-tune:

Steps to perform Fine tuning:

- ❖ Remove the fully connected nodes at the end of the network (i.e., where the actual class label predictions are made).
- ❖ Replace the fully connected nodes with freshly initialized ones.
- ❖ Freeze earlier CONV layers earlier in the network (ensuring that any previous robust features learned by the CNN are not destroyed).
- ❖ Start training, but only train the FC layer heads.
- ❖ Optionally unfreeze some/all the CONV layers in the network and perform a second pass of training.

Chapter 4

Database Integration with Python

Data Base is the most essential part of any Project or work, because while making our projects we must have something where we have to save our records or information, somewhere we may need to upgrade of data, through Inserting, updating or some kind of deletion. For that we must save the data in different databases, from where we can easily access and improve the data as per requirements concerned, and we can upgrade our data.

4.1 My SQL:

The software tool we choose for our project's database is MySQL, the reason for selecting specifically MySQL is that, In MySQL there is tool named MySQL Workbench, This Tool give their user a facility of "Visual Display", That whatever change happened to databases, it visually availability to its users, further help to understand what is going on in a database, what are possibly changes required to get the desire outcomes. In our project we use the latest version of MySQL.

Fig 4 1 About My SQL

4.2 Wamp Server Concept:

After done with the Installation of MySQL, while we want to access MySQL from command prompt and from python Anaconda navigator, we can observe an error of "access denied localhost" each time. To handle this kind of error, we install the "wamp-server". From inside, the Wamp-server provides with different facility of different soft wares and databases, it provides services of PHP, MairaDB, and MySQL. As our requirements, we needed to troubleshoot the MySQL (localhost) issue.

In command prompt, rather we give the path of MySQL, we gave the path of wamp's MySQL bin's path and set the username as root, password is as null, for doing that we can get rid of "access denied" error.

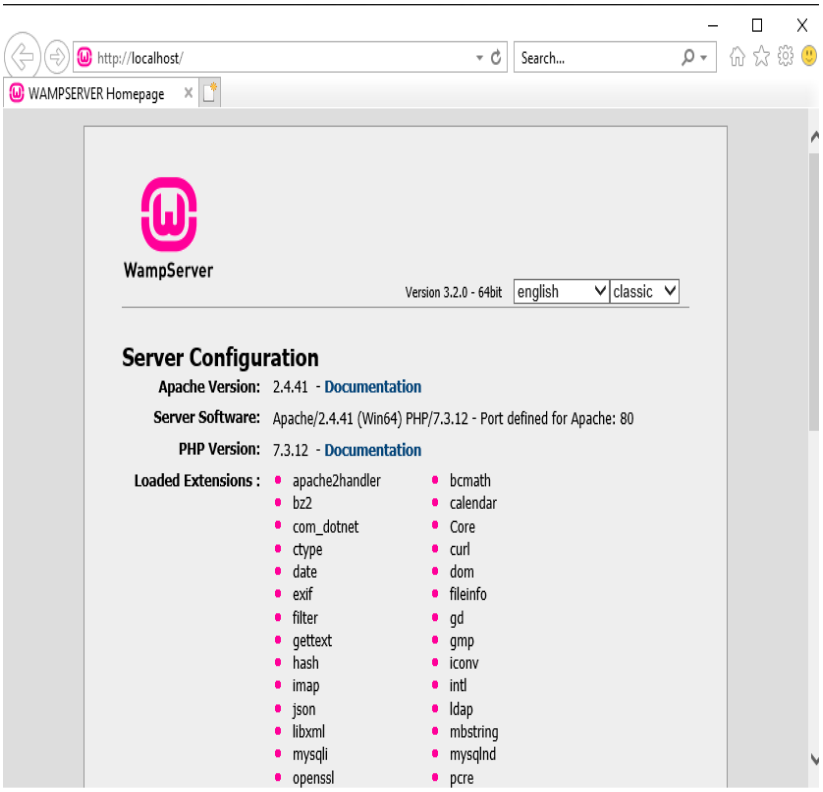


Fig 4 2 About WAMP Server

4.3 Making and Maintaining Databases:

According to the requirements of our project “Deep face recognition and surveillance” we are working with images, we must have to maintain the datasets of those university students that are already the part of our Databases, and those who are not the part of it. For those who the part of it, for them our database should work in a smooth way, there we must save their record as a tuple, with their I’d, name, date time, images and a Boolean yes. For those who are not recognized by our model, we maintain another database where we save Images for them. In MySQL for storing images, we use the concept of datatype BLOB. Because this software cannot save images with the extension of PNG and JPG, So, we save them as Binary file.

4.4 Making tables in database:

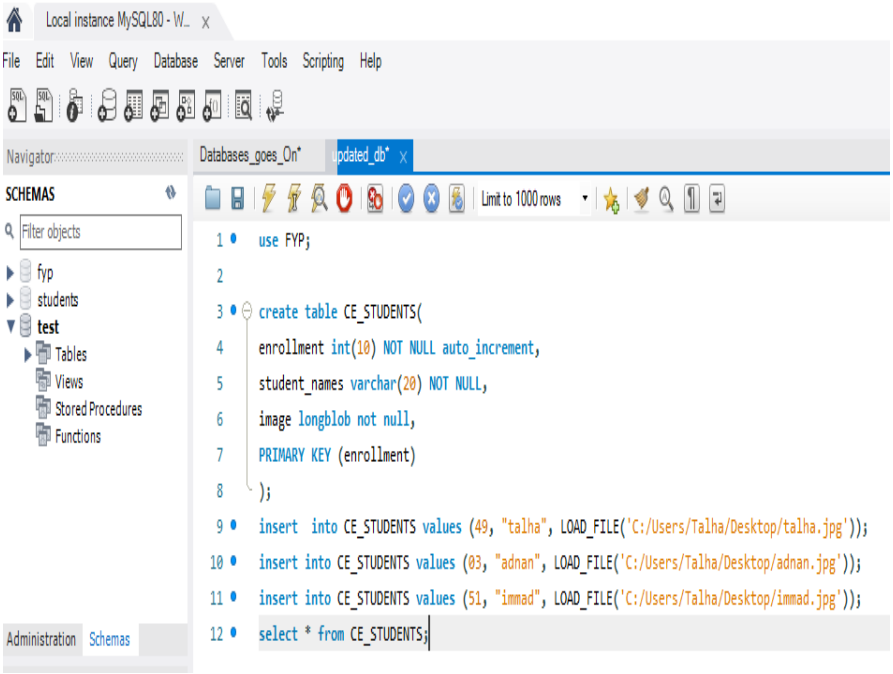


Fig 4 3 Database tables.

4.5 Configuration with Python:

Our last task is to connect all databases with python, for that we firstly install and import some libraries such as IMPORT MYSQL, for it and then by calling some functions we access those data bases and even we can make upgrade those databases from python environments. We are done with all that stuff successfully.

```
def draw_test(name, pred, im):

    face_cascade = cv2.CascadeClassifier('D:/Study/Python stuff/data/haarcascades/haarcascade_frontalface_alt2.xml')
    faces_found = face_cascade.detectMultiScale(im, 1.3, 5)

    if faces_found is ():
        face = "No face found"

    for (x,y,w,h) in faces_found:
        cv2.rectangle(im, (x,y), (x+w, y+h), (0, 255, 255), 2)
        cropped_face = im[y:y+h, x:x+w]
        face = face_recognize_dict[str(pred)]
        ID = face_recognize_dict_enroll[str(pred)]


        today = datetime.datetime.now()
        #print(today)
        print(str(pred))
        #Here we will apply database coding#
        try:
            s = "insert into attendence(enroll_id, name, time, present) values (%s,%s,%s,%s)"
            b1 = (ID, face,today,True)
            mycursor.execute(s,b1)
        except:
            print('ALready present')



    Gray = [100,100,100]
    expanded_image = cv2.copyMakeBorder(im, 60, 0, 0, 0 ,cv2.BORDER_CONSTANT,value=Gray)
    cv2.putText(expanded_image, face, (20, 40) , cv2.FONT_HERSHEY_SIMPLEX,1, (0,255,255), 1)
    cv2.imshow(name, expanded_image)
    return
```

Fig 4 4 Connecting with Python.

4.6 Inserting Images in Database:

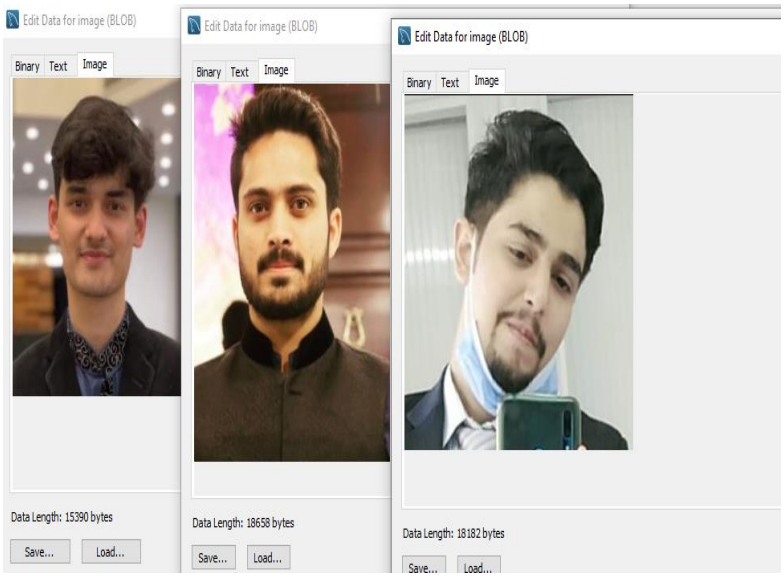
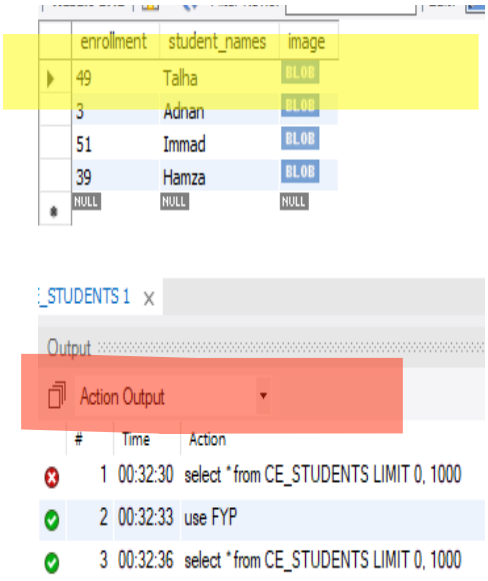


Fig 4 5 Database Images

4.7 Database Output:



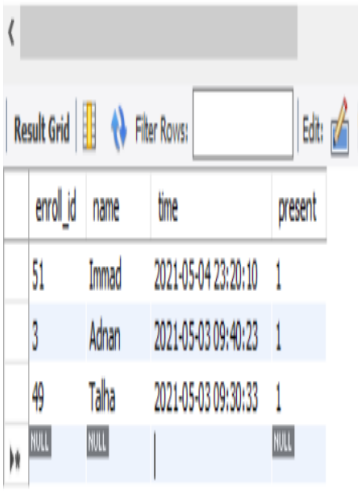


Fig 4 6 Output

As you can see from the figure 4.7, camera is taking the images on real time while database saving the information/attendance of the particular student, whose records are matched with the database. In this way attendance is marked easily of each person.

4.8 Training accuracy:

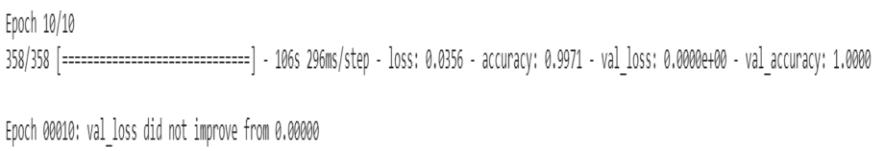


Fig 4.8 Accuracy

After augmentation taking 5370 images for training and 125 for validation of each class. Having epoch size 10 and batch size 16 we got our training accuracy of 99.7% and validation accuracy up to 100%.

Chapter 5

Hardware Requirements

This chapter describes all the physical components of our project and how they work:

5.1 Raspberry Pi 4:

Fig 5 1 Raspberry Pi 4

A raspberry pi 4 have a high performance 64-bit quad core processor, dual display output with two Micro HDMI ports, up to 4k resolution. It is hardware video decoding at up to 4Kp60. It has had 4GB of RAM with dual band 2.4/5.0 GHZ wireless LAN. Bluetooth 5.0, Gigabit Ethernet USB supported up to 3.0 version and having POE capability.

5.2 Raspberry Pi 4 (Power Supply):

Fig 5 2 Power Supply

As we raspberry pi 4 consumes high power, so it required a minimum 3.0A USB-C power supply. As we are using 5.0A of power supply according to our project requirement.

5.3 ETHERNET Cable:

Fig 5 3 Ethernet Cable

For communication purposes we require a Ethernet cable. We will use this cable for using the internet. We can also communicate with other desktop Pcs by using this cable.

5.4 SanDisk:

Fig 5 4 SanDisk

For fastest communication with the memory of raspberry pi 4, we are using SanDisk memory card of 32GB. It can read 100Mbps and writes at up to 90Mbps and has labeled it with a UHS rating of 3. Its video speed ratings are 30 and application speed ratings are up to A/1. As we must deal with images on real time, this card provided us with best results according to our project requirements.

5.5 Camera:

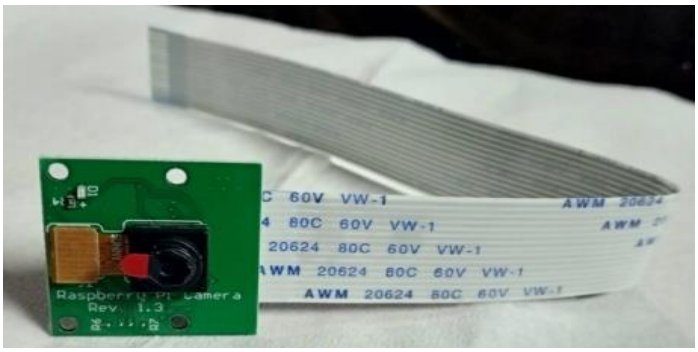


Fig 5 5 Camera

We are using Raspberry Pi 4 default camera for our initial work, later we will use the USB port advance camera if we don't get the good results from the default camera of RASP.

5.6 LED Tv HDMI:

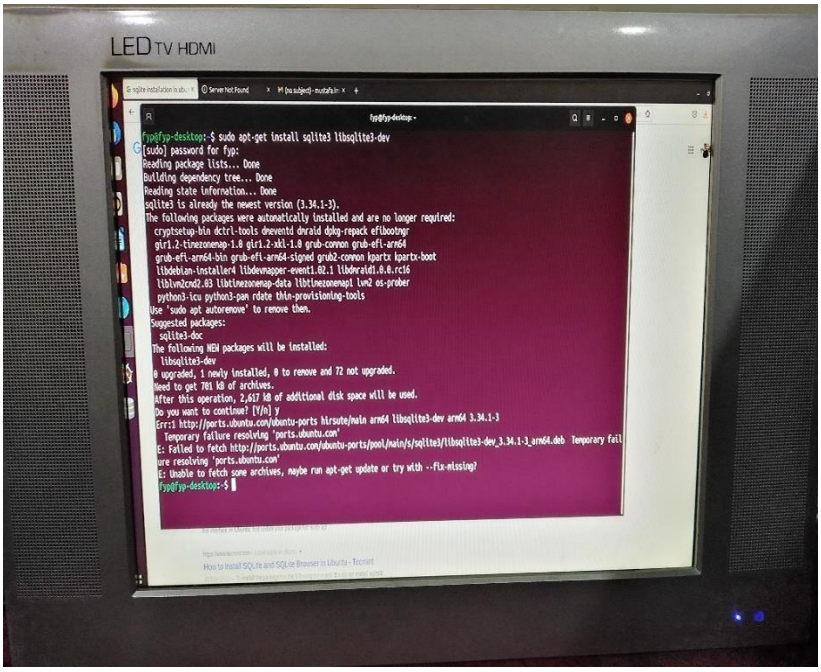


Fig 5 6 LED

We are using LED TV connecting the Raspberry Pi 4 with HDMI cable. We are using this because it gives quality resolution as we needed for our FYP. Most important thing is that it is very cheap and less expensive, every layman can afford and use. We can also use USB port for direct connection of keyboard, mouse and many other peripherals devices can be attached easily, which is a big advantage to us.

Chapter 6

Graphical User Interface (GUI)

This chapter describes the full implementation of our GUI with hardware and software. Below is the brief explanation regarding the GUI.

6.1 About the GUI:

Basically, GUI is just like the desktop app which provides the us with an interface that helps the users to interact with the machines, computers and enlightened us with the command line input to our code. These GUIs are used to perform the different kind of tasks in our desktops, machines, laptops, and many other electronic devices etc.

Some applications where the GUI are widely used such as:

1. Creating the Calculator, where the user interface is very important to perform the different functionalities.
2. We need GUIs for the text editor, ide's for coding the GUI App.
3. We need GUI in games.
4. Chrome, Firefox, MS-Edge are also controlled and used by the help of GUI

For making the GUI we have two options, one option is creating the GUI by using the Tkinter Package and the second one is by installing the PyQt Packages in python.

6.2 Preparing the Libraries for the PyQt-Designer:

PyQt is the most famous platform python unbreakable while implementing and importing the Qt library for the Qt-application designs. Currently, PyQt is available in many famous operating systems like Linux/Unix, Windows, Mac OsX. It is a great combination with PyQt with Python which provides the facility to the programmers to make and create a program by writing the python code or by using the Qt-Designer to create the GUIs.

For making the GUI on designer we have to install the PyQt libraries and its required packages. For this we simply use the anaconda command prompt, after this when it is opened, we have to write the pip install PyQt5-designer in the command prompt. Command

prompt automatically install all the required packages for the PyQt tools and its applications. As you can see below:

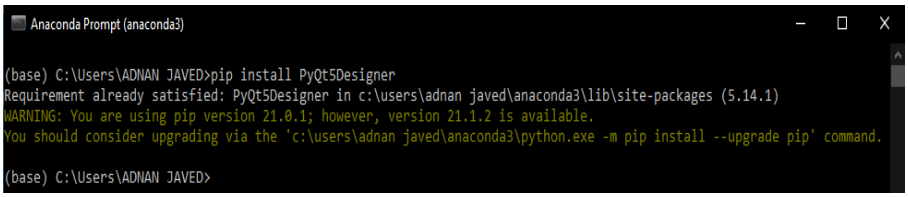


Fig 6 1 Designer Packages

After this you have install PyQt tools, by using the pip install PyQt5-tools, as below you can see:

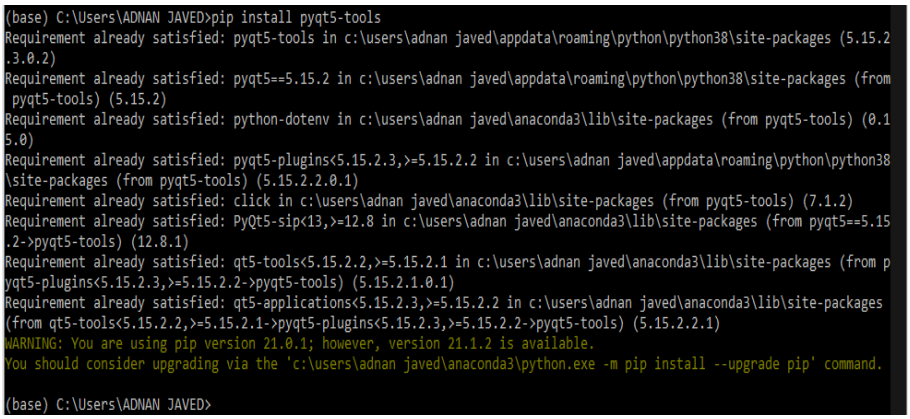


Fig 6 2 PyQt5-tools

6.3 Launching the PyQt-Designer:

As previously all the required packages are installed. Now we can launch the designer, for this we must find the Lib and site packages folder where it is installed, once we found it, we can launch this from the Qt-Application where designer is present like an app. After this we can launch and below you can see the main window of the designer, from where we can create GUI just by dragging and dropping the buttons, icons, main-display screen where we will show the camera in it.

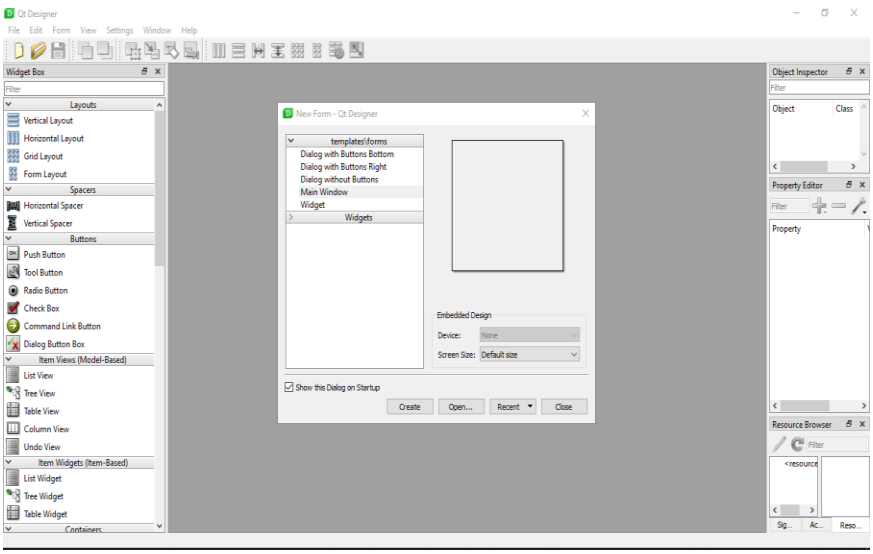


Fig 6 3 Qt-designer

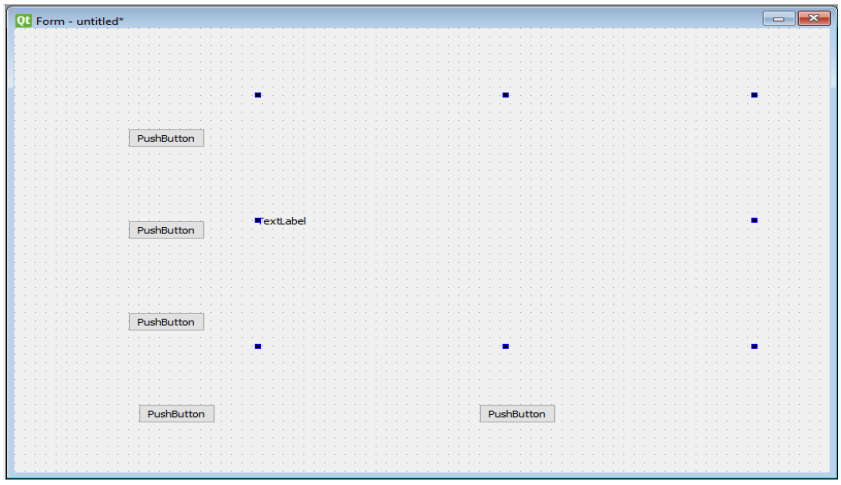


Fig 6 4 Qt-designer

6.4 Creating the GUI on PyQt-Designer:

Now our designer is working properly, by dragging and dropping the buttons, icons, screens, labels, frames, and text browser, we have made our GUI as you can see in below image:

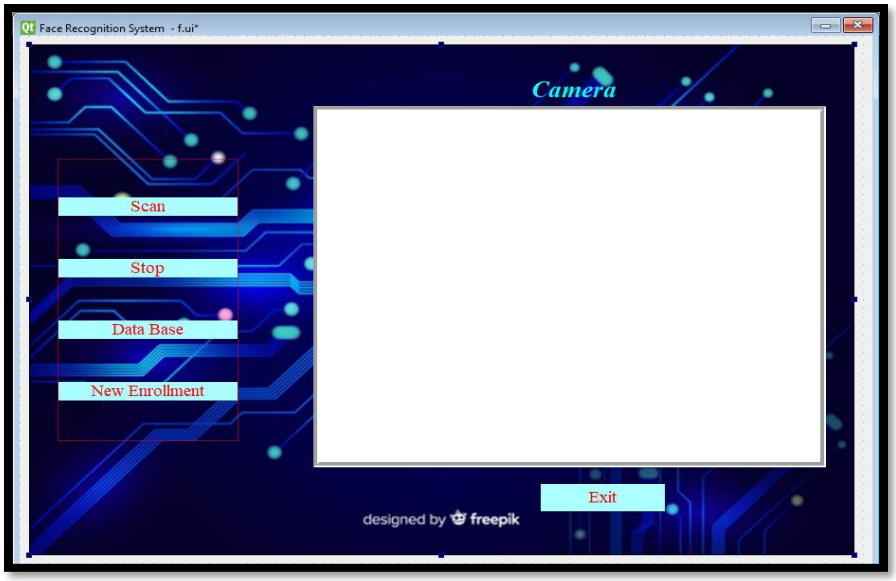


Fig 6 5 GUI

Above is our GUI which we made on the Qt-Designer. From this GUI admins can control and manage all the activities by simply using the Desktop app which we had made. It is very easy use and manage, any layman can be used this GUI.

6.5 Conversion of .UI file to. Py file:

Once our GUI is created, the next step is to convert the .ui file to .py file. As we have faced many problems like ours .ui file is not supported by the python software. For this we have converted the ui to py file by using this command: pyuic5 -x “path-filename.ui” -o “path-filename.py”

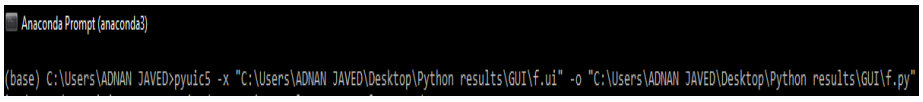


Fig 6 6 Conversion

Chapter 7

Software and Hardware Implementation:

In this chapter we will briefly explain, how we deployed and implemented our project on hardware and software level. We will discuss the approach and their result analysis. We faced many difficulties during the hardware implementation. Sometimes we faced, that hardware is not supporting the software, but we managed to resolve this problem. Below we will discuss how we implemented hardware with respect to the software.

7.1 Prerequisite:

As we already discussed about the hardware requirements, first we attached the Raspberry pi, its required components with each port and connected it with the LED-TV. By default, raspberry software is installed in it.

7.1.1 Operating system installation:

As we know by default Raspberry pi had Raspbian operating system installed in it. But we need the Ubuntu-64 Bit operating system. So, we uninstalled the Raspbian operating system, after this from laptop windows we downloaded the ubuntu in our Sd-Card. We made the Sd-Card bootable for the raspberry pi, so it managed to pick the Sd-Card as default boot device. Now raspberry will automatically read the Sd-card and start installing the ubuntu-64 Bit operating system in it. We have to wait about 25-30 minutes for its complete installation. Once it installed in it, it will be ready to use. Below figures will clear more about the ubuntu installation process:

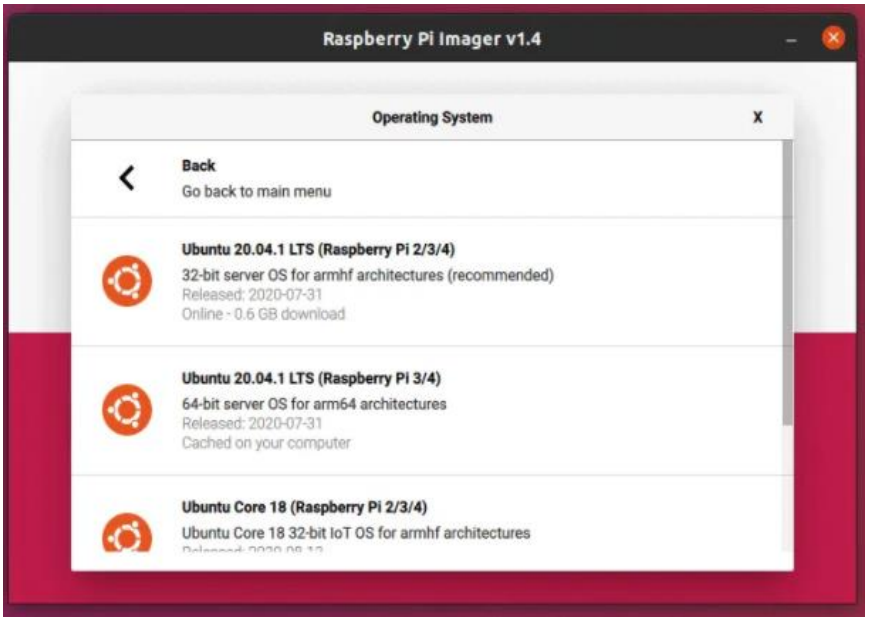


Fig 7 1 Ubuntu Installation

Fig 7 2 Ubuntu Installation

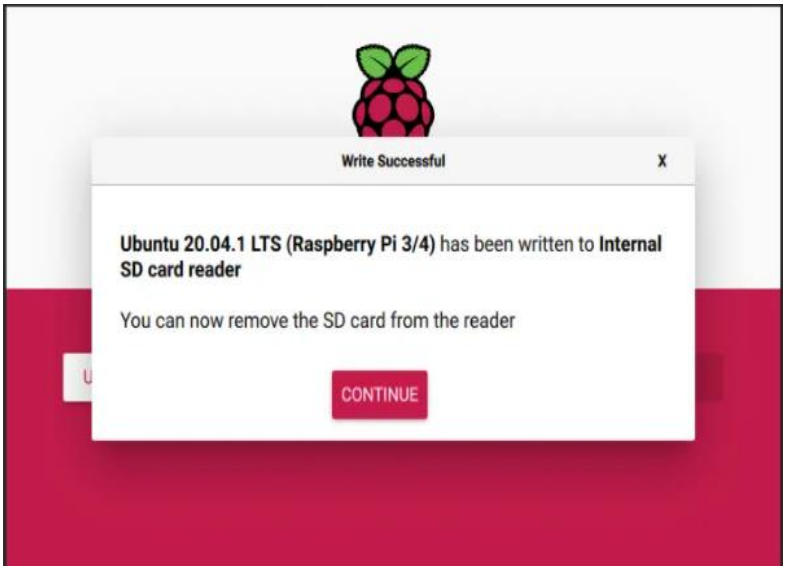


Fig 7 3 Ubuntu Installation

- In below figure you can see ubuntu is installed successfully in raspberry pi:

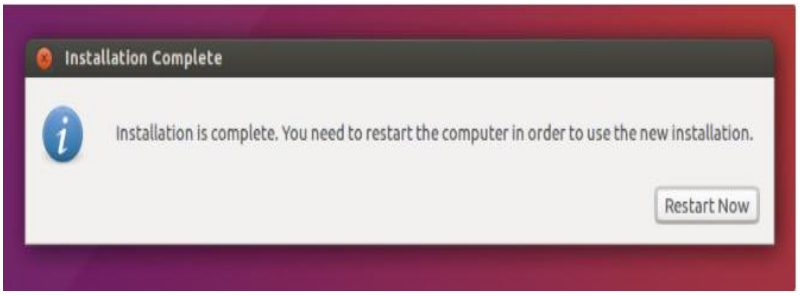


Fig 7 4 Ubuntu Installation

- Now the ubuntu is successfully installed in it and ready to use.

7.1.2 Anaconda Navigator installation:

Now we have to install our main tool which is called anaconda navigator. This tool contains the set of different python software's, which are used for different purposes. Our main concern is that we have to use Spyder tool which is our main platform where we done our final year project coding. The unique thing of this tool is that some packages are already installed in it. For some outsource packages we can install them easily by using the command terminal, which is available with the anaconda navigator.

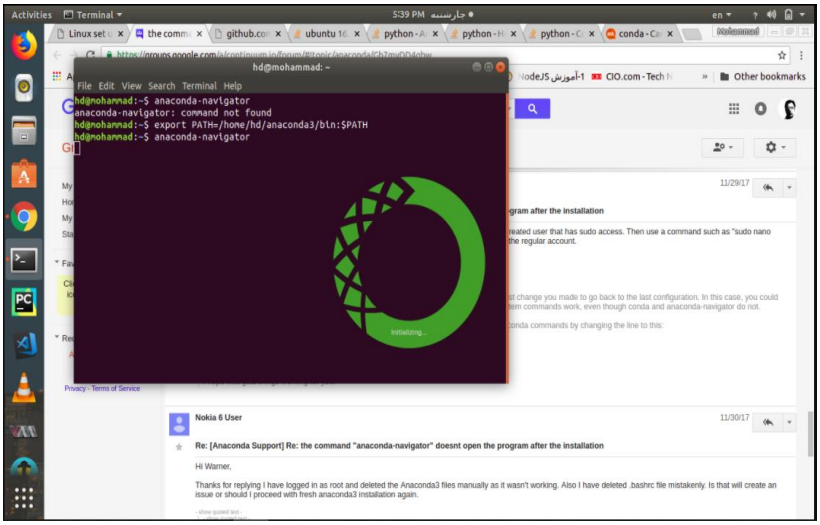


Fig 7 5 Anaconda Installation

Above you can see the ubuntu in raspberry pi, installed and running successfully. This all is done by the terminal which is available with the ubuntu.

7.1.3 Libraries installation:

Once the anaconda navigator is installed in ubuntu, now our next step is to install library packages. We must install the Deep Learning Packages as anaconda do not have these outsource packages. For this we will simply go to the terminal of ubuntu. Once the ubuntu terminal is opened, our next step is to install the packages through this terminal by simply giving the:

sudo apt install python3-pip

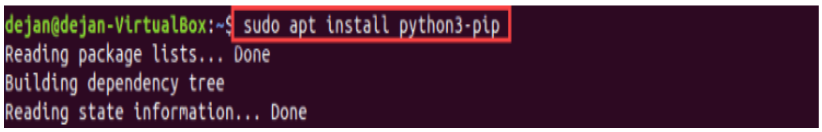


Fig 7 6 Pip Installation

Above you can see python3-pip is install is successfully. Now we can simply use pip and install all the required packages. Following are the main packages we will install for our project:

1. TensorFlow: sudo install pip install tensorflow

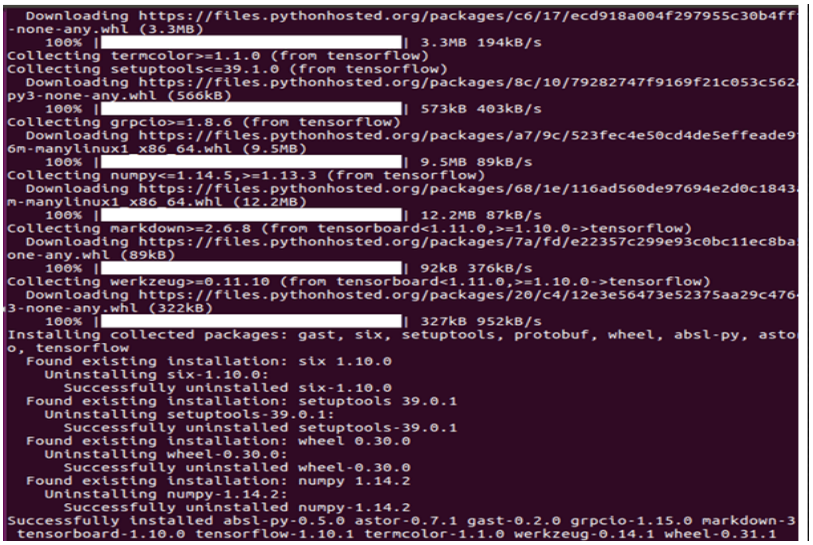


Fig 7 7 TensorFlow Installation

1. Keras: sudo install pip install keras.

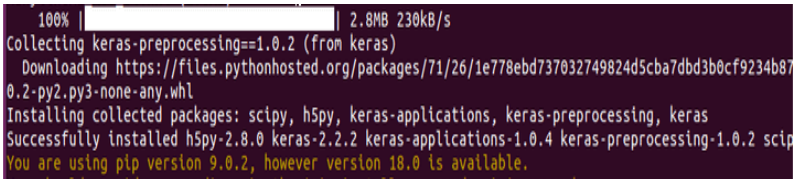


Fig 7 8 Keras Installation

7.1.4 SQL-Lite3 installation:

Once we done with the required libraries, our next step is to install the SQL-3 in our ubuntu operating system. As previously we worked on the Wamp server on windows, but for now we will use Sql3 in our ubuntu. The reason is that SQL3 is more fast, efficient, and easy to implement on hardware and software level of Raspberry Pi. SQLite library is made on C-Language. SQL database engine are mostly used in the world. SQL is built in many mobiles, computers, and by default present inside in many other applications which is used by many users. The SQL file-format is very durable on many cross-platforms, especially it is very compatible on raspberry pi and on many other devices. So, we preferred this platform for making and saving all our real time dataset in the SQL-3 database.

We can install SQL3 in our environment by using this simple command which is below:

Sudo apt-get install sqlite3.

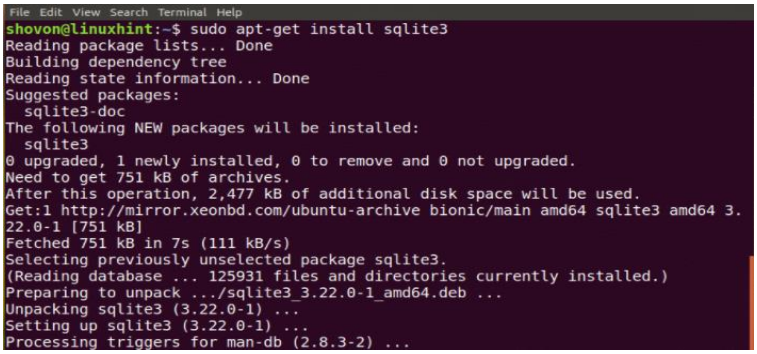


Fig 7 9 Installation

As you can see from the above figure, SQLITE-3 is successfully installed in our hardware and software environment, and ready to use for making the database.

7.2 Complete hardware and software Setup:

In above sections we already discussed in detail about the hardware and software integration. How they will be linked with each other on raspberry setup. Now here we will show you the complete hardware and software in working condition by the figure, which is given below, all the hardware and software part is working properly:

Fig 7 10 Main Desktop

7.3 Full working of product with attendance and access control:

From the base of the previous sections, our product, which is attendance and access control system is ready and can be used in any organization new system. In below figures we will discuss and show you how this product will work and give used:

- This is our main desktop app as you can see having different buttons and will be controlled and by the admin.

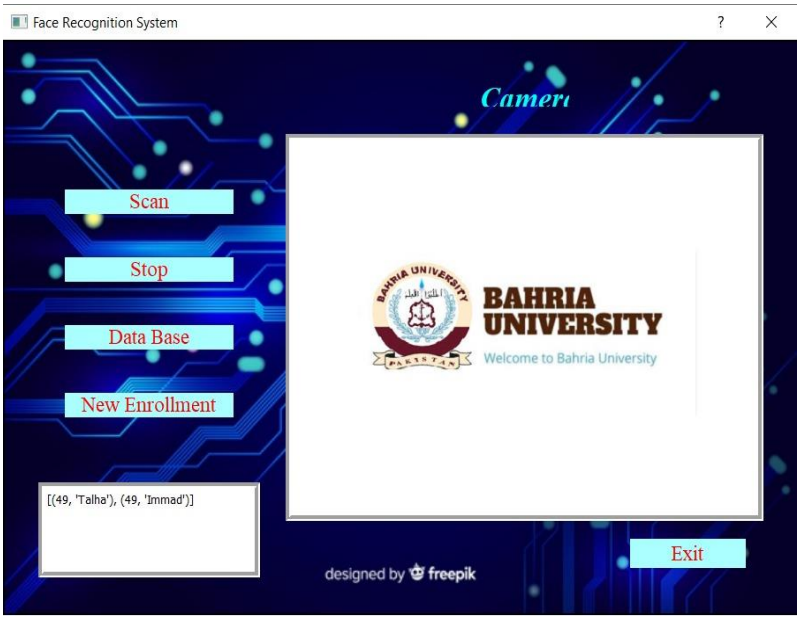


Fig 7 11 Main Desktop App

- When you press the scan button, camera will be turned on and start scanning the faces.

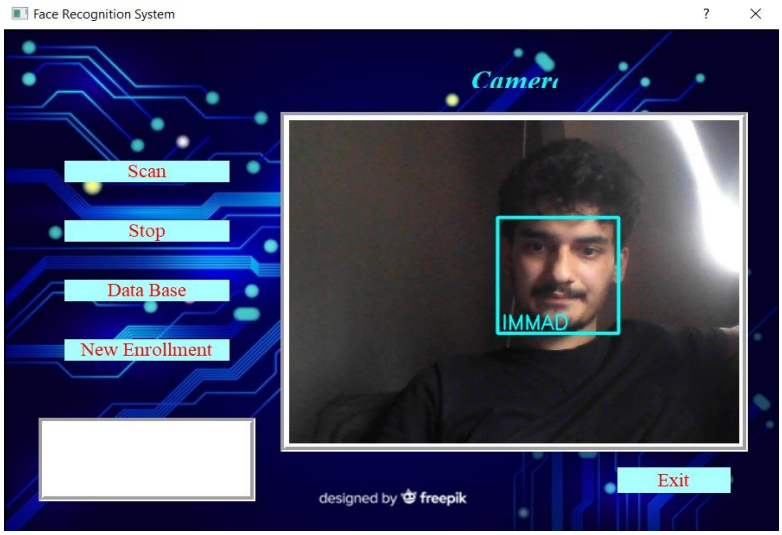


Fig 7 12 Scanning start

- Once the scanning is completed, we also stop the camera, you can see a pop-up box will appeared.

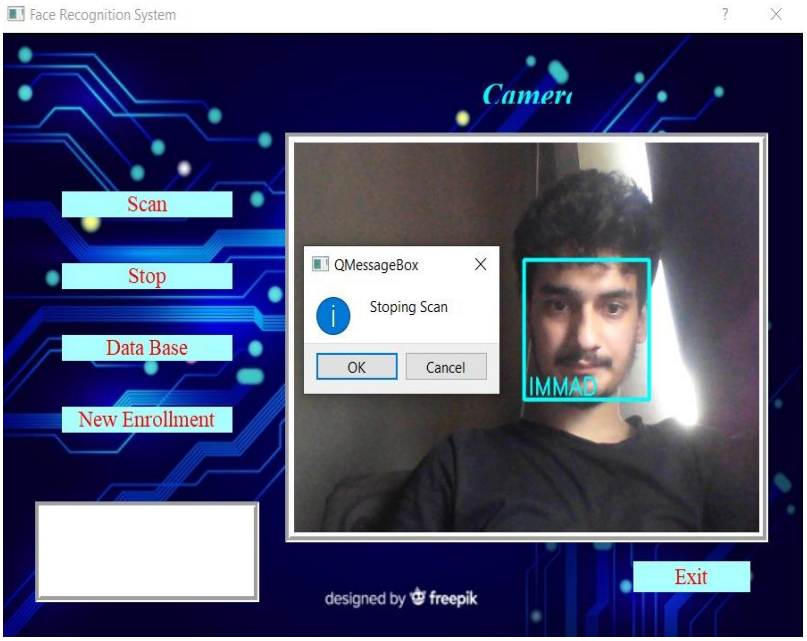


Fig 7 13 Stop Scanning.

- When you [press] the New Enrollment Button, it will be turned on the camera and start taking the dataset of the new admitted students in university/organization. Below you can see:

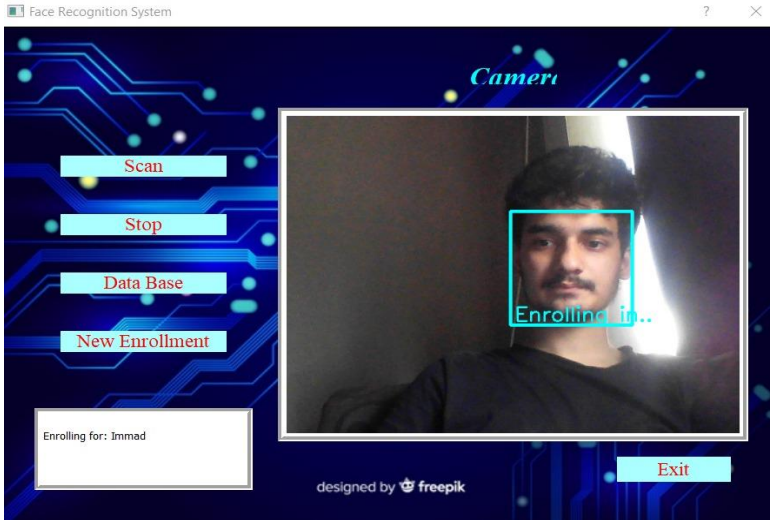


Fig 7 14 Enrolling Start.

- When the required dataset is completed, a pop-up message will be appeared with the notification of “Enrollment Complete”.

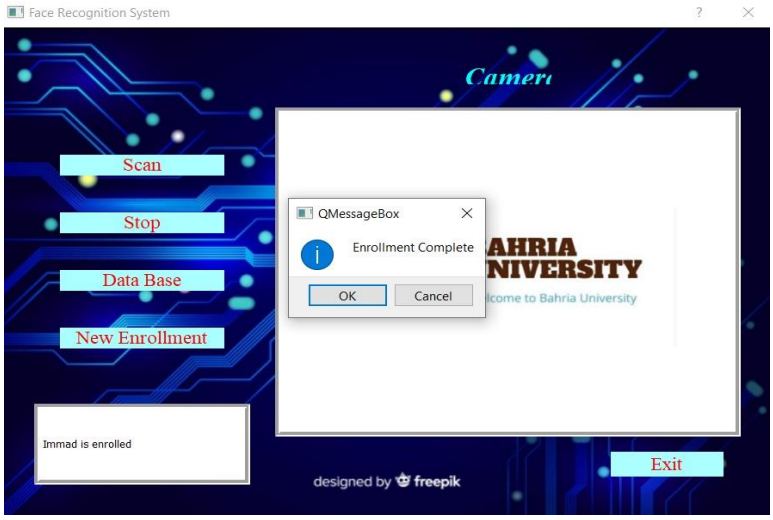


Fig 7 15 Enrollment Complete.

- Here you can see once the enrollment of new student is completed, our system will start recognizing the new admitted students, and give their face, date, and time in our database. Below you can see:

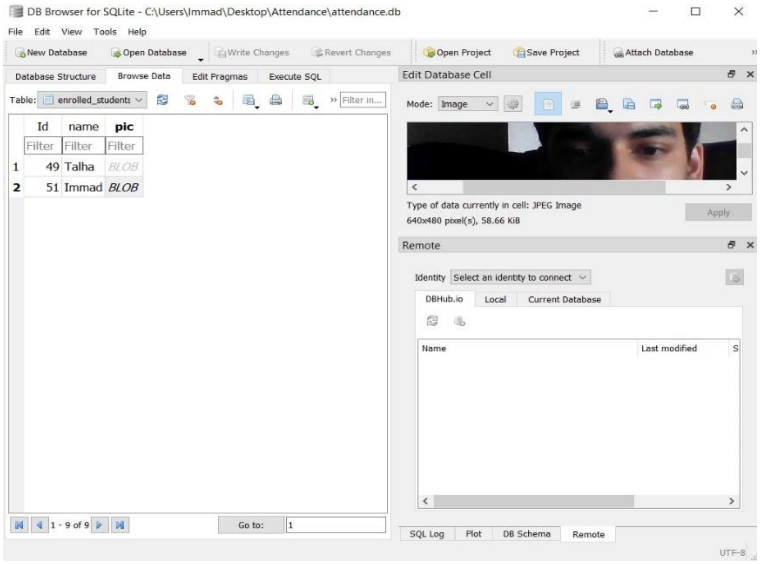


Fig 7 16 Enrolled Student table in SQL3 database.

- Here the table of present student will be open, when you press the Database button from the main desktop app. Below you can see the results:

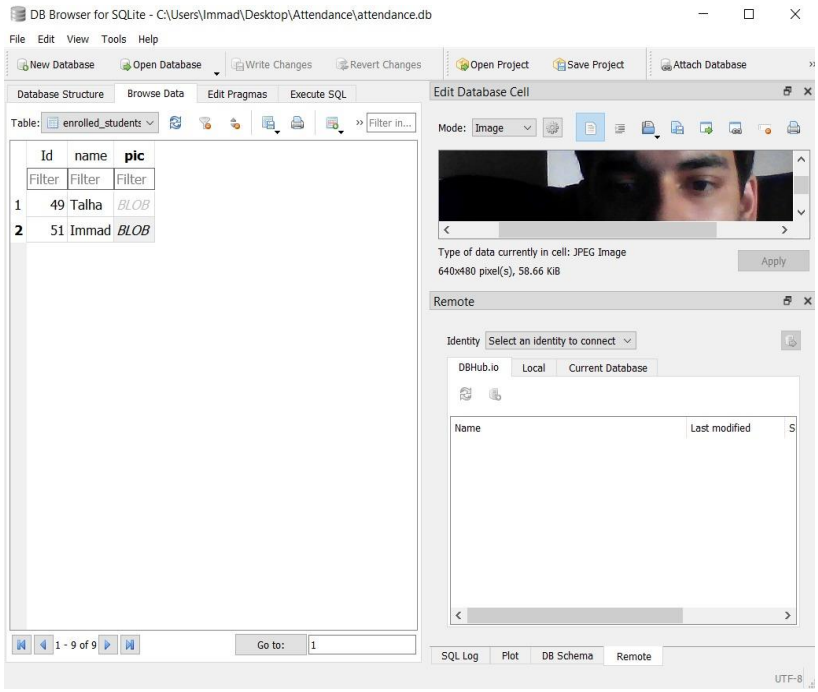


Fig 7 17 Present Student table in SQL3 database

- Our face recognition attendance system is so smart, it can also detect the unknown persons, if someone try to enter in the organization. Below figure we show the output:

Fig 7 18 Unknown Student

From the above section, you can easily understand the complete working of Face Attendance System. We have completed this project on product level.

Chapter 8

Conclusion

In this chapter we will discuss the results of the project. Here all the information is repeated from the previous sections of the reports.

With the supervision of Engr. Waqar Tanveer at the Bahria University Islamabad Main Campus, a face recognition attendance system was built and tested on the different platform. The Raspberry pi 4 kit was chosen, and each component were fully interfaced, tested, and verified to be working properly. Similarly, we use Anaconda Navigator and perform the coding part on the Spyder (python3.8), all the required libraries were installed timely. We have tested and imported all the packages for the satisfaction. We installed ubuntu 64-bit operating system in the Raspberry Pi 4 and integrated our software part with hardware by using this environment. We done the fine tuning, data augmentation and especially the training on Google Collab, to achieve the maximum accuracy in recognition and detection between known and unknow identities. We are using the 32-Gb SD card as a memory of Raspberry Pi4 for storing the whole project. A maximum 15 Gb of space is used. A USB camera relates to ports of Raspberry Pi 4 for taking the images as an input and also for the recognition purposes. A GUI is created on the Qt-designer software. The purpose of GUI is to provide a desktop app for controlling and managing all the activities regarding attendance, new enrollment, and scan and stop the camera. This project required members not only to integrate the hardware and software part, but also exposed the training, testing, recognition, detection, and programming tasks and to make the reality of project management to accomplish the project objectives.

Chapter 9

Future Scope

Today, in my fields if we observe that face recognition system is mostly used for the security. Face recognition is very useful technique that can helps in law enforcement for finding the criminals and many software companies are developing these kinds of technologies to promote the users to access like these secure systems.

In many other venues we can use these technologies like we can use in ATMs, accessing confidential files or other kind of sensitive stuffs. This can help us to improve our passwords and keys more secure.

Many new innovators are seeking to implement the facial recognition system in many subways and other transportation outlets. They are promoting this technology to use our faces as credit cards to pay our fees. Instead of going to the ticket box for buying the ticket for a fare, the facial recognition system would take the images of your face, after this it will passes through the FR system, and will deduct the money for the fare from your account.

As the world is using facial recognition technology and taking full benefits from it. Why should Pakistan be left out from this. There is a tremendous scope of this technology in Pakistan, especially it can help the country in various fields. This technology and its applications can be implemented in different regions of Pakistan if government supports the Engineers.

- Reporting duplicate voters in Pakistan.
- Visa and Passport identification can be done by utilizing this technology.
- Verification of the driving license can be done using this approach.
- In military, airports, and many other important places, this technology will lead and make sure the full surveillance and security.

- This technology can also be used in the examinations, like ECAT, NET, UET, NTS, MBBS, IT, SSC, and many others, where identification of candidate is priority.
- We can use this system in many government offices for the attendance tracking purposes.
- Identification and verification of authentication of various users, where they have bank lockers and vaults.
- Police can use this system for the tracking and tracing the criminals.

As you see above, this is the future scope of face recognition system in an upcoming year. This technology will be growing and spread in each country. And we are also planning how to make a new change in our country by visiting, observing the needs, and making surveys.

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ABBREVIATIONS

DCNN: Deep Convolutional Neural Network

RNT: Res-Net 50

FRT: Face Recognition Technique

PCA: Principle Component Analysis

NN: Neural Network

DBMS: Data Base Management System

CN: Convolutional Network

FT: Fine Tunning

CV: Computer Vision

RASP: Raspberry Pi 4

FD: Face Detection

GUI: Graphical User Interface

AI: Artificial Intelligence

UB: Ubuntu-64 Bit

APPENDIX

- Anaconda Navigator
- Python Coding
- Database Coding
- Code Deployment
- Google Collab
- GPU/CPU
- Jupyter notebook
- I-python
- Ubuntu
- Tkinter
- Keras
- TensorFlow