Automatic attendance system using facial recognition

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A thesis submitted to the Department of Computer Science and Engineering
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Declaration

It is hereby declared that

1. The thesis submitted is my/our own original work while completing degree at BRAC University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. We have acknowledged all main sources of help.

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Ethics Statement

We, hereby declare that this thesis is based on the findings of our research. All other materials used have been properly noted in the document. This work, neither in whole nor in part, has never been submitted by anyone to any other university or institution for the award of any degree.

Abstract

Artificial Intelligence has brought revolutionary change all around the world proving its effectiveness almost in every aspect. AI is not only a science-fiction dream anymore, but also a constant part of our everyday lives. At present, computing is widely used to work smart and precise by eradicating human error and physical labour. An a System that will be recognizing face autonomously is a practical application of AI which made life much easier. After we face the camera, it'll Capture our photo and send it to the system, to check the database. If the system finds a match, it autonomously check that person's attendance as present within the table and stores it in the database so that we can view the current version of the attendance sheet. Throughout the paper we mainly used a Convolutional neural network and pretrained FaceNet model and we got an accuracy of approx. 94.85% using 100 different images. This paper proposes a quick face detection algorithm supported by a classifier, Support Vector Machines (SVM) which we used to separate more non-face regions from the taken image. Face is identified by detecting eye and mouth region. The results demonstrate that the accuracy of the detection can be improved further by cutting down false detection.

Dedication

We would like to dedicate this research work to our dearest parents. Beyond their absolute support and motivation, we could not have succeeded this far.

Acknowledgement

To begin with, all praise to the Great Allah for whom our thesis has been completed without any vital interruption. Along with, we would like to thank our honorable and conscientious supervisor and co-supervisor Hossain Arif and Faisal Bin Ashraf sir for his kind support, guidance and feedback in our work. He motivated us to conduct this research and always gives his valuable time to make us understand the research works. Furthermore, We would like to thank our respected BRAC University for providing important resources and facilities during our research phase . To conclude, a big thanks to our parents without their perpetual sup-port it may not be possible. With their mention-able support and prayer we are now on the brink of our graduation.

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Chapter 1

Introduction

Regular attendance in school, college describes the consistency of a student to their studies, it is considered to be a powerful predictor of student outcome. Manual and mostly used method of taking attendance is calling students by their names and marking present in paper Which is time-consuming and grueling. To skip this problem the proposed system will detect the student's face and after recognizing will mark them present automatically. In the period of technological advancement manual attendance-taking procedure is a waste where the proposed system can make the procedure hassle-free and automatic. Image processing has been used in a wide range and recognition of the face is a part of it. Recognizing a person by a unique feature falls under biometric; these features can be Irish, fingerprints, face. Again the face of a person out of all faces gives the most unique feature. Along with that, this system will assure practical solutions which will minimize human error and student proxies. In the proposed system, convolutional neural network CNN is used to analyze visual representation in deep learning.Now for a classifier support vector machine (SVM) is used along with that For face recognition, faceNet is used which is dependent on CNN. After combining all these deep learning methods the proposed system will be created. This system will save both time and energy as it won't take more than 12-15 minute for attendance of approximately 50 students. Now with this system, this time can be used in more productive work. where each student will only have to stand before the camera for a few seconds and it will automatically mark them present in their respective excel sheet which will mark them present. More precisely this whole procedure will be human error-free.

1.1 Research Problem

Attendance in classrooms or anywhere is always a chaotic experience for both teachers and students or anyone. In this pandemic situation online classes or online meetings became a general thing in online platforms. Recently some online platforms like ZOOM, Google Hangouts, Google Meet, Skype became so popular that people are using these platforms in their daily activities. Some of them are used to take classes for educational institutes. Some institutes held mandatory classes in which students had to attain. Some of the students who don't want to attain classes may put their photos in front of the webcam, so that the teachers may be unable to trace their bluffs. As far as physical classes teachers had to do it manually to check students attendance. Which is an extra hassle for the teachers. If the class room is large

like a hall room or a gallery room students may not be able to hear the teacher while calling names. In the corporate world most companies have a fingerprint entry system. Which is time consuming while someone is in a rush. If we use facial recognition technology in the corporate world they can save more time and people will not need to touch any fingerprint scanner for attendance in this pandemic where we all need to maintain a minimum social distance.

As a result, we hypothesized that by using machine learning to create a system, we could reduce these bluff activities of students while also reducing teacher workload. The methodology will result in a browser extension for online platforms as well as software for physical classes or corporate companies that will use face recognition to automatically identify students or employees.

1.2 Research Objective

Our main intent of this paper is to create and build a system that identifies a person by their face and it has to be done by their image , videos, and real-time.

In advanced human-computer interface and security cameras, facial recognition technologies have been widely used. It also used for automatic indexing of images, taking attendance and so on.

it is also used as a medium of security for example most of the mobile phones have face detection lock system , facial recognition can offer smart and time saving services allowing us not to worry about keyboard combinations or badges.We are aiming to make that service more seamless, friction less using deep learning.

In general the process will be taking photos and matching with the database. This whole system will be designed with the help of CNN, SVM and FaceNet model mostly ; improving their detection accuracy furthermore.

1.3 Thesis Structure

Chapter 1 - Introduction where motivation, problem statement, research objectives and contribution are discussed.

Chapter 2 - Related works where background, literature review and algorithms are discussed. In the literature review part, we reviewed the previous work on violent and nudity image detection.

Chapter 3 - Our Proposed Approach, here it discussed about the workflow and our methodology to detect faces for taking attendance.

Chapter 4 - Experimentation where we discussed about the codes used in our research.

Chapter 5 - Result Analysis and Data Visualization, where we visualized our data and analyzed the result occur-ed from our algorithms.

Chapter 6 - Conclusion and Future works where the conclusion consists of our work till now and future works include the scope of improvement.

Chapter 7 - Bibliography

Chapter 2

Related Work

2.1 Literature Review

In [33], The Authors provided a overview about bio metric face identification. Face detection algorithms based on facial characteristics and LSVM were reviewed by the authors. They demonstrated deep learning-based methods by using skin color regions to pick samples and detecting zones. By recognizing the eyes and mouth, this technique is an effective way to identify face candidates. Furthermore, the wavelet transform compresses the sample images, and the discrete cosine transform extracts and reduces the sample feature vector, reducing the SVM classifier's training difficulty and matching times. The authors show lsvm helps to refine the detection rates along with that it minimizes the rates of faulty face detection moreover it increase detection rate.

In [32], The Authors proposed a system that takes attendance automatically which willuse in academic institutions and it would genarate more precisd result compared to the handmade attendant paper by Aligned Face Dataset. Firstly the added MTCNN next to Extract face embeding and notting they used FaceNet. they achived very high accuracy but for taking challenge they turn dowwn their dataset but it result didnot get any lower sucess rate than before it was as it . Authors also shared a view of utilizing CNN method along with that they used a model which is already trained called Face net , this whole system assures detection rate aroun 98 percent among 100 faces which are not simmilar to each other .

In [7] the paper shows three different methods of facial recognition. Here, the authors try to show the comparison among the methods with various experiments like comparing different sizes of training daa average running time etc. Based on the comparison an acceptable identifying Sucess rate and the great runtime speeed will be achived. Although LDA has lower recognition accuracy than KNN and SVM. Where SVM has higher recognition accuracy about 95 percent but has much slower running speed than other classifiers. However, KNN assure a moderate level of bot run time speed and identifying Suceess rate .

In [29], this paper the author proposes a system for face recognition using both machine learning and computer vision. This mainly worked on these three different methods which are used as classifiers to evaluate the outputs. As inputs were taken

through camera which could be a reason for accuracy decrease in the evaluation. With real time inputs the performance accuracy was around 56 percent for both SVM and MLP and around 89 percent for CNN. This study showed that high level equipment is needed for better accuracy in face idntification.

Depending on the ideologies of CNN, FPGA is introduced in this paper [9]. The algorithm is divided into two parts ; getting the network parameters and building the face recognition system on the FPGA. Because of its weight sharing structure CNN works effectively to image classify based on Image dimensionality reduction, CNN makes huge data for using in face recognition field through a series of methods. Here MATLA is being used to devolop training module including CNN initialization unit, where CNN is divided in to training unit and CNN test unit. here basic parameter are being set and through the CNN training unit, the collected data sets are trained. The usage of the CMU-PIE face database hides the worse pararmeters , allowing to improve the robustness of the network. From the datas it's quite visible that the face recognition network designed by this paper occupies less resources and power consumption. error rate most of the times depend on the number of time it is being trained which is more accurate than that of human eye recognition. In spite of its feature of increasing the computation speed , it is relatively difficult to use an FPGA to design a deep learning network for face recognition as no improved results are found from previous research.

In [3] Arsenovic et al. describes a new way of facial recognition through the usage of state-of-the-art methods and advanced machine learning. The author further mentions how low cost bearing the system can be to the potential users using the method as an alternative to other security measures used in schools,hospitals, etc. The method consists of 4 steps where the user's face is detected, analyzed and then matched with the initial database to get a proper match for the intended person. CNN, Facenet and linear support vector(SVM) are used throughout the process with python codes running in the background.The initial dataset produced an accuracy of 95.02 percent using advanced CNN and multiple python scripts. The accuracy can be increased if the blur of the image and saturation is controlled to a certain degree to make the machine detect it more easily. The system can be a good alternative to RFID,security cameras and fingerprints as it is cost efficient and doesn't depend upon the GPU which in retrospect is a very good potential for the underdeveloped and developing countries.

In [16] Khan et al. implemented a convolutional neural network(CNN) that is known as AlexNet which creates different layers of the face in order to detect and trace it simultaneously. It is a deep-learned multiple layered model which creates an image of the person and then matches it with the existing database for a match. The margin of error is very minimal as the accuracy recorded is very high. It works in 4 steps applying CNN, Haarlike features along with MATLAB to comprehend the calculation of the system. There are multiple layers in the CNN or AlexNet where it detects the distance between the eyes and many more details to comprehend a better study of the face detection. The initial dataset contained around 1000 images and was made into batches of 10 which created an accuracy of 97.95percent . It is a very reliable and good alternative from the pre-existing techniques which makes

Facial Recognition more usable and accurate.

Biglic et al in [6] compared VGG Face deep learning model with Multi-Layer Perceptron (MLP) classifier and reduced deep features by principal component analysis which is suggested by the author. After verifying 40 individuals with different facial expressions and lighting conditions it's found that VGG face deep learning has a 97.8 percent classification ratio on the other hand MlP classifier and reduced deep feature by PCA have 100 percent recognition accuracy. After experimenting it has been found that VGG face deep learning by CNN has better performance on face recognition in a different light, expression Whereas MLP by PCA has better performance in terms of dimension reduction in deep learning.

Patil et al In [26] proposed a system that will track down the attendance by making use of facials recognition Where Viola-Jones and HAAR Cascade algorithm.is used for face detection of the students.LDA, SVM, KNN has been utilized as a feature selection and recognition. For experimenting a dataset has been created with 5 students and 30 pictures of each student in different lighting conditions and dimensions of 92*112 . Viola Jones is a framework for real-time image feature detection, where LDA is used to decrease the amount of features utilized in a classifier. SVM and KNN are the classifiers, and when compared individually, KNM+LDA outperforms SVM+LDA in terms of precision, recall, and accuracy.

In [17] Kim et al. proposes a system using machine learning that can classify facial expression and then further classify in many layers. This is detected by Haar-like features. The face is first detected with the help of ROI arrangements. The facial expression is then matched with SVM labelled as HOG is then used to match the person's expression. The expressions were then matched to see the extent of accuracy. The experiments that were conducted resulted in better accuracy than the conventional methods. The ROI procedure indulged in the FER machine can result in a good and appropriate alternative as it gives higher and better input than the conventional methods. The initial dataset scores set a great example to be used in school, traffic systems, etc.

In [22]T. Nyein and A. N. Oo states today human face recognition is an important and commonly used technology in a variety of applications such as facial recognition payments, facial recognition unlocking, and video monitoring systems. The traditional method of attendance is to record student attendance on a sheet, which takes a long time. As a result, we use systems such as automatic attendance to solve problems such as wasted time and improper attendance. This is a computerized system that uses facial recognition technology to record student attendance. It hit a new highest in accuracy of 99.63. FaceNet is used to extract the features of the proposed system and works by integrating the features into 128 dimensions. The support vector machine is used as a classifier after feature extraction. For face recognition, support vector machines are a better learning approach than multilayer perceptron classification. The raw student face dataset is preprocessed with a Python package. The FaceNet model is used to extract features. Features are extracted from the preprocessed image. Use a support vector machine for classification. This proposed system provides a reliable system that can replace human systems with automated

systems using multifaceted recognition.

In [40] Xi Zhao et. al describes How the automatic 3D facial expression recognition approach works based on BBN in combination with the morphable SFAM. The model learns global variations using morphology and textures that use the shapes around the landmarks. It enables not only automatic land marking, but also the calculation of beliefs for feeding BBN. In the experiment, SFAM's manual and automatic land tags achieved recognition rates of 87.2% and 82.3%, respectively, demonstrating the efficiency of the approach to phrase recognition. These experiments and the numbers performed by this approach will help expand the artificial intelligence sector in many ways and help require more research through this widely improved approach.

In [35], Schroff et al. introduced An innovative system called FaceNet. This system relies on Deep Neural Networks (DNN) for face recognition. The author also mentioned how fast deep learning is progressing. As a result, using deep CNN has greatly improved the accuracy rate of face recognition. They proposed a way to directly learn embedding in Euclidean space for face recognition. Also, the model requires minimal alignment. The proposed method achieved stunning results with 99.63 percent accuracy on the Wild Label Face (LFW) dataset and percent with 95.12 percent accuracy on YouTube Faces DB. This study shows that this system can reduce error rates by 30In [19], Li et al. talked about different technologies that are used in Facial recognitionsystems. Firstly Li mentions the algorithms for example they mention in the paper about PCA, LDA. Also how PCA LDA are different from each other. Sequentially, the author describes the classifiers and Artificial features. They described the Support vector machine (SVM), AdaBoost, the structure of AdaBoost Cascading, how small samples can be problematic, and the consequences of weak classifiers. They also elaborated, the neutral network works as the main function in facial recognition. How the brain works for humans here the brain is this neural network. After that writer also mentioned deep learning and as a method of deep learning, CNN is described where he explained how conventional neural networks works. And why it should be used then they pointed to the factors that affect this system. Then they compared different methods and its accuracy rates which show innovative technology have the highest accuracy which is near about 99.88 percent.

In [19],Shu-juan Li et al. discussed a method for developing an autonomous face recognition system While it may be necessary to recognize the specific location of facial featurepoints. As a result, automatic facial expression detection has proven to be a difficult method in the field of face recognition. This work proposes an algorithm based on Local Binary Patterns of Local Areas (LLBP) for implementing this strategy. The local areas of the eyes and mouth's neighbourhood are determined by prior knowledge of face structure after the position of the eyeball has been fixed. After that, The LBP feature is being implemented. The JAFFE facial database is used in the experiment.

In [20], Shangfei Wang et al, did an analytical discussion on infrared facial expression recognition using wavelet transformation.Firstly, the current state of infrared

facial expression recognition research was quickly reviewed and appraised. Second, picture features were extracted using wavelet transformations.Sequentially, in this thesis used "Euclidean Distance Maximizing Method" to choose features. Then, to minimize feature dimension,principal component analysis was applied, followed by a classifier based on NN. At last,a method on Equinox's medium-wave thermal facial expressions database evaluated the approach.

In[35],Florian Schroff et al, presented a system called FaceNet that can directly map a face image to a compact Euclidean space whose length directly corresponds to the face matching scale. Once this space is designed, tasks such as face recognition, validation, and clustering can be easily mentioned using standard FaceNet embedding techniques as feature vectors. The method was based on learning one Euclidean embedding per frame using a deep convolutional network. This is different from other methods that use the CNN bottleneck layer or require additional post-processing such as chaining multiple models or PCA and SVM classification. End-to-end training has shown that performance can be improved by simplifying setup and directly optimizing losses associated with the task at hand. Another strength of the model was that it only requires minimal alignment.

In [22], Nyein et al. demonstrate a FaceNet and Support Vector Machine model of a university classroom attendance system FaceNet was used to extract features, with 128 dimensions per face, and SVM was used to classify the given training data using the collected features. They used photographs of their classmates and celebrities from social media to collect data. Furthermore, they were able to obtain a 99.6% accuracy rate. As a result, they claim that the suggested system is capable of multi-face recognition. Even after comparing the proposed system to the VGG16 model on the same data set, the proposed system is more accurate.

2.2 Problem Definition

Facial Recognition has became a dynamic purpose for the upcoming technology. As an effective workforce in the future security system facial recognition has become a booming subject at the very least. The way people can use their face as a security part purpose is an overwhelming tech and can help many people to have a secured lifestyle. The motive behind using this facial recognition was to make a safe and secured environment for school and college going students. As people can effectively walk without any type of ID card or identification of themselves and walk into the school using their face as a bio-metric solution.

After this project we can hope to see an overwhelming usage of facial recognition as it will become more stereotype in the future. As a result we can say that this facial recognition using supervised deep learning can become an inevitable future for the upcoming technology as a safe and secured process.

2.3 Existing Algorithm

We have used different kinds of Algorithms for our research purpose. Followings are explained in this section.

2.3.1 Support Vector Machine

SVM or support vector machine is used to distinguish between results and problems that are stored as datasets. SVM is mainly used to match and check between different results in ML. The main target of the SVM algorithm is to distinguish the datasets into different classes to discover a better marginalized hyperplane. The plane that is hyper is the finest choice margin. The lines that are detached will help to form a centralized point along the plane. The data points are then distinguished by a set of lines of with the help of the plane. Data points falling on each quarter of the plane can be differentiated to different classes. The idea is to distinguish and classify between datasets, matrix vectors to get a match for the system in order to check the accuracy.

SVM chooses the outstanding points/vectors that benefit in making the plane that is hyper. These outstanding cases are called support vectors, and later it is known as Support Vector Machine. Pros and Cons of Support Vector Machine: Pros:

1.With the help of svm a high dimensional based data can genarate accrate outcome.

2.it can also arrange datas in full range in one go which also defines its not increasing appeal.

Cons:

1.It is expensive interm of training.

2.It does not have scale measuring characterstics.

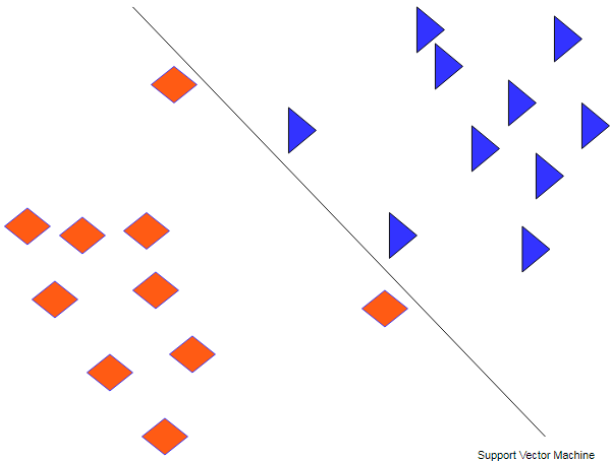


Figure 2.1: Support Vector Machine Algorithm

2.3.2 FaceNet

FaceNet is a face recognition project developed by three researchers at Google, Florian Schroff, Dmitry Kalenichenko, and James Philbin in 2015. The main objective of this research is to produce an embedding from the face of a person.

An embedding is a condensed vector representation of any object. A good embedding is one where two faces that are the same, have the cosine distance and Euclidean distance between them being very low. In contrast, two embeddings with dissimilar faces should have a Euclidean distance and cosine similarity being far apart.

FaceNet learns a mapping from face images to a compact Euclidean Space in which the distances between faces are proportional to their similarity. After that, activities like face recognition, verification, and clustering are simple to complete using standard techniques (using the FaceNet embeddings as features). Rather of using the output of an intermediary bottleneck layer, a Deep CNN is trained to optimize the embedding itself. In training, images such as an anchor ('anchor'), a positive exemplar ('positive exemplar'), and a negative exemplar ('negative exemplar') are used. The main benefit is representational efficiency: cutting-edge speed may be achieved with just 128 bytes per face (record 99.63 percent accuracy on LFW, 95.12 percent on Youtube Faces DB).
Pros and Cons of FaceNet :
Pros: 1.Closely cropped, but no alignment other than the crop

2.As in these model takes input in very closely cropped then no adjust is needed.

Cons:

1.if an image is Edited then it is hard to identify good match.

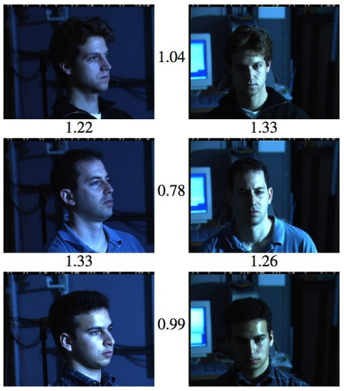


Figure 2.2: Illumination and Pose in-variance

Chapter 3

System Model

3.1 Work of The System

To describe our work process, we divided the whole piece of work into three sub-sections. Let's explain the sections.

3.1.1 Pre-Preparation

Firstly, we finalized the idea that our paper is going to be an automatic attendance system using facial recognition. After selecting a topic we started Reading related Journals, articles, Research papers thoroughly of related fields. From the researched papers we get the idea of which algorithm gives better accuracy in the shortest time.

3.1.2 Selecting Algorithm

From the previous section, we get a brief idea about different algorithms and how accurate results each algorithm gives us. Therefore we used three algorithms which are CNN, FACENET, LSVM. Initially, The picture will be scanned and if there is a face it will be detected by CNN. With the development of CNN, the recognition in various competitions are becoming increasingly extraordinary, making it the center of inventions. Reducing the number of learning parameters is an effective method for helping the trained state of the forward BP algorithm. This is accomplished by the convolution of the neural network's spatial relationship. The stature is proposed as a convolutional neural network, which minimizes initial data. In the stature of a convolution neural network, the initial data is given from the first given layer, processed by each layer, and then into the other stages, where each layer has a convulation differentiate to obtain the most important data characteristics. This method can obtained from the similar features such as translation, rotation, and so on **??** represent the method of CNN.

After CNN, the images go through the FaceNet algorithm and FaceNet have to understand a mapping from face images to a diverse Euclidean Space, where lengths correspond majorly to distinguish between a face. After it is completed, standard techniques such as face recognition checking and clustering can be used to easily complete tasks such as face recognition, checking, and clustering using the FaceNet

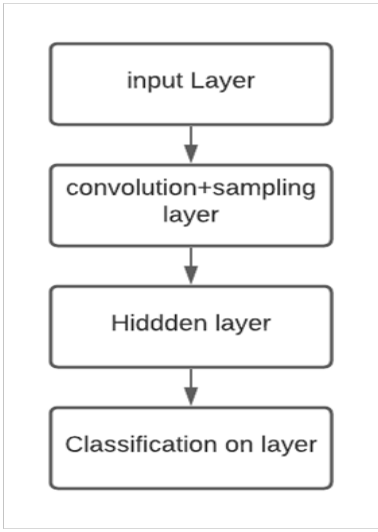


Figure 3.1: Structure of CNN

embeddings as features. The diagram in Figure 4.2 shows the block diagram of FaceNet.

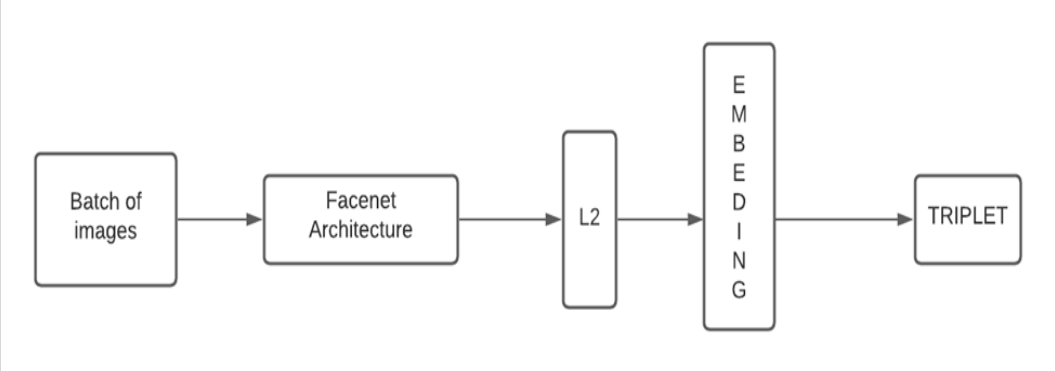


Figure 3.2: Block Diagram of FaceNet

Finally, LSVM Classifier along with CNN decides if a student can or can not enter the classroom. If he belongs to the class then his or her picture will be in the database and if not then will not match and the system will deny access to the class. When the data is passed through FaceNet it gives an embedded vector and it will be the input for linear SVM and this algorithm will calculate and present the output matrix in the graph now this output will find its match if the face that is being tested is present in the database so it will mark him present and if it is absent then the output will generate that the input is false. The Figure 3.3 below represents LSVM 's structure

3.1.3 Dataset Preparation and modification according to the system's need

For data collection, we took face images of our own teammates and some random people from the internet. Therefore, our dataset is mixed photos of our own and random people. Along with that, we took around 5 photos of each person in different

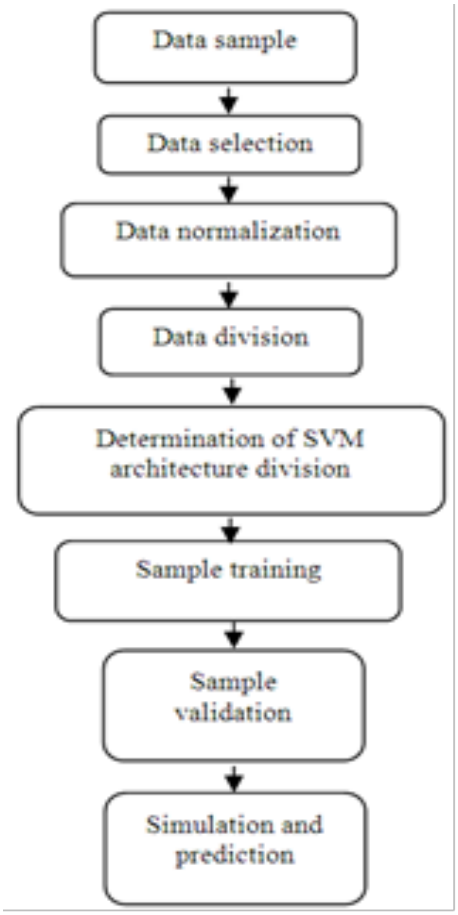


Figure 3.3: Structure of LSVM

angles that are noisy, blurred, right, angle,left-angled. A small example of our data set is shown in Figure 3.4. Data are divided into two sections training and testing. let us start with training, we had to preprocess the data by cropping and resizing the pictures and kept each person's all pictures in the same folder, and named that folder to its owner name. Finally, in Figure 3.5, we can see the whole system sequentially in diagram.

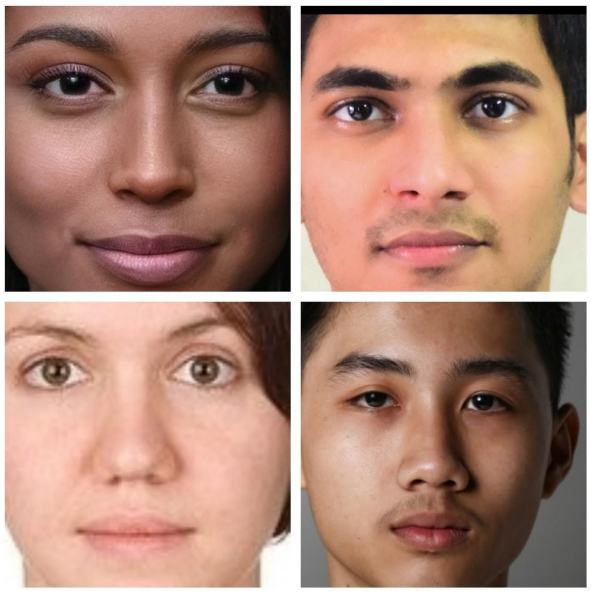


Figure 3.4: Example of Dataset

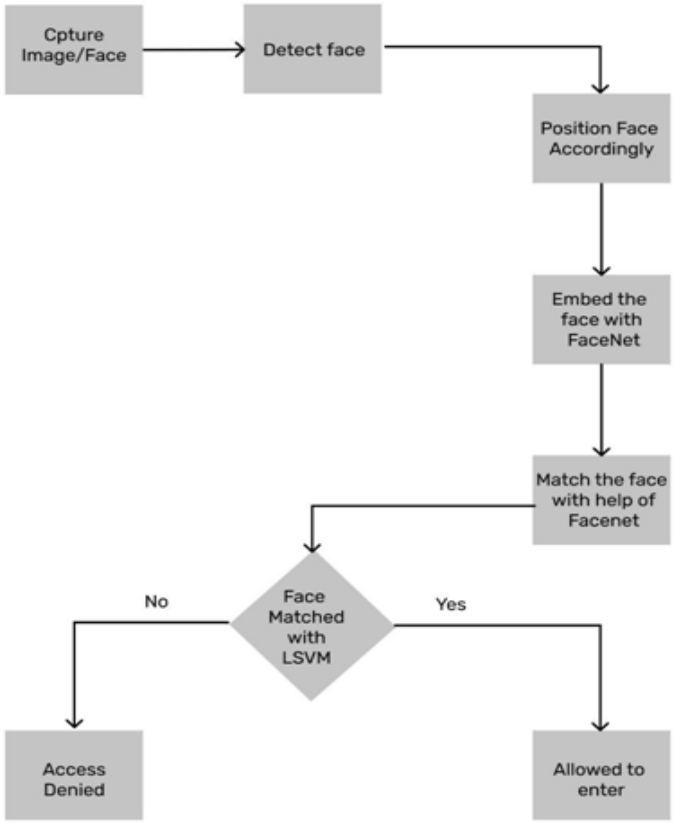


Figure 3.5: :Workflow of Entire System

Chapter 4

Experiment Analysis

4.1 Methodology

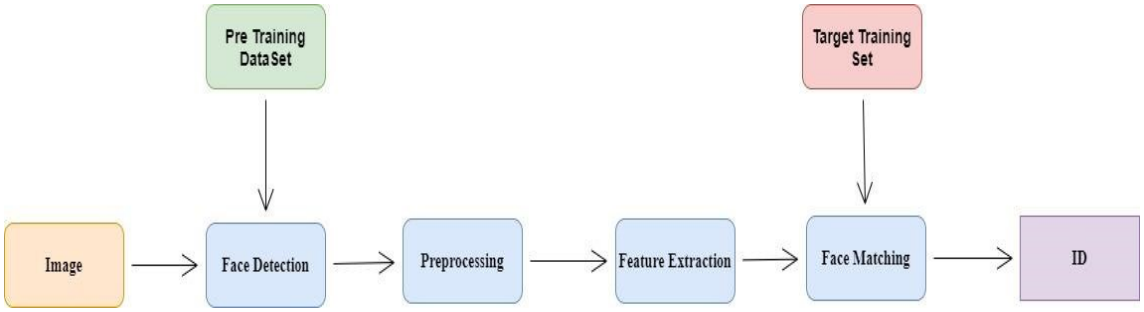


Figure 4.1: Frame Work

In the below figure it is shown how an image will be taken by the camera and processed by the help of FaceNet and given a matrix value. After the matrix value is calculated by the help of Eigenface Embedding function it will further process the value to create a dataset that is to be matched with the existing dataset in the LSVM. After matching the existing values with the new value, the face can be detected successfully if it is in the target training set or not. Successfully matching the values will ensure that the face is detected and the person belongs to the institution further strengthening the security of the school.

FaceNet is an advanced part of CNN (Convoluted Neural Network) developed by Google researchers Florian Schroff, Dimitry Kalenichenko and James Philbin. It is used to recognize different types of faces and develop an eigenface matrix containing a value or a classifier to assign a face. FaceNet is a CNN just for feature extraction but not for classification. The goal of FaceNet is to distinguish between different faces independently. FaceNet is trained to be applied in any type of face without re-training. The use of FaceNet makes the number of faces i.e. the sample size necessary to handle face-related tasks smoothly and efficiently. FaceNet is based on the Euclidean Embedding function. It maps a face clip to a Euclidean space so that similarity can be measured. For example if we graph a face in 2D Euclidean Space then the horizontal axis will represent the hair length and the vertical axis will represent the skin tone. After embedding the faces in the graph by FaceNet it will represent as points in the space. The distance between the points can be

calculated. After matching the given points and distance, the values will then be matched with the given dataset and further show the results of the match by the help of lsvm. F(x) = (x1,x2,x3,. . . ..xn)

The first step of FaceNet is to use a Deep CNN to perform Euclidean Embedding that maps x to a d-dimensional feature vector. The second step uses L2-norm to constraint embedding to the d-dimensional surface of the hypersphere, that is f(x) = 1.0. The network used in FaceNet for Euclidean Embedding can use any type of deep CNNs. FaceNet performs the best when the value of d is set to 128 in most cases. The faces that have been already set in the data set will have smaller distances compared to faces that are new and distinct will have large distances respectively.

After the initial dataset the values can be calculated more easily and swiftly as it will result in more accuracy and efficiency in the method. Also the FaceNet has proven more efficient as it has been time and time again by increasing the number of datasets and training sets respectively.

Figure 1 shows the proposed automatic face recognition system. Face detection, preprocessing, feature extraction, and face detection are the four stages of the system. In the first stage, one or more faces are detected in the image. In the second stage, image processing technology is used to prepare the facial image for use in the machine learning model. In the third stage, the features of the face image are extracted. In the final stage, facial features are compared to the registered user's known facial features to identify the individual. This section describes the face detection phase, which detects a face image in an input frame in an unconstrained context. At this stage, the face recognition process should be able to handle the following photo volatile factors: B. Pose, scale, lighting. The method chosen was developed after extensive research on numerous face recognition schemes for real-time applications.

This procedure uses a one-step deep neural network technique. The preprocessing phase uses a data approach aimed at improving the overall quality of the features extracted in the next phase. There are many ways to preprocess your data, but it's important to match what you need based on the problem you're trying to solve and the data you're using to run it. Color and geometric changes, standardization and normalization are examples of image preprocessing techniques. In this study, we use the CNN network to extract features. This includes resampling the facial image to match the width and height of the in the photo used to train the identification algorithm. The bicubic interpolation approach was chosen to resample the facial photo. It also uses one of the most commonly used image normalization techniques, the L2 standard approach. Since various studies have shown that normalizing data improves the performance of biometric systems, this technique normalizes data values based on a total of, which is the square of the absolute penalty.

Face image properties are a recently proposed feature extraction method developed for both analysis and image face recognition, calculated using a DeepCNN-based training scheme. A CNN consists of a series of hidden layers, each layer consisting of a layer's input data and a set of nested 2D filters. To reduce the

amount of data in the next convolution layer, the output layers of these layers are fed to a series of pooling layers, one or two fully connected layers. It is based on the concept of removing a fully connected layer from a CNN and replacing it with a Lagrange Support Vector Machine (LSVM) to develop a combined architecture for each facial recognition classifier. Instead of the last fully connected layer, LSVM and CNN are injected into the original FaceNet network, followed by L2 normalization and implementation. In this network, the weight of CNN is used as the base, and in the training step, the triplet loss function (suggested by FaceNet) is replaced by the softmax + cross entropy loss function to generate FaceNet +. Then use the weight to initialize all layers of the CNN to the end. Then, using the target training dataset, the CNN is trained to extract facial features and use those features to train the LSVM. Figure below shows the structure of the proposed model and the recognition process of the system. In this phase, the baseline of the proposed approach is presented and the recognition results are evaluated. The proposed FaceNet + LSVM and FaceNet + CNN method were compared to the baseline (FaceNet +) tested for face recognition tasks.

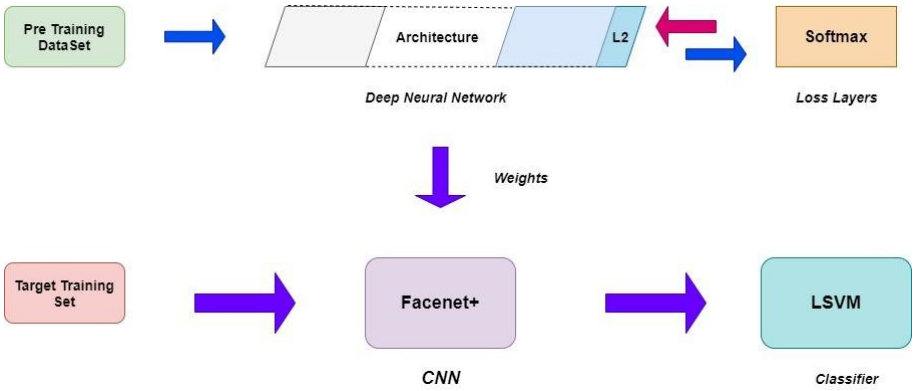


Figure 4.2: Methodology

Chapter 5

Result Explanation

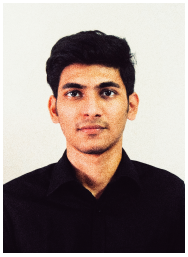
5.1 Data Analysis

Recognizing faces from real-time scenarios can be challenging as the environment is susceptible to pose variation, expression or even occlusion. Therefore, extraction of various face features without much error is expected and for this the system should be as accurate as possible. Angle of face in image plays a vital role here as image containing good result requires side face where at least some feature of face should be extracted. So a minimum number of pictures for each student must be taken from different angles (front, above, right, left) to make the system work more efficiently. The dataset will consist of those pictures.

Figure 5.1: Images from different point of view

For higher accuracy, larger data can help. This approach suggests augmenting the data by taking an image with noise or blurring the image. The first task is to take the original image and change it. In this way large data is not needed rather than this approach can enlarge the data set. As a result, we could achieve higher accuracy with a small data set[14]. The first one is noise, this system will have a standard camera but the situation may occur to have a technical error which may cause noise to the image as used augmented images in the data set can adapt this for any noised image. The next one is a blur , it is normal to have a rush at the entrance. This often causes blurring images as not being able to focus correctly, and having a blurred image in augmented data can solve the problem. Python will automatically generate the augmented images from the original one.

Another approach can be taken for facial recognition .for than we need to first



(a) Noisy Image

(b) Blurry Image

(c) Close-shot image

(d) Covered Image

locate the parts of the human face i.e. eye, mouth, nose, chin then marking it on the image using a machine learning tool kit, After sensing the position of the nose, mouth eyes, in the image python will automatically add different properties like glasses, mustache, wigs which will make difference from the original image will be added to training data set as a new picture. As it is for training data sets this approach will increase the data while reducing over fitting in CNN's learning and also help to improve the accuracy[14]. As shown in figure. We can see how a Python script recognizes face locations and aligns the image is based on the face locations from the input images in these two photos, using a Python script that will automatically identify the landmarks using the proposed technique. Face landmarks are 68 unique locations on a human face. The first step is to find the face landmarks and position the image using an affine transformation to focus the landmarks as much as possible without changing the image. The embedding procedure with FaceNet is then depicted in the stage after that. Deep CNN is used in this method to learn a mapping from facial images to Euclidean space, where distances correspond to face similarity metrics.As a result, every face has a 128-byte embedded. This network's training comprises of triplets. (1)The face image of a specific user. (2)The testing face image of the specific user. (3)Another person's face image.

The final phase in building the face recognition system for recognizing students' attendance is to train the classifier using the deep CNN based on the previously obtained embedded from the students' dataset. Because this system is has a smaller dataset, a support Vector Machine (SVM) was chosen for this classification problem.

5.2 Accuracy Formula

Accuracy = [TP+TN]/Total With this formula of your accuracy=(TP+TN)/(Total).Face detection and recognition accuracy is calculated as a percentage of identified faces divided by number of faces examined for the same person.

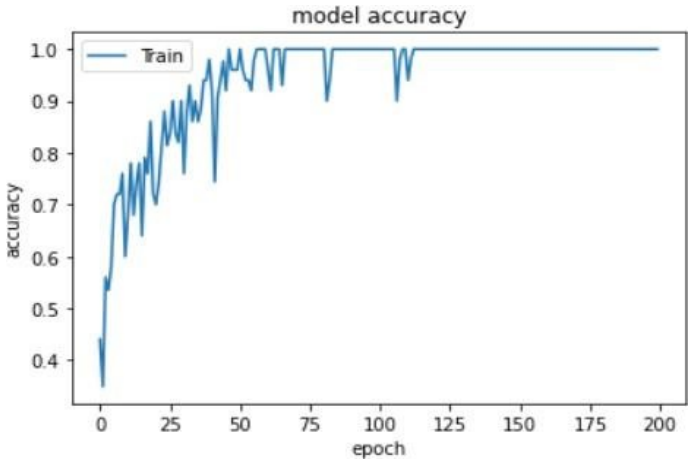


Figure 5.3: Face Detection Train accuracy curve

Algorithms	Accuracy Rate
FaceNet	99.63%
RNN	98%
SVM	97%
KNN	96.97%

Table 5.1: Accuracy table

We can observe from the above comparison that the FaceNet with LSVM has an accuracy of around 99.63 percent. The other algorithms, support vector machine and random forest, were also mentioned before. As a result, network grows increasingly complex as more parameters are added, leading to classifiers.

5.3 Data Visualization

We put them in different graphs to give a better perspective of the size of our dataset because we're working on a wide -ranging algorithm that requires lots of images to produce a excellent result. Within the collection, we utilized several tags that will help to quickly identify the images.Aside from that, we gathered thousands of regular photos and used data augmentation to create different types of images to maintain a balance. We classified the images as noisy, blurred, close-up, side view, top view, and bottom view. We also gathered images of people wearing masks or other items to hide their faces. We gathered over a thousand photographs of facial masks, sunglasses, shades, hats, and other similar items for this purpose. We then used data augmentation to expand its size as well. Finally, we employed data augmentation to fit the quantity of images in the FaceNet model where it can easily identify the relevant images in the normal face segment. This shows the proportion of the data set's image accuracy rate.

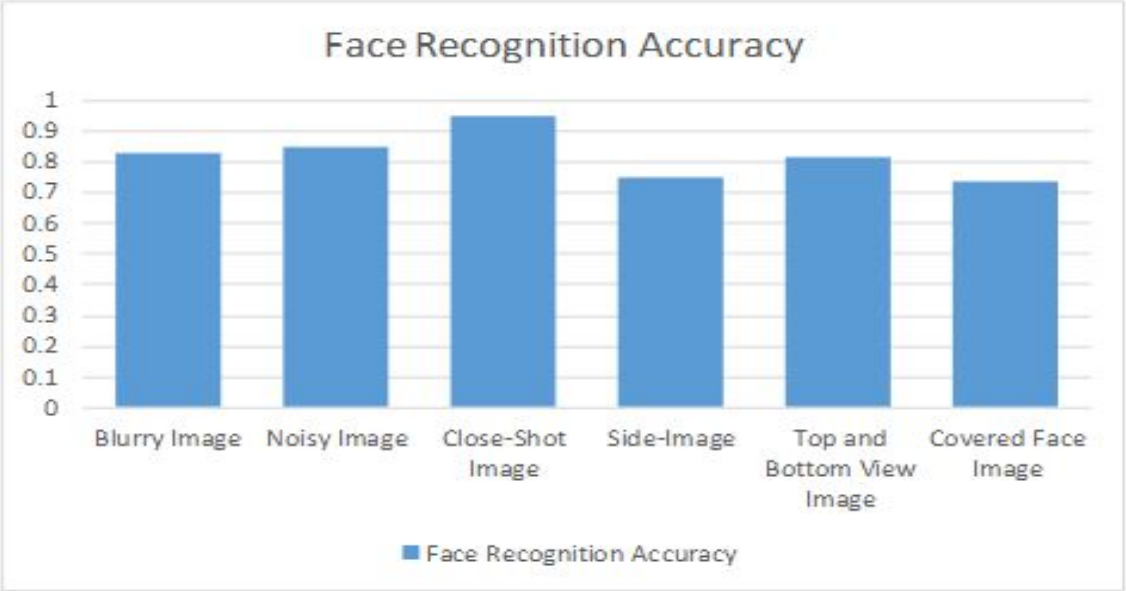


Figure 5.4: Bar plot Analysis

5.4 Result Analysis

The model was built utilizing the recommended augmentation method and a small number of images.As a result, the original dataset was expanded, and overall accuracy improved. The photos were analyzed.It's possible that it was saved in the database throughout the acquisition process.The recognition was influenced by the light circumstances, it was discovered.process. The majority of the mistakenly predicted images.While the door was open, It was exposed to daylight. This is something that might happen.Gradient transformation may be used to correct the issue.Only a few photos were correctly predicted as being affected by noise from an unknown source.By combining newly acquired images predicted by the model with a high accuracy rate with time interval continuous testing of the embedded deep CNN, the total accuracy may be improved.. Let's start with how we prepared our images for further testing. Consider the following scenario: we wish to train on an image. For this experiment, we chose a blurry and noisy image to compare to a regular image with any blurry and noisy face. The image was then examined to check if it was in good condition. We've presented an example of that result below:

Thereafter Training the dataset we receive near about 0.9300 that is almost 93% is feasible to get and the loss is around 0.1800 or 18%. Also if we see the validation then we gain 0.9503 or 95.03 percentages accuracy and we lose 0.1413 or14.13 %.

In order to make our model's performance evident, we need a visual depiction of the end outcomes. We can also make use of other visualization techniques that are already in use. Python comes with a plethora of libraries that can help us visualize our results. We employed the proposed model's accuracy in various ways for both training and testing data to gain a better understanding. We also receive some expected value from the test images that were used. The accuracy of the FaceNet model, as well as curves, are shown below for face detection from various points of view of the images:

There is a face visible in this close-shot. Our model has a possibility to be recognized under the close-shot category for our images because it was built in such a

```
Epoch 1/20
5/5 [==============================] - 4s 896ms/step - loss: 0.4777 - accuracy: 0.8000 - val_loss: 0.4013 - val_accuracy: 0.8549
Epoch 2/20
5/5 [==============================] - 4s 880ms/step - loss: 0.4998 - accuracy: 0.8000 - val_loss: 0.4067 - val_accuracy: 0.8238
Epoch 3/20
5/5 [==============================] - 4s 833ms/step - loss: 0.5272 - accuracy: 0.8605 - val_loss: 0.3473 - val_accuracy: 0.8601
Epoch 4/20
5/5 [==============================] - 4s 874ms/step - loss: 0.5377 - accuracy: 0.7442 - val_loss: 0.4039 - val_accuracy: 0.8290
Epoch 5/20
5/5 [==============================] - 4s 876ms/step - loss: 0.4928 - accuracy: 0.8200 - val_loss: 0.3095 - val_accuracy: 0.8497
Epoch 6/20
5/5 [==============================] - 4s 877ms/step - loss: 0.5941 - accuracy: 0.8200 - val_loss: 0.5004 - val_accuracy: 0.7306
Epoch 7/20
5/5 [==============================] - 4s 874ms/step - loss: 0.3647 - accuracy: 0.8400 - val_loss: 0.3105 - val_accuracy: 0.8549
Epoch 8/20
5/5 [==============================] - 4s 871ms/step - loss: 0.2359 - accuracy: 0.9302 - val_loss: 0.2695 - val_accuracy: 0.8912
Epoch 9/20
5/5 [==============================] - 4s 877ms/step - loss: 0.4553 - accuracy: 0.8600 - val_loss: 0.3270 - val_accuracy: 0.8756
Epoch 10/20
5/5 [==============================] - 4s 826ms/step - loss: 0.2738 - accuracy: 0.8837 - val_loss: 0.2294 - val_accuracy: 0.9275
Epoch 11/20
5/5 [==============================] - 4s 878ms/step - loss: 0.2951 - accuracy: 0.8400 - val_loss: 0.2355 - val_accuracy: 0.9326
Epoch 12/20
5/5 [==============================] - 4s 886ms/step - loss: 0.3196 - accuracy: 0.8400 - val_loss: 0.4143 - val_accuracy: 0.8031
Epoch 13/20
5/5 [==============================] - 4s 876ms/step - loss: 0.2546 - accuracy: 0.9200 - val_loss: 0.1830 - val_accuracy: 0.9326
Epoch 14/20
5/5 [==============================] - 4s 870ms/step - loss: 0.1970 - accuracy: 0.9200 - val_loss: 0.2759 - val_accuracy: 0.8860
Epoch 15/20
5/5 [==============================] - 4s 875ms/step - loss: 0.2152 - accuracy: 0.9400 - val_loss: 0.7824 - val_accuracy: 0.6891
Epoch 16/20
5/5 [==============================] - 4s 869ms/step - loss: 0.1837 - accuracy: 0.9000 - val_loss: 0.5811 - val_accuracy: 0.7720
Epoch 17/20
5/5 [==============================] - 4s 884ms/step - loss: 0.2409 - accuracy: 0.9200 - val_loss: 0.1996 - val_accuracy: 0.9171
Epoch 18/20
5/5 [==============================] - 4s 873ms/step - loss: 0.4638 - accuracy: 0.8200 - val_loss: 0.2291 - val_accuracy: 0.9171
Epoch 19/20
5/5 [==============================] - 4s 885ms/step - loss: 0.3095 - accuracy: 0.8605 - val_loss: 0.1259 - val_accuracy: 0.9534
Epoch 20/20
5/5 [==============================] - 4s 886ms/step - loss: 0.1700 - accuracy: 0.9400 - val_loss: 0.1313 - val_accuracy: 0.9430
```

Figure 5.5: Training Accuracy Result

way that it identifies the correct classification of an image that is compatible and can be.

The accuracy is 0.9485 or 94.85 percent in this case (fig:5.6). After that, we tested with a different era and saw how the results changed. In the same manner that we used the proposed model's accuracy differently for training and testing data to achieve a better understanding of both, we utilized the proposed model's accuracy differently for training and test data to develop an understanding of both. We also get a predicted value from the test images that were used.

When it came to our analysis of the results, that was the end of it. The FaceNet model, as can be seen, has a high level of precision, which is owing to the fact that our model was kept as light as possible. Having a look at the accuracy diagrams, we can conclude that when the software will include, the detection accuracy will be good. Our target was to find out the higher accuracy model for face recognition. We compared FaceNet+LSVM, KNN+LSVM and RNN+LSVM. Among them we prefer to use FaceNet+LSVM because of it's high accuracy rate. We also ran several test using KNN and RNN. But the accuracy was not as good as FaceNet.

Model	**Accuracy Rate**
FaceNet+LSVM	94.85%
RNN+LSVM	92.95%
KNN+LSVM	91.97%

Table 5.2: Accuracy Chart

```
Epoch 1/20
5/5 [==============================] - 5s 939ms/step - loss: 0.6221 - accuracy: 0.8258 - val_loss: 0.2254 - val_accuracy: 0.9296
Epoch 2/20
5/5 [==============================] - 4s 898ms/step - loss: 0.5183 - accuracy: 0.7936 - val_loss: 0.1974 - val_accuracy: 0.8967
Epoch 3/20
5/5 [==============================] - 4s 889ms/step - loss: 0.2011 - accuracy: 0.9150 - val_loss: 0.1111 - val_accuracy: 0.9718
Epoch 4/20
5/5 [==============================] - 4s 892ms/step - loss: 0.0899 - accuracy: 0.9769 - val_loss: 0.0781 - val_accuracy: 0.9765
Epoch 5/20
5/5 [==============================] - 4s 891ms/step - loss: 0.1200 - accuracy: 0.9278 - val_loss: 0.9320 - val_accuracy: 0.7371
Epoch 6/20
5/5 [==============================] - 4s 896ms/step - loss: 0.3839 - accuracy: 0.9586 - val_loss: 0.0805 - val_accuracy: 0.9812
Epoch 7/20
5/5 [==============================] - 4s 886ms/step - loss: 0.1143 - accuracy: 0.9586 - val_loss: 0.0680 - val_accuracy: 0.9718
Epoch 8/20
5/5 [==============================] - 4s 898ms/step - loss: 0.0671 - accuracy: 0.9753 - val_loss: 0.0995 - val_accuracy: 0.9624
Epoch 9/20
5/5 [==============================] - 4s 902ms/step - loss: 0.0288 - accuracy: 0.9933 - val_loss: 0.2296 - val_accuracy: 0.9296
Epoch 10/20
5/5 [==============================] - 4s 896ms/step - loss: 0.0800 - accuracy: 0.9728 - val_loss: 0.3576 - val_accuracy: 0.8685
Epoch 11/20
5/5 [==============================] - 4s 890ms/step - loss: 0.2450 - accuracy: 0.9008 - val_loss: 0.0762 - val_accuracy: 0.9765
Epoch 12/20
5/5 [==============================] - 4s 895ms/step - loss: 0.0568 - accuracy: 0.9589 - val_loss: 0.0667 - val_accuracy: 0.9624
Epoch 13/20
5/5 [==============================] - 4s 888ms/step - loss: 0.0672 - accuracy: 0.9800 - val_loss: 0.0551 - val_accuracy: 0.9765
Epoch 14/20
5/5 [==============================] - 4s 846ms/step - loss: 0.0650 - accuracy: 0.9742 - val_loss: 0.0416 - val_accuracy: 0.9906
Epoch 15/20
5/5 [==============================] - 4s 895ms/step - loss: 0.2681 - accuracy: 0.9161 - val_loss: 0.3049 - val_accuracy: 0.8451
Epoch 16/20
5/5 [==============================] - 4s 889ms/step - loss: 0.1667 - accuracy: 0.9892 - val_loss: 0.1029 - val_accuracy: 0.9718
Epoch 17/20
5/5 [==============================] - 4s 896ms/step - loss: 0.0869 - accuracy: 0.9586 - val_loss: 0.0694 - val_accuracy: 0.9812
Epoch 18/20
5/5 [==============================] - 4s 848ms/step - loss: 0.0874 - accuracy: 0.9472 - val_loss: 0.1569 - val_accuracy: 0.9343
Epoch 19/20
5/5 [==============================] - 4s 891ms/step - loss: 0.0362 - accuracy: 1.0000 - val_loss: 0.0574 - val_accuracy: 0.9906
Epoch 20/20
5/5 [==============================] - 4s 852ms/step - loss: 0.0837 - accuracy: 0.9337 - val_loss: 0.1115 - val_accuracy: 0.9624
```

Figure 5.6: Recognition Accuracy Result

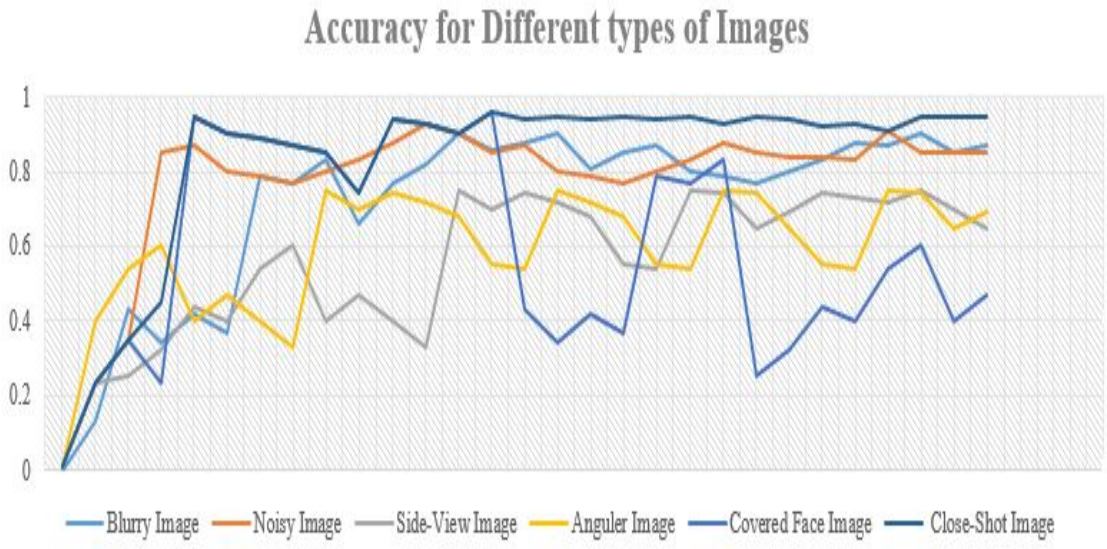


Figure 5.7: Model Accuracy

Chapter 6

Conclusion And Future Works

6.1 Conclusion

The term Facial recognition is one of the most basic of all bio metric measurements and acquires highest accuracy among different technologies wand also it has been used as a medium of tracking down and identifying mugs and criminal..The process of taking attendance using the old method is stressful to most of the institutions. In this manner, the facial recognition feature inserted within the attendance monitoring system can not only guarantee participation to be taken accurately and also eliminate the imperfections prevailed in the past framework. According to previous research, facial recognition algorithms showed better results spotting undetectable characteristics as well. It has the accuracy of a physiological approach without being intrusive. In this paper, we proposed algorithms that are capable of detecting multiple faces, and performance of the system has acceptable good results. A must requirement is to have adequate space in the database storage to store all the images. For that, micro SD can compensate with the volume of the data. The result of our experiment provides an accuracy of approx. 98 percent which we are hoping to improve by further research.

6.2 Future Works

In spite of some tremendous striking results, none of the past works were entirely effective without any drawbacks. In this research, we present a system that will use real-time data to improve the efficiency and accuracy of prior operations, using algorithm discussed above. Later on, we will proceed to implementation and evaluation on the basis of experimental results. It is also in consideration that future work will have many more facial images as much as possible for the training and testing for better authentication of the system. More algorithms can be combined to take care of the issues of posing and illumination. Improvements will be dependent on making better implementation of video and camera technology. We hope this system will provide some useful insight and offer to contribute to the improvement into the field of face recognition.After testing the general images with suitable algorithm and researching and changing as much needed which will make the algorithm fastest for any photos or pictures.

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