STUDENT ATTENDANCE SYSTEM BASED ON THE FACE RECOGNITION

A SUMMER PROJECT REPORT

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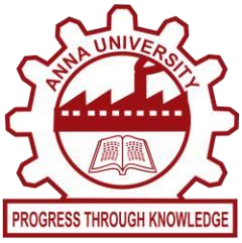

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ABSTRACT

Automatic face recognition technologies have made many improvements in changing world. Smart attendance using real time Face-Recognition is a real-time solution which comes with day-to-day activities of handling student attendance system. Face-recognition based attendance system is a process of recognizing the students face for taking attendance by using face biometrics based on high definition monitor video and other information technology. In my face recognition project computer system will be able to find and recognize human faces and precisely in images or videos that are being captured through a webcam. Numerous algorithms and techniques have been developed for improving the performance of face recognition but the concept to be implemented here is by Machine Learning. It helps in conversion of the frames of video into images so that the face of the student can be easily recognized for their attendance so that the attendance database can be easily reflected automatically.

TABLE OF CONTENT

TABLE OF FIGURES

CHAPTER – 1

INTRODUCTION

1.1 MACHINE LEARNING

A core objective of a learner is to generalize from its experience. Generalization in this context is the ability of a learning machine to perform accurately on new, unseen examples/tasks after having experienced a learning data set. The training examples come from some generally unknown probability distribution (considered representative of the space of occurrences) and the learner has to build a general model about this space that enables it to produce sufficiently accurate predictions in new cases.

The computational analysis of machine learning algorithms and their performance is a branch of theoretical computer science known as computational learning theory via the Probably Approximately Correct Learning (PAC) model. Because training sets are finite and the future is uncertain, learning theory usually does not yield guarantees of the performance of algorithms. Instead, probabilistic bounds on the performance are quite common. The bias–variance decomposition is one way to quantify generalization error.

For the best performance in the context of generalization, the complexity of the hypothesis should match the complexity of the function underlying the data. If the hypothesis is less complex than the function, then the model has under fitted the data. If the complexity of the model is increased in response, then the training error decreases. But if the hypothesis is too complex, then the model is subject to overfitting and generalization will be poorer.

In addition to performance bounds, learning theorists study the time complexity and feasibility of learning. In computational learning theory, a computation is considered feasible if it can be done in polynomial time. There are two kinds of time complexity results: Positive results show that a certain class of

functions can be learned in polynomial time. Negative results show that certain classes cannot be learned in polynomial time. The Graphical model of the Supervised learning is given below in fig 1.1.

SUPERVISED LEARNING:

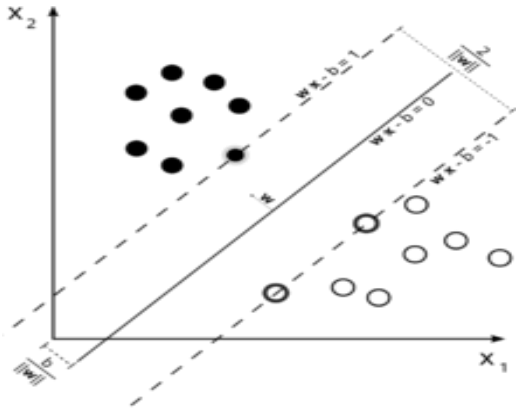


Fig 1.1-The Graphical representation of the Supervised Learning Model

A support-vector machine is a supervised learning model that divides the data into regions separated by a linear boundary. Here, the linear boundary divides the black circles from the white. Supervised learning algorithms build a mathematical model of a set of data that contains both the inputs and the desired outputs. The data is known as training data, and consists of a set of training examples. Each training example has one or more inputs and the desired output, also known as a supervisory signal. In the mathematical model, each training example is represented by an array or vector, sometimes called a feature vector, and the training data is represented by a matrix. Through iterative optimization of an objective function, supervised learning algorithms learn a function that can be used to predict the output associated with new inputs. An optimal function will allow the algorithm to correctly determine the output for inputs that were not a

part of the training data. An algorithm that improves the accuracy of its outputs or predictions over time is said to have learned to perform that task.

1.2 K-NN ALGORITHM

The training examples are vectors in a multidimensional feature space, each with a class label. The training phase of the algorithm consists only of storing the feature vectors and class labels of the training samples. In the classification phase, *k* is a user-defined constant, and unlabeled vector is classified by assigning the label which is most frequent among the *k* training samples nearest to that query point. A commonly used distance metric for continuous variables is Euclidean distance. For discrete variables, such as for text classification, another metric can be used, such as the overlap metric (or Hamming distance). In the context of gene expression microarray data, for example, *k*-NN has been employed with correlation coefficients, such as Pearson and Spearman, as a metric. Often, the classification accuracy of *k*-NN can be improved significantly if the distance metric is learned with specialized algorithms such as Large Margin Nearest Neighbour or Neighbourhood components analysis.

The accuracy of the *k*-NN algorithm can be severely degraded by the presence of noisy or irrelevant features, or if the feature scales are not consistent with their importance. Much research effort has been put
into selecting or scaling features to improve classification. A particularly popular approach is the use of evolutionary algorithms to optimize feature scaling. Another popular approach is to scale features by the mutual information of the training data with the training classes.

1.3 AUTOMATION

Automation describes a wide range of technologies that reduce human intervention in processes, namely by predetermining decision criteria, subprocess relationships, and related actions, as well as embodying those predeterminations in machines. Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronic devices, and computers, usually in combination. Complicated systems, such as modern factories, airplanes, and ships typically use combinations of all of these techniques. The benefit of automation includes labor savings, reducing waste, savings in electricity costs, savings in material costs, and improvements to quality, accuracy, and precision. Automation includes the use of various equipment and control systems such as machinery, processes in factories, boilers, and heat-treating ovens, switching on telephone networks, steering, and stabilization of ships, aircraft, and other applications and vehicles with reduced human intervention. Examples range from a household thermostat controlling a boiler to a large industrial control system with tens of thousands of input measurements and output control signals. Automation has also found space in the banking sector. In control complexity, it can range from simple on-off control to multi-variable high-level algorithms.

CHAPTER-2

LITERATURE SURVEY

2.1 Huang, J., Heisele, B., and Blanz, V., Component-based face recognition with 3D morphable models. In Proceedings, International Conference on Audio- and Video-Based Person Authentication, 2003

Presented a new development in component-based face recognition by the incorporation of a 3D morphable model into the training process. This combination allowed the training of a face recognition system which required only three face images of each person. From these three images, 3D face models were computed and then used to render a large number of synthetic images under varying poses and lighting conditions. The synthetic images were then used to train a component-based face detection and recognition system. A global face detection and recognition system was also trained for comparison.

2.2 Brunelli and Poggio, Face Recognition: Features Vs Templates, IEEE Transactions on Pattern Ananlysis and Machine Intelligence, vol 15, no. 10, October 1993.

The feature based strategy, however, may allow a higher recognition speed and smaller memory requirements (information can be stored at one byte per feature, which requires only 35 bytes per person in our experiments). The result is clearly specific to our task and to our implementations. Additional features may be used, and it may be possible to extract them more precisely.

2.3 Rabia Jafri* and Hamid R. Arabnia A Survey of Face Recognition Techniques Journal of Information Processing Systems, Vol.5, No.2, June 2009.

Encouraging results have been obtained and current face recognition systems have reached a certain degree of maturity when operating under

constrained conditions; however, they are far from achieving the ideal of being able to perform adequately in all the various situations that are commonly encountered by applications utilizing these techniques in practical life.

2.4 C. Lin, 2005, Face Detection by Colour and Multilayer Feedforward Neural Network", Proc. 2005 IEEE International Conference on Information Acquisition, pp. 518-523,Hong Kong and Macau, China.

A robust and effective face detection system is presented to detect face in various kinds of face images. Because the relative value between r, g, and b are almost similar with the different skin colours and changed lighting circumstances.

2.5 S. Kherchaoui and A. Houacine, 2010, "Face Detection Based On A Model Of The Skin Colour With Constraints And Template Matching", Proc. 2010 International Conference on Machine and Web Intelligence, pp. 469-472, Algiers, Algeria.

Used combination of method for detection and recognition. This technique achieves good performance by combining different algorithms for detection and recognition of real and fake (picture) face. This algorithm is fast and simple for implement and gives higher accuracy and security. In the future research, we are planning to integrate the proposed face recognition approach with a hardware support.

2.6 Pentland, B. Moghaddam, T. Starner, View-Based and Modular Eigenspaces for Face Recognition , Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, Seattle, Washington, USA, pp. 84- 91, 21-23 June 1994.

The technique to handle a variable viewing geometry, using a view-based approach by describing faces with a set of 2-D aspects". The key to the success of such a view-based approach is the ability to localize the object (or features

on an object) and identify the correct aspect. the ability of the DFFS lter to accurately and reliably detect features was critical for successfully incorporating a parts-based description.

2.7 Sharkas, M. Abou Elenien, Eigenfaces vs. Fisherfaces vs. ICA for Face Recognition; A Comparative Study, 9th International Conference on Signal Processing, 2008, ICSP 2008., 2008, pp. 914919.

The most popular face recognition algorithms are compared. Some transformations are applied on the data while carrying out the algorithms. AR and AT&T databases are used in the study. And all the results were compared one time with a large set of training images and the other time with a much smaller set of training images.

CHAPTER-3

FACE RECOGNITION

3.1 INTRODUCTION

A facial recognition system is a technology capable of matching a human face from a digital image or a video frame against a database of faces. Such a system is typically employed to authenticate users through ID verification services, and works by pinpointing and measuring facial features

from a given image. Development began on similar systems in the 1960s, beginning as a form of computer application.

Since their inception, facial recognition systems have seen wider uses in recent times on smartphones and in other forms of technology, such as robotics. Because computerized facial recognition involves the measurement of a human's physiological characteristics, facial recognition systems are categorized as biometrics. Although the accuracy of facial recognition systems as a biometric technology is lower than iris recognition and fingerprint recognition, it is widely adopted due to its contactless process.Facial recognition systems have been deployed in advanced human–computer interaction, video surveillance and automatic indexing of images.

Facial recognition systems are employed throughout the world today by governments and private companies. Their effectiveness varies, and some systems have previously been scrapped because of their ineffectiveness. The use of facial recognition systems has also raised controversy, with claims that the systems violate citizens' privacy, commonly make incorrect identifications, encourage gender norms and racial profiling, and do not protect important biometric data. The appearance of synthetic media such as deepfakes has also 12 raised concerns about its security. These claims have led to the ban of facial recognition systems in several cities in the United States. As a result of growing societal concerns, Meta announced that it plans to shut down Facebook facial recognition system, deleting the face scan data of more than one billion users. This change will represent one of the largest shifts in facial recognition usage in the technology's history.

3.2 FACE RECOGNITION OPERATION

The technology system may vary when it comes to facial recognition. Different software applies different methods and means to achieve face recognition. The algorithm of face recognition process is mentioned in fig 3.1. The stepwise method is as follows:

- Face Detection: To begin with, the camera will detect and recognize a face. The face can be best detected when the person is looking directly at the camera as it makes it easy for facial recognition. With the advancements in the technology, this is improved where the face can be detected with slight variation in their posture of face facing to the camera.

- Face Analysis: Then the photo of the face is captured and analyzed. Most facial recognition relies on 2D images rather than 3D because it is more convenient to match to the database. Facial recognition software will analyze the distance between your eyes or the shape of your cheekbones.

- Image to Data Conversion: Now it is converted to a mathematical formula and these facial features become numbers. This numerical code is known a face print. The way every person has a unique fingerprint, in the same way, they have unique face print.

- Match Finding: Then the code is compared against a database of other face prints. This database has photos with identification that can be compared. The technology then identifies a match for your exact features in the provided database. It returns with the match and attached information such as name and addresses or it depends on the information saved in the database of an individual.

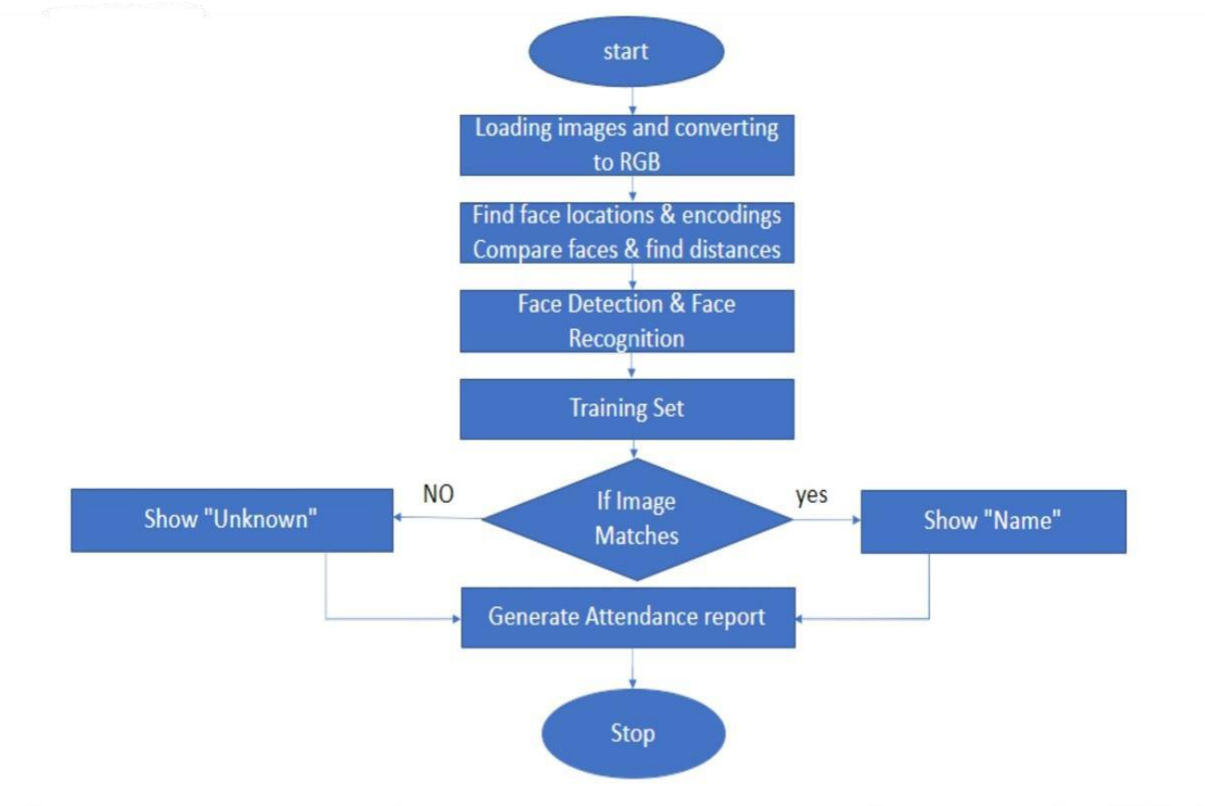


Fig 3.1-Algorithm of Face recognition process.

3.3 DESIGNING FACE RECOGNITION PROGRAM

PYTHON AND VISUAL STUDIO

Python is a dynamic, interpreted (bytecode-compiled) language. There are no type declarations of variables, parameters, functions, or methods in source code. This makes the code short and flexible, and you lose the compiletime type checking of the source code. Python tracks the types of all values at runtime and flags code that does not make sense as it runs. Every Programming language serves some purpose or use-case according to a domain. for e.g., Javascript is the most popular language amongst web developers as it gives the developer the power to handle applications via different frameworks like react, vue, angular which are used to build beautiful User Interfaces. Similarly, they have pros and cons at the same time. so if we consider python it is general-purpose which means it is widely used in every

domain the reason is it's very simple to understand, scalable because of which the speed of development is so fast. Now you get the idea why besides learning python it doesn't require any programming background so that's why it's popular amongst developers as well. Python has simpler syntax similar to the English language and also the syntax allows developers to write programs with fewer lines of code. Since it is open-source there are many libraries available that make developers' jobs easy ultimately results in high productivity. They can easily focus on 17 business logic and Its demanding skills in the digital era where information is available in large data sets.

Visual Studio is an Integrated Development Environment(IDE) developed by Microsoft to develop GUI(Graphical User Interface), console, Web applications, web apps, mobile apps, cloud, and web services, etc. With the help of this IDE, you can create managed code as well as native code. It uses the various platforms of Microsoft software development software like Windows store, Microsoft Silverlight, and Windows API, etc. It is not a language-specific IDE as you can use this to write code in C#, C++, VB (Visual Basic), Python, JavaScript, and many more languages. It provides support for 36 different programming languages. It is available for Windows as well as for macOS. Evolution of Visual Studio: The first version of VS (Visual Studio) was released in 1997, named as Visual Studio 97 having version number 5.0. The latest version of Visual Studio is 15.0 which was released on March 7, 2017. It is also termed as Visual Studio 2017. The supported .Net Framework Versions in latest Visual Studio is 3.5 to 4.7.

3.4 LIBRARIES USED IN PYTHON

1. **OpenCV-python**: It stands for Open Source Computer Vision Library. This library consists of around 2000+ optimised algorithms that are

useful for computer vision and machine learning. There are several ways you can use open cv in image processing, a few are listed below:

- Converting images from one colour space to another i.e. like between BGR and HSV, BGR and gray etc.
- Performing thresholding on images, like, simple thresholding, adaptive thresholding etc.
- Smoothing of images, like, applying custom filters to images and blurring of images. Performing morphological operations on images.

2. **Face-recognition**: Python Module. Automatically find all the faces in an image. Automatically locate the facial features of a person in an image. Recognize faces in images.
3. **Dlib**: Dlib is one of the most powerful and easy-to-go open-source library consisting of machine learning library/algorithms and various tools for creating software.
4. **Numpy**: NumPy can be used to perform a wide variety of mathematical operations on arrays. It adds powerful data structures to Python that guarantee efficient calculations with arrays and matrices and it supplies an enormous library of high-level mathematical functions
5. **Cmake**: Cmake is cross-platform free and open-source software for build automation, testing, packaging and installation of software by using a compiler independent method.

3.5 SOURCE CODE

import cv2 import numpy as

np import face_recognition

```
import os from datetime

import datetim # from PIL

import ImageGrab path =

'photos' images = []

classNames = [] myList =

os.listdir(path) print(myList)

for cl in myList:

    curImg = cv2.imread(f'{path}/{cl}')

images.append(curImg)

classNames.append(os.path.splitext(cl)[0])

print(classNames) def

findEncodings(images):

    encodeList = []

for img in images:

img =

cv2.cvtColor(img,cv

2.COLOR_BGR2R

GB)         encode =

face_recognition.fac

e_encodings(img)[0]
```

```
encodeList.append(e
ncode)     return
encodeList def
markAttendance(na
me):
    with open('Attendance.csv','r+') as f:
        myDataList = f.readlines()         nameList
= []         for line in myDataList:              entry
= line.split(',')
nameList.append(entry[0])         if name not in
nameList:              now = datetime.now()
dtString = now.strftime('%H:%M:%S')
datestring=now.strftime('%d/%m/%y')
            f.writelines(f'\n{name},{dtString},{datestring}')
#### FOR CAPTURING SCREEN RATHER THAN WEBCAM
# def captureScreen(bbox=(300,300,690+300,530+300)):
#     capScr = np.array(ImageGrab.grab(bbox))
#     capScr = cv2.cvtColor(capScr, cv2.COLOR_RGB2BGR)
#     return capScr encodeListKnown =
findEncodings(images) print('Encoding
```

```
Complete') cap = cv2.VideoCapture(0)

while True:

   success, img = cap.read()     #img = captureScreen()

imgS = cv2.resize(img, (0,0),None,0.25,0.25)     imgS =

cv2.cvtColor(imgS, cv2.COLOR_BGR2RGB)

facesCurFrame = face_recognition.face_locations(imgS)

   encodesCurFrame        =        face_recognition.face_encodings(imgS,

facesCurFrame)     for encodeFace, faceLoc in zip(encodesCurFrame,

facesCurFrame):

       matches        =        face_recognition.compare_faces(encodeListKnown,

encodeFace)

       faceDis        =        face_recognition.face_distance(encodeListKnown,

encodeFace)

       print(faceDis)        matchIndex =

np.argmin(faceDis)        if

faceDis[matchIndex] < 0.50:

           name = classNames[matchIndex].upper()

           markAttendance(name)

print(name)        else:

           name = 'Unknown'            print(name)        y1, x2, y2, x1 =

faceLoc        y1, x2, y2, x1 = y1 * 4, x2 * 4, y2 * 4, x1 * 4
```

cv2.rectangle(img, (x1, y1), (x2, y2), (0, 255, 0), 2)

cv2.rectangle(img, (x1, y2 - 35), (x2, y2), (0, 255, 0), cv2.FILLED)

cv2.putText(img, name, (x1 + 6, y2 – 6), cv2.FONT_HERSHEY_COMPLEX, 1, (255, 255, 255), 2)

cv2.imshow('Webcam',img) cv2.waitKey(1)

CHAPTER-4

RESULT AND DISCUSSION

The test was performed using Data set consisting of five images. Each image is renamed after the corresponding students. An excel sheet is created as the result of the process which stores the students name, recorded date and time in a sequential manner. The Data set images are mentioned in Fig4.1 and in Fig4.2, output(detected) images are mentioned in Fig4.3 and in Fig4.4, output(unknown) image is mentioned in Fig4.5 and excel sheet(recorded attendance) is mentioned in Fig4.7

DATA SET

Fig 4.1, 4.2-The images given in the data set to identify the faces in real time.

A data set is a collection of related, discrete items of related data that may be accessed individually or in combination or managed as a whole entity. A data set is organized into some type of data structure. A dataset acts as an example to teach the machine learning algorithm how to make predictions. The common types of data include: Text data. Image data.

END OUTPUT

KNOWNFACES

Fig 4.3, 4.4-Detected Faces after performing the Face recognition process

UNKNOWN FACES

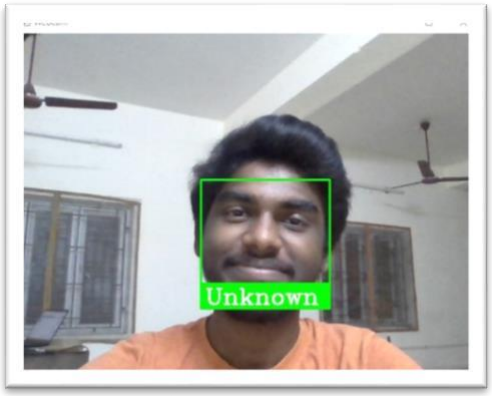


Fig 4.5-Recognition of the Unknown Faces after performing Face detection process.

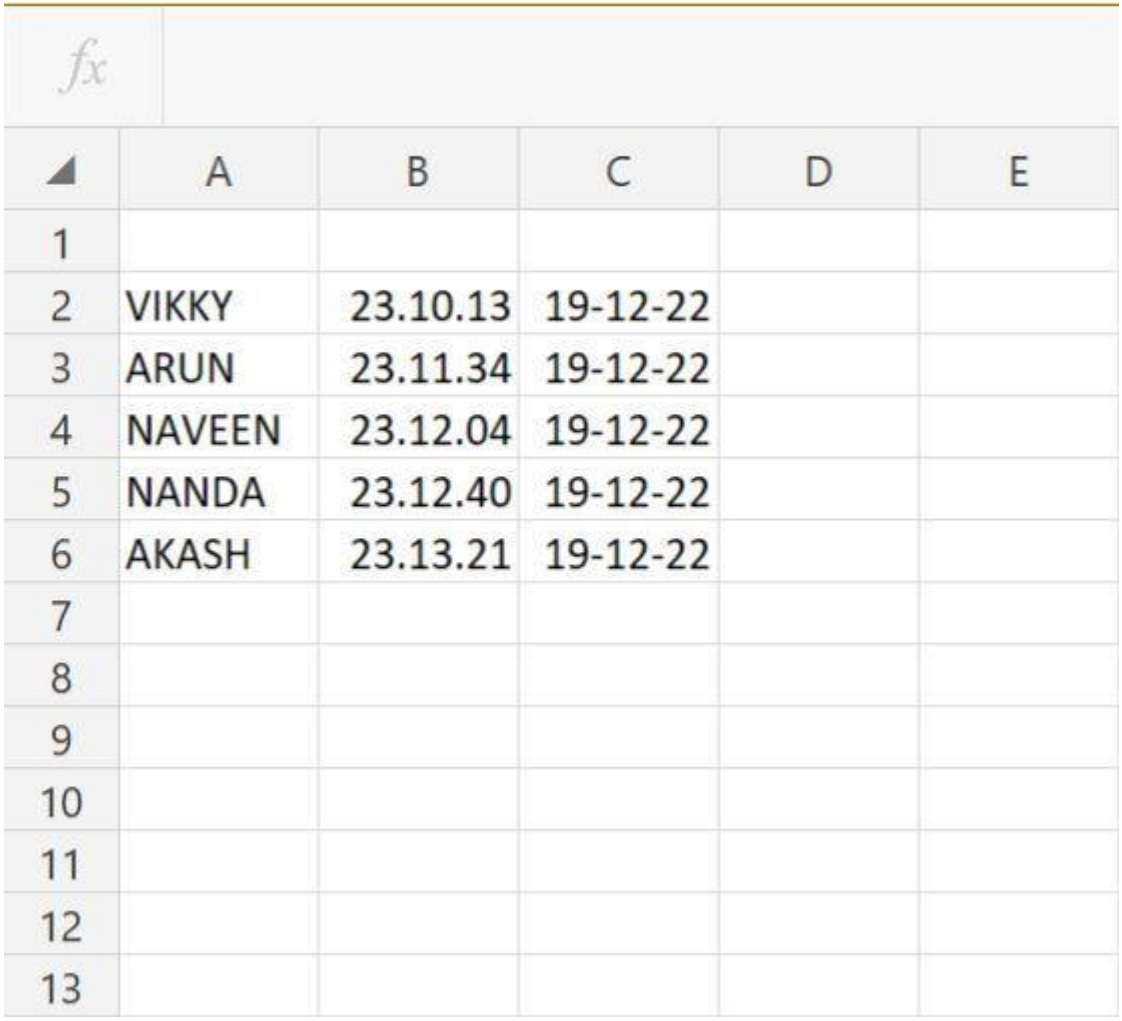
FACE DISTANCES

```
VIKKY
[0.64312038 0.4912219  0.67029703 0.57415873 0.42084694]
VIKKY
[0.66079278 0.49408143 0.66712764 0.57324857 0.43684172]
VIKKY
[0.66024393 0.49004334 0.6513098  0.56460306 0.43511951]
VIKKY
[0.66168101 0.50517689 0.65758128 0.56011948 0.44109297]
VIKKY
[0.65244981 0.51258417 0.65916855 0.56139334 0.42650758]
VIKKY
[0.64646439 0.5205558  0.66111305 0.56437607 0.40877002]
VIKKY
[0.64499606 0.51256984 0.636641   0.58371547 0.39186059]
```

Fig 4.6-correlation between data set image and the real-time student image

Correlation describes the strength of an association between two variables, and is completely symmetrical, the correlation between A(Data set images) and B(real time student images) is the same as the correlation between B and A. However, if the two variables are related it means that when one changes by a certain amount the other changes on an average by a certain amount. More than one independent variable is possible – in such a case the method is known as multiple regression. This is the most versatile of statistical methods and can be used in many situations.

ATTENDANCE SHEET



	A	B	C	D	E
1					
2	VIKKY	23.10.13	19-12-22		
3	ARUN	23.11.34	19-12-22		
4	NAVEEN	23.12.04	19-12-22		
5	NANDA	23.12.40	19-12-22		
6	AKASH	23.13.21	19-12-22		
7					
8					
9					
10					
11					
12					
13					

Fig4.7- Excel sheet(recorded attendance of students).

The Face detection algorithm shows 90% - 95% of right hit rate, and 0% of repeat rate, and 5% of false hit rate. The average execution time of the program is 26 seconds. The program runs till the user closes the program or end the program.

CHAPTER-5

CONCLUSION

The objective of class attendance system is to automate the time consuming and error prone attendance system. The system has been verified with the help of real time data samples. The processed image will then be compared against the existing stored dataset and then attendance is marked in the database accordingly. Compared to existing system traditional attendance marking system, this system reduces the workload of people. The system developed gives 90%-95% accurate results. Along with the challenges such as bad illumination and image orientation faces are detected, recognized and attendance is updated. This system detects and recognizes all the faces which is given as input without the loss of information.

Thus, it can be concluded from the above discussion that a reliable, secure, fast and an efficient system has been developed replacing a manual and unreliable system. This system can be implemented for better results regarding the management of attendance and leaves. The system will save time, reduce the amount of work the administration has to do and will replace the stationery material with electronic apparatus and reduces the amount of human resource required for the purpose. Hence a system with expected results has been developed.

FUTURE WORK

The system can be extended to more number of students with freedom to change list of students according to class changes. The system can be made more flexible to allow updating of templates in case student incurs significant amount of change in his facial features. The system can also be extended to allow better face recognition algorithm in which even rotational features of face can be detected efficiently. Scaling the number of attendees (which can be done easily by any user). Optimizing the synchronization between VISUAL STUDIO and Excel attendance sheet.

The face recognition model would be done more precisely so that maximum accuracy can be achieved. Adding each student manually can be a tedious task, despite of this fetching data from excels would be efficient. The marked attendance is stored in only one excel, rather different excels for different date can be created. The number of pictures taken and transmitted to the facial recognition system per second. Higher FPS can provide higher accuracy and performance.

Designing training methods to minimize the negative effects of data label noise would increase the accuracy and make the recognition more robust for more extreme environments with low image quality, varying facial poses, and low illumination. Balancing datasets over the races and genders in addition to training procedures to make the models learn generic facial representations in a more efficient way are topics that need further research to improve the accuracy and robustness of the end-to-end system.

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