FACIAL RECOGNITION BASED ATTENDANCE SYSTEM FOR BANGLADESHI EDUCATION INSTITUTION

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This Thesis report has been submitted in fulfillment of the requirements for the Degree of Bachelor of Science in Software Engineering.

Fall-2022

APPROVAL

Approval

This thesis titled "**FACIAL RECOGNITION BASED ATTENDANCE SYSTEM FOR BANGLADESHI EDUCATION INSTITUTIONS**", submitted by **KOWSHIK SARKAR (ID: 191-35-2774)** to the Department of Software Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of Bachelor of Science in Software Engineering and approval as to its style and contents.

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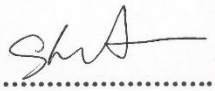

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ACKNOWLEDGEMENT

First, to Almighty God, I express my heartiest thanks and gratefulness for His divine blessing in making it possible to complete the final year thesis successfully.

I am grateful and wish our profound indebtedness to **Md. Shohel Arman**, **Assistant Professor**, Department of Software Engineering, Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of "Deep Learning" to carry out this project. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior drafts, and correcting them at all stages have made it possible to complete this project.

I would like to express my heartiest gratitude to **Dr. Imran Mahmud**, **Associate Professor & Head In-Charge**, Department of Software Engineering, Daffodil International University, Dhaka, for his kind help to finish my thesis and also to other faculty members and the staff of the SWE department of Daffodil International University.

Finally, I must acknowledge with due respect the constant support and patients of my parents. Also, I want to thank me for believing in me.

ABSTRACT

In Bangladesh, we still follow the traditional way to take attendance in class, which is a time-consuming and monotonous job to do. Students give proxies of their fellow students and bunk classes after the attendance session. To prevent this and make the attendance procedure smarter we need to make an attendance system through biometrics authentication. Among all the biometrics methods facial recognition is the most renowned and reliable. It is faster and more accurate than other biometric methods. This paper proposes a system that will mark attendance through face recognition. To detect and recognize the faces we have used OpenCV, Python, and deep learning. In this paper, we have used a pre-trained model called the face_recognition library. After recognizing the faces, they will be matched with faces in the database and stored attendance in a CSV file with the time and the name of that student.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND:

We are currently living in a modern world where everything now has a touch of modernity. Where taking attendance manually is a tedious job to do, on the other hand, many companies and educational intuitions use the fingerprint scanner as an attendance-taking machine which is costly to maintain and also has many kinds of technical issues. The typical cost of a fingerprint scanner ranges from $40 to more than $400. There are some issues we face during using the fingerprint attendance system like when fingerprints are smudged with grease or grime or have cuts or wounds, it is difficult to identify the person. Normally sensors of fingerprint scanners are more sensitive its works fine if fingers are clean however, these sensors are ineffective for businesses like manufacturing, construction, and mining. Either safety equipment, like gloves, is worn by the workforce in these occupations, or their fingers are covered in dust and filth.

As fingerprint-based attendance systems are fully dependent on hardware and peripherals most of the time it is expensive because we need to install hardware at every location. Sometimes fingerprint data can be stolen because these systems store data of physical traits like fingerprints and palm veins in a local database. The accuracy of fingerprint-based attendance systems is less because it depends on fingerprint conditions. Also, this is not so versatile or fast. This system extremely depends on hardware which affects its performance.

On the other hand, every institution or institute has a unique system in place for recording attendance. One of the outdated systems uses a file, register, or paper-based approach, while others use more modern approaches like biometrics. colleges have been quite concerned with student attendance because teachers waste a lot of time by taking attendance manually. The current biometric attendance system needs a line of people to have their fingerprints scanned to register their attendance because it is not automated, which takes a lot of time and is difficult to maintain. Students giving false attendance is another problem we face regularly. After giving attendance students bunk the classes which are unethical.

In other countries, they have already developed some face recognition attendance systems using haar cascade, CNN, LBPH, and other models. Where their accuracy is good but faces recognition time is not fast enough.

In my work, I have approached a face recognition attendance system made of OpenCV, python, and deep learning, to make this in an efficient way I have used the dlib library for deep metric learning, face recognition library for facial recognition, OpenCV library for preprocessing and imutils library to make image processing functions easier. Here I have used HOG as a detection method.

1.2 MOTIVATION OF THE RESEARCH:

Taking attendance manually is a tedious job to do, it takes a lot of time just to take attendance. Many institutions use fingerprint scanners as attendance-taking machines, which are more costly not accurate, and time-consuming. Many people use fingerprint spoofing for unethical authentication. Many students give false attendance to their fellow students. Maintaining all these are hard to do. If there have a system for the authority to mark attendance based on face recognition all these unethical works can be prevented. In other countries, they have already developed some systems which can recognize faces, and after that gives attendance. Like there are some face recognition systems “Real Time Automatic Attendance System for Face Recognition Using Face API and OpenCV” (khan, 2020). “Implementing CCTV-Based Attendance Taking Support System Using Deep Face Recognition: A Case Study at FPT Polytechnic College” (Son, 2022). The developed systems have high accuracy. But in our country, we still follow the tradition of taking attendance with a fingerprint sensor which is not cost effective and also less accurate. By motivating us to consider creating a system for our county institutions to take attendance. So, the motivation behind the work is to make a time effective face recognition base attendance system for our county which will give best results.

1.3 PROBLEM STATEMENT:

If attendance is managed manually, it may be quite taxing on the instructors (Sawhney, 2019) We know that taking attendance manually is quite problematic for teachers, as they have to cover their lessons in time after that they have to take attendance. Early many works on the face recognition attendance system have already been done. Numerous researchers' authors employ a variety of algorithms, including Eigenface values, Principal Component Analysis (PCA) and Convolutional Neural Network (CNN), YOLO V3 (You only look once) algorithm, and Microsoft Azure face API. Some approaches with haar cascade algorithm to detect faces, and some approaches with LBPH algorithm to recognize the faces. With several systems, they gathered the data. Some employed specially created datasets, while others utilized readily accessible global data. For our county, we want to make a faster face recognition model for the attendance system and also which will be cost effective.

1.4 RESEARCH QUESTION:

The research question was

- What detection method should we use to correctly encode the face?
- Can this model recognize multiple faces at a time?

1.5 RESEARCH OBJECTIVE:

My paper's primary goal is to make a faster face recognition attendance system in a sufficient way.

Our thesis goals are:

- Creating a smart attendance system
- Constructing a system that is inexpensive and accessible to Bangladesh
- Recognize faces from Photos
- To get a faster system

1.6 RESEARCH SCOPE:

Research's main scope is as follows:

- We can use this system at any institutions for attendance purpose
- Where security is primary goal, and entry is restricted we can use it there
- Where record of attendance is necessary

1.7 THESIS ORGANIZATION:

The first chapter includes a section on the facial recognition-based attendance system and how it is used, the context of the work, the driving force behind the investigation, the problem statement, the research questions, and the research purpose are explored. The other parts related to our research are as below:

In the following chapter, I'll go over the literature review, in which we can see some researchers' studies that have already been done on the same topic of face recognition-based attendance systems, their methodologies, any gaps, and a comparison between my work and theirs based on our shared field of study. Our research's methodology will be covered in chapter three. Data collection, data pre-processing, and work analysis will all be included in the methodology section of my paper. In chapter four, the methodology's findings will be described. The final chapter serves as the conclusion. Here I will provide the conclusion, which will include a complete summary of my efforts. Here, I've talked about the work I'll undertake going forward to further the work.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION:

A researcher evaluates earlier work, research, conference papers, books, articles, etc. in a literature review. With it, one may learn what research has previously been done on the subject, give a general overview of it, and identify any gaps in the work. After analysis, they may focus on.

2.2 PREVIOUS LITERATURE:

The idea of repairing the face recognition-based attendance system started from the time when people started to realize taking attendance manually is a tedious job to do, it is a time-consuming process, and sometimes teachers forget to take attendance or students give proxies to their fellow students. After that fingerprint base attendance system came but, it was a costly process and it shows less accuracy. Numerous academics have previously conducted their studies and used various sorts of machine learning algorithms to detect faces in videos or photographs and record attendance. Some of the works are face recognition attendance along with notification system. Therefore, I have concentrated on attendance and face recognition for my work.

Tej Chinimilli et al. [1] proposed the Haar cascade for face detection and the LBPH algorithm for face recognition. They got face recognition rate of students is 77% and its false-positive rate is 28%. Which is not so good but their system recognizes students even when students are wearing glasses or have grown a beard. That means this system can recognize obligated faces, but in this paper, they didn't mention how much time it takes to process.

In today's world, face recognition (FR) and verification is the incomparable technology to catch any illegal activity. With impressive applications ranging from criminal identification, security, and observation to entertainment websites. Manna et al. [2] This study presented a facial recognition system that effectively aids police and administration by speeding up the process of looking for offenders. In this paper, a pre-trained model i.e., FaceNet (FN) is used for face recognition from video. The model they have used is efficient because it takes less training.

The emergence of the big data age and the economic significance of facial recognition technology has greatly increased the potential and market demand for this technology. Yang and Han [3] proposed a system based on four problems which are the accuracy of the face recognition system during actual check-in, stability of the face recognition attendance system with real-time video processing, truancy rate of the face recognition attendance system with real-time video processing, and interface settings of the face recognition attendance system using real-time video processing. According to experimental data, the video facial recognition system's accuracy rate can reach 82%. They have used the LDA method for feature extraction.

If attendance management is handled manually, it may be a significant load on the instructors. Sawhney et al [4] propose a model for implementing an automated attendance management system for students of a class by making use of face recognition techniques, using Eigenface values, Principal Component Analysis (PCA), and Convolutional Neural Network (CNN). As PCA simplifies the complexity and CNN is mainly used for image recognition with multiple layers using these two in a model brings a good result.

A facial characteristic may be employed in numerous video surveillance applications as well as several face and emotion identification methods in computer vision. Damale and Pathak [5] have presented three different methods such as SVM, MLP and CNN. DNN is used to detect faces. The features are retrieved using PCA and LDA feature extraction methods for SVM and MLP-based approaches. In a CNN-based technique, the photos were sent as a feature vector straight to the CNN module. Among these methods CNN shows best accuracy at 98%.

The teachers must spend a lot of time and laboriously mark the attendance by hand, which has historically been a big worry for institutions. Khan et al [6] proposed a model on YOLO V3 (You only look once) and Microsoft Azure face API. YOLO V3 is an old algorithm for object detection however this system has proven to gather high accuracy in face detection and performance.

The learning process depends on student participation. There are various ways to record student attendance, with student signatures being one of them. The procedure has several flaws, including the lengthy attendance request process. To overcome this problem Sutabri et al [7] proposed a web-based system using Convolutional Neural Network (CNN), deep metric

learning, and K-NN. As we know KNN makes highly accurate predictions so this model will be good for recognition.

The hardest job in every company is keeping track of attendance. Madhu et al [8] proposed a model using a Histogram of Oriented Gradients (HOG) and HOG with LBPH (a type of machine learning algorithm for classification) approach to recognize HOG descriptors of people. LBPH beats other algorithms in real-time circumstances with a higher recognition rate and a lower false positive rate.

In the business sector, effective and adequate attendance management is crucial. Sanath et al [9] propose a model using RFID and face recognition along with temperature checks. Also, it captures the facial expression of the employee to detect the emotion. During power outages, RFID systems may not function properly which can affect the model.

The teacher's notebook or any other application is used in the academic setting to manually record and update attendance. Uddin et al [10] proposed a system using DLib and ResNet-34 with an accuracy rate of 96.03% to 96.62%. As DLib is good for face detection it shows a good accuracy rate, in my work I have also used the dlib for face detection with CNN detection method for embedding and HOG for face detection from videos.

Wu et al [11] proposes a face image recognition method based on haar-like and Euclidean distance. The experimental findings indicate that one attendance takes between 5 and 10 seconds, and face recognition is successful 91.1% of the time. Haar is a backdated model to use.

2.3 SUMMARY:

There are many different kinds of algorithms in use. For having a good result, they have used many algorithms, some have use advance technology to detect temperature and emotion. Some used some backdated algorithms but got a good result. Most of the author didn’t mention about embedding or face recognition time. In our work we have focused the time.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION:

We have used the dlib library contains the "deep metric learning" that we utilized to build the face embeddings that were employed in the recognition procedure. The “Face recognition” library makes it simpler to use by wrapping around dlib's facial recognition functionality. To make the face recognition capability easier to use, face recognition library offers a wrapper around dlib. OpenCV It is a free software library for computer vision and machine learning. A standard infrastructure for computer vision applications was created with OpenCV in order to speed up the incorporation of artificial intelligence into products. The imutils library is a collection of useful OpenCV functions that simplify basic image processing tasks. We have used encodings.pickle to store 128-d face embeddings for each face in our dataset.

3.2 DATA COLLECTION:

On the internet, there is already a dataset that has been the subject of much research. Like Face Recognition Attendance system- Yashesh Tiwari 2019. On the internet, other dataset resources come from many nations. However, no dataset on Bangladeshi pupils' facial recognition attendance data is available. So, we have thought to collect data from Bangladeshi educational institutions. For this work, I have collected data from the DAFFODIL INTERNATIONAL UNIVERSITY classroom, and face data from students.

Figure 1: Students face data sample

3.3 DATA PREPROCESING:

We started preprocessing our dataset after gathering data from the students and the classroom. In this stage, we prepare the data for the machine to train on so that it can readily learn the data. As we have used a pre-trained model, we just need to train the model with our student's facial data to recognize those faces from the photo data set. Before being able to recognize faces in images and videos. First, we have to encode (or measure) the faces in our training set. We have to keep in mind that we are not actually training a network here-the network (in the library 'face_recognition') has already been trained to create 128-d embeddings from a dataset of ~3 million images. We conducted the final face classification using a straightforward KNN model and user votes. There is also room for other conventional machine learning models in this situation.

3.4 FACE RECOGNITION LIBRARY:

The CNN approach will first be used to construct facial patterns. We will choose the portion of the compressed images that most closely resembles the authentic, well-known CNN face pattern. The recognized face is then surrounded by a bounding box. The facial landmark estimation algorithm will be used to locate the 68 distinctive points on every face. By applying straightforward image transformations like rotation, scale, and shear, OpenCV's affine transformation will try to make the eyes and lip appear in the same location on every image with the aid of the detected landmarks. From the centered facial images, a deep convolution neural network creates a 128-dimensional unit hypersphere with 128 measurements. Because we are using facial recognition, classification is our plan of action.

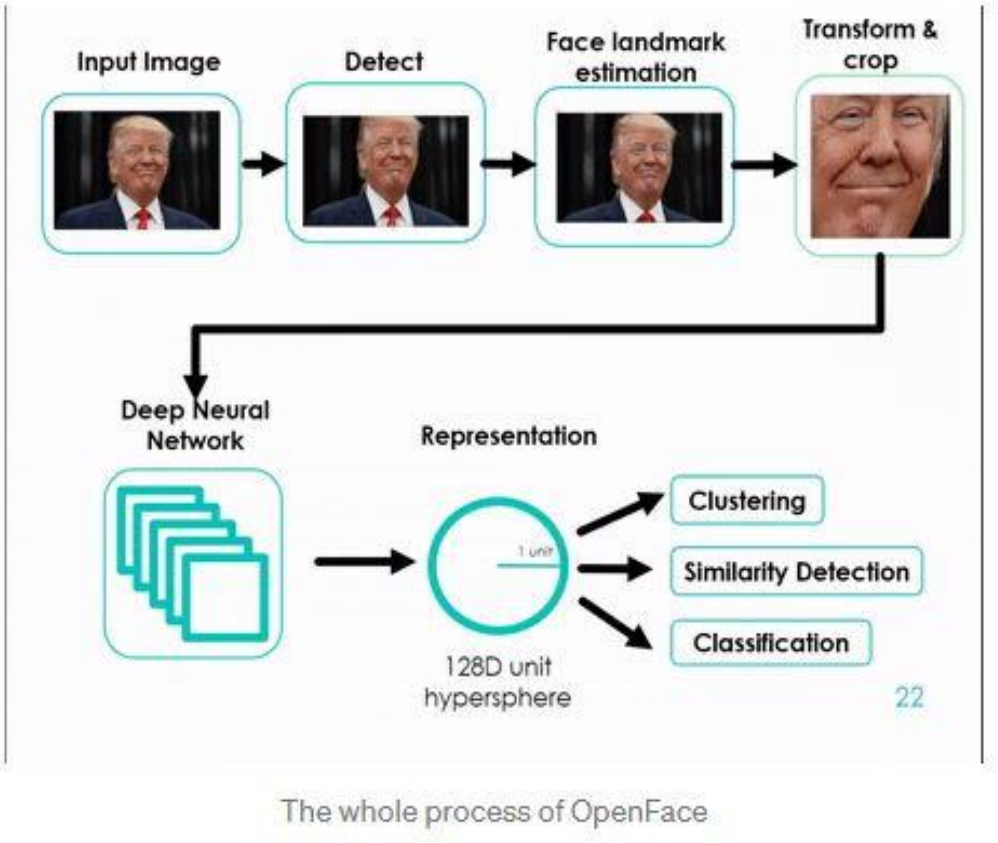

Figure 2: Picture of face recognition library

3.5 OpenCV:

We must first encode (or measure) the faces in my training set before we can recognize them in photos and videos. The network (in the package "face recognition") has already been trained to produce 128-d embeddings from a dataset of around 3 million photos, so we are not technically training a network here. Alternately, we could train a network from scratch or even tweak the model's weights, but it would be too much work for many tasks. Furthermore, to train the network from start, we would require a large number of photos. It is simpler to utilize the pre-trained network and create 128-d embeddings for every face in my dataset using that network. I conducted the final face categorization using a straightforward KNN model and votes. There is also room for other conventional machine learning models in this situation. A "triplet training step" is necessary for deep metric learning to recognize faces. The triplet consists of three distinct facial photographs, two of which are of the same individual. Each of the three facial photos receives a 128-d vector from the NN.

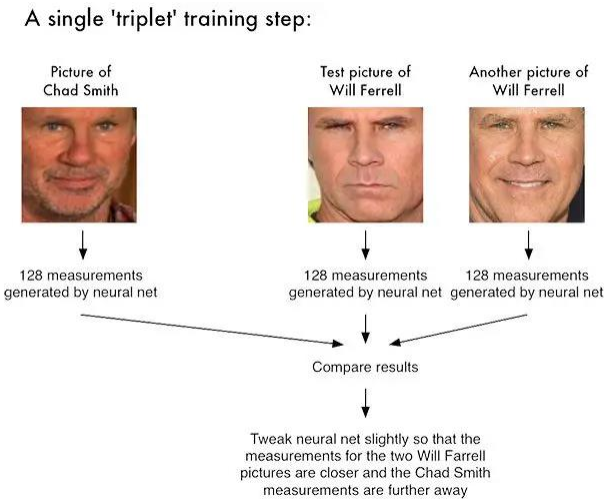

Figure 3:Triplet training step

3.6 DLib FACE DETECTION:

The Dlib open-source C++ application and library package is distributed under the adaptable Boost license. DLib provides two face detection routines, one for a HOG + Linear SVM face detector and another for the MMOD CNN face detector.

3.6.1 HoG + Linear SVM:

Although the Histogram of Oriented Gradients (HoG) + Linear Support Vector Machine (SVM) method in Dlib can recognize faces quickly from the front, it is only partially capable of doing so for faces posed at acute angles (such as CCTV footage, or casual surveillance environments where the subject is not actively participating in the ID process). While recognizing faces from the video we have used this HOG detection method as it is faster than CNN but less accurate.

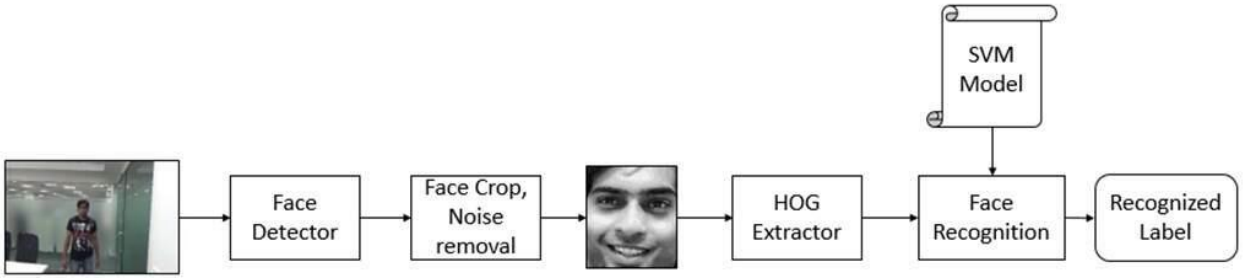

Figure 4: Face detector using Hog

3.6.1 Max-Margin (MMOD) CNN:

The durable and dependable MMOD face detector uses a convolutional neural network (CNN) and is GPU-accelerated. It is far more capable of catching faces in difficult lighting and obscure angles, making it ideal for casual surveillance and urban analysis. While creating facial embeddings we have used cnn face detection method as it is more accurate than the Hog method.

3.7 TRANSFER LEARNING:

The proposed method in the work is the transfer Learning of OpenCV. Transfer learning is the process of taking a shortcut to reuse previously trained model weights. The generic qualities of images can be recognized using transfer learning methods. It reached state-of-the-art performance and the system is still functional.

3.8 KNN:

One of the simplest machine learning algorithms, based on the principle of supervised learning. The K-NN algorithm assumes similarity between the new case/data and the existing cases and places the new case into the category that is most similar to the existing categories. In order to classify a new data point based on similarity, it stores all of the existing data. This means that utilizing the K-NN method, fresh data can be quickly and accurately sorted into a suitable category.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION:

In the previous chapter, I discussed data collecting, data pre-processing, and the model I have used in this system. In this part, I will discuss the embedding process time and the result of this model.

4.2 RESULT DISCUSSION:

After implementing the pre-trained model on our dataset, we have gotten the model's accuracy of 87%, face embedding time, and face recognition time is given here.

4.3.1 FACE EMBEDDING TIME:

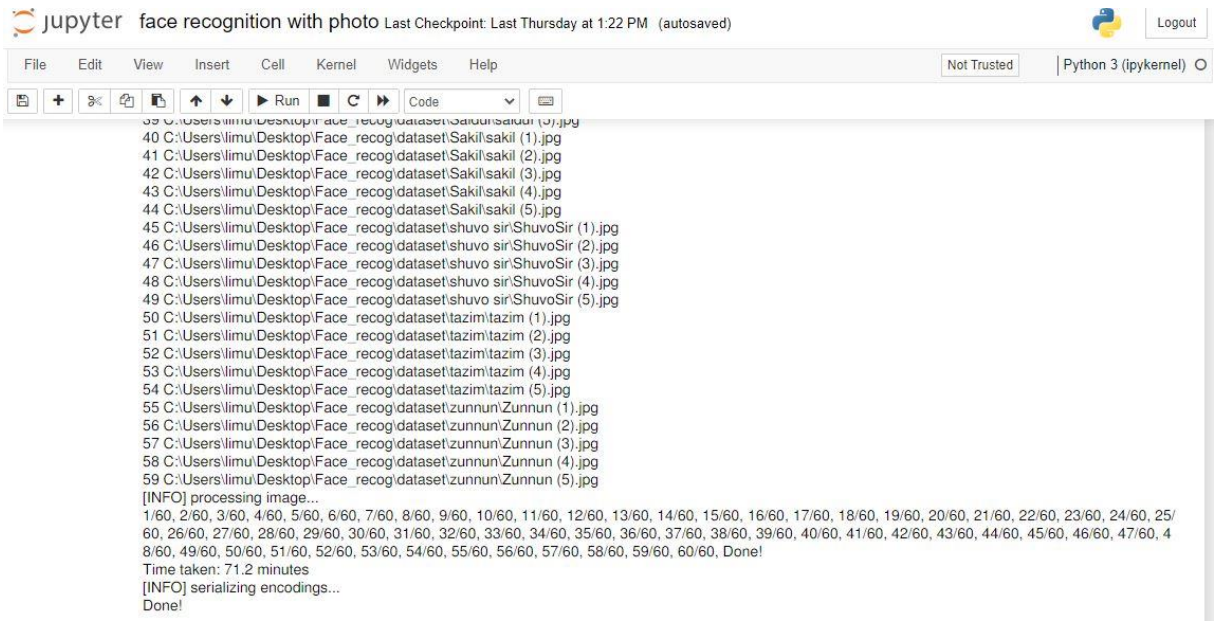

Figure 5: Students face dataset encoding time

4.3.2 FACE RECOGNITION TIME:

```
In [19]: args['image'] = os.getcwd() + '\\image_test\\test (10).jpg'
         recognise_faces(args)

         [INFO] loading encodings...
         [INFO] recognising faces...
         ['Sakil', 'Rifat', 'Niloy']
         Time taken: 35.5 seconds
```

Figure 6: 1st input picture

```
In [21]: args['image'] = os.getcwd() + '\\image_test\\test (12).jpg'
         recognise_faces(args)

         [INFO] loading encodings...
         [INFO] recognising faces...
         ['Pranto', 'Fahad']
         Time taken: 64.8 seconds
```

Figure 7: 2nd input picture

4.3.3 OUTPUT:

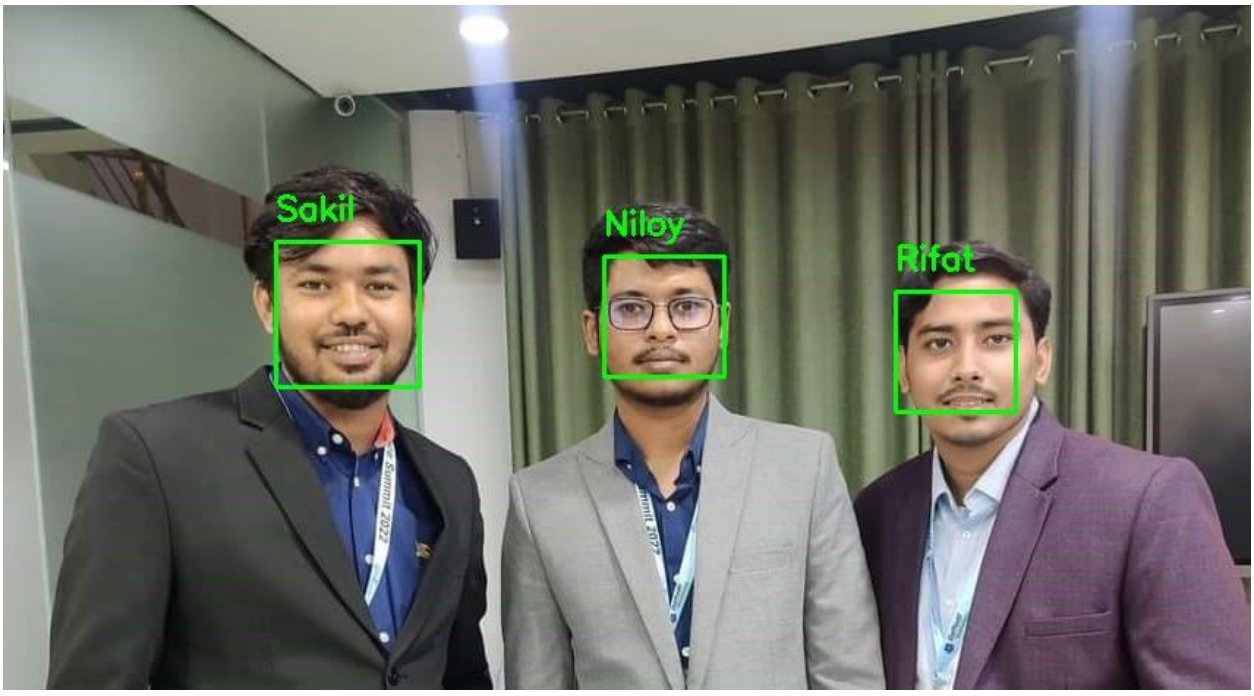

Figure 8: 1st picture output

Figure 9: 2nd picture output

4.3.4 ATTENDANCE SHEET:

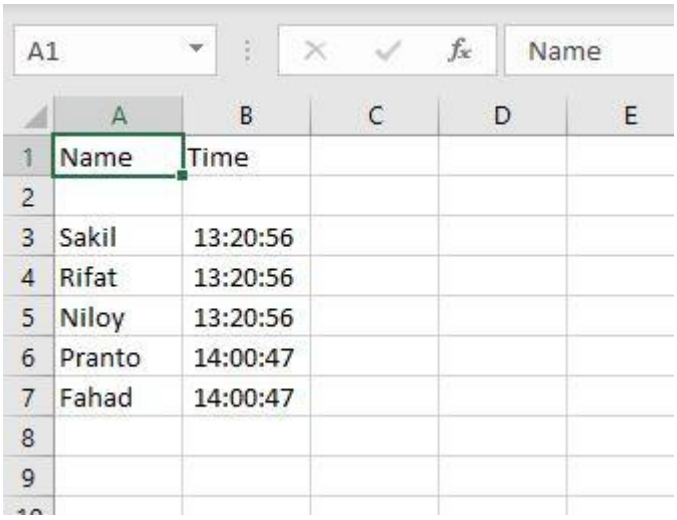

Figure 10: Attendance sheet output

4.4 DISCUSSION:

As we expected the pretrained face recognition model in not showing a good result, for covered faces like faces with glasses it showing wrong recognition. For CNN detection method it is showing less accuracy but in hog method, it is working faster.

4.5 SUMMARY:

In this segment, we discussed the final result of our model. The face recognition model is a pre-trained model where I have tested my data set.

CHAPTER 5

CONCLUSION & LIMITATIONS

5.1 CONCLUSION:

The professors must spend a lot of time and laboriously mark attendance manually, which has historically been a major worry for institutions. Students don't get the full class time and sometimes teachers forget to take attendance, which affects the attendance mark of the students. Many students give proxy attendance to their classmates which is unethical work. To prevent this, we need a smart face recognition system. It will help the authority to track down attendance without any hassle. So, with my work, I have tried to make a system that has a fast embedding and recognition time. For the work, I have used the deep learning method. From deep learning, I have used the transfer learning method of a pre-trained model. With this we can recognize multiple faces from a single picture.

5.2 LIMITATION:

The model's precision in the work is unsatisfactory. It might be a result of the tiny dataset that is based on a DIU classroom. This model can't recognize faces in low light. Further, I will try to increase the dataset to get higher accuracy. And in my next work, I want to recognize kerchiefed faces.

5.3 FUTURE WORK:

In future we want to implement presentation attack detection in our work, so that we ensure more security. Also, we want to work for the faces which are covered with objects like glasses, burkha, cap etc.

CHAPTER 6

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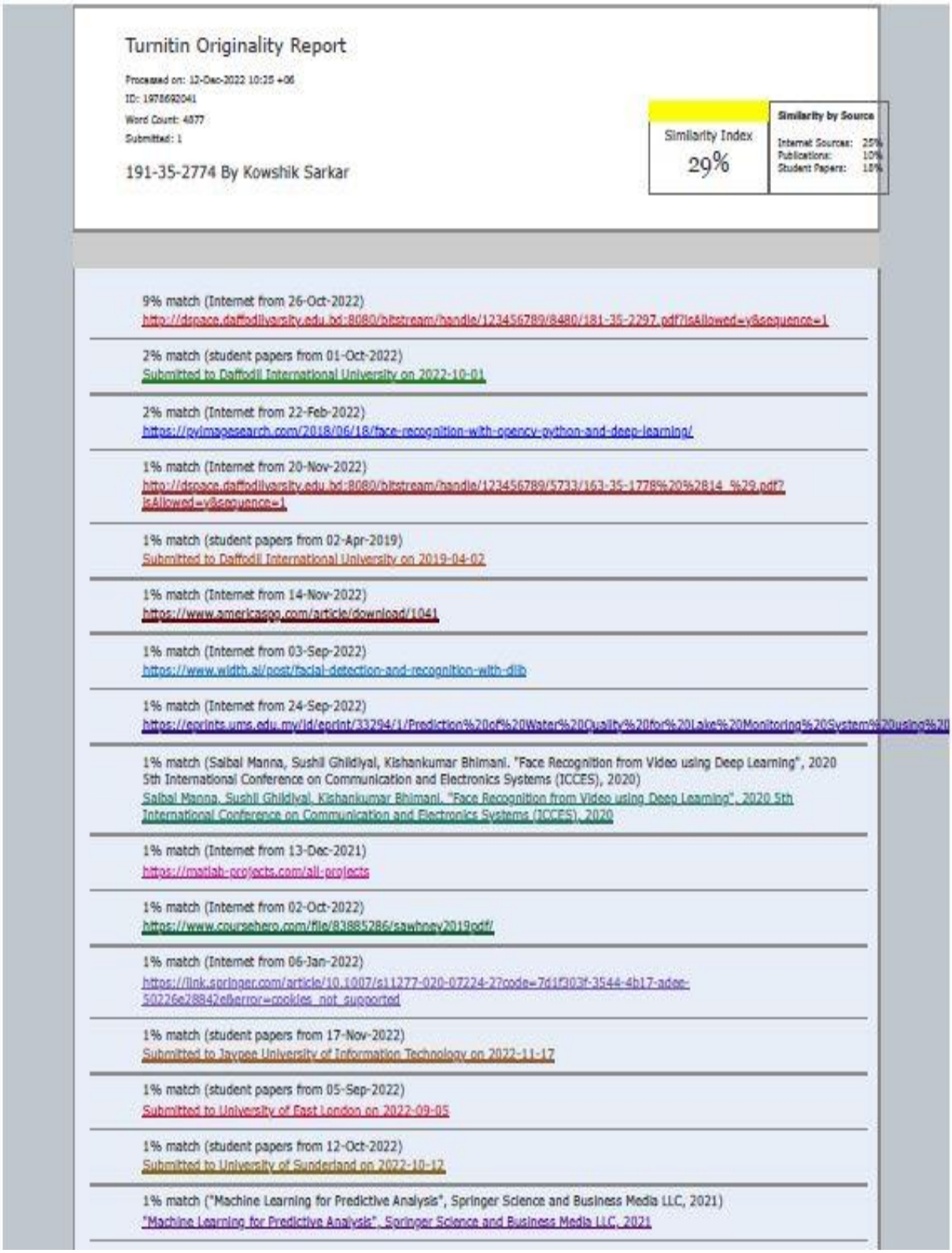

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