Automated Attendance System Using Face Recognition with One-Shot Learning and Siamese Neural Networks.

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

This Project titled "**Automated Attendance System Using Face Recognition with One-Shot Learning and Siamese Neural Networks**", submitted by Md. Abu Shaik, ID No: **152-15-5612** and Ashikul Islam, ID No: **152-15-5638** to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 02.05.2019.

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DECLARATION

We hereby declare that this project has been done by us under the supervision of **Nafis Neehal, Lecturer, Department of Computer Science Engineering,** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

A face is the identity of a person. Not only human but also machines can now identify a person. Face recognition system is a Biometric Artificial Intelligence application. Now it is widely used everywhere in the world. It can be also used in our classroom. It is compulsory to take attendance in an educational institute like school, college, university. Corny approach for attendance is to call students by their names and record the attendance. We are going to use an automated attendance system in our classroom to avoid it. In this approach, we can use the face detection and recognition method. Face detection differentiates the faces from each other and recognition method recognizes the person for daily attendance. For face detection, we can use Haar cascade classifier and for face recognition, we can use Google's FaceNet model. It takes less time than a corny approach. It also helps the teacher to maintain a large classroom. The system also helps to avoid a large number of students from skipping the daily classes. In this system, there is no way of cheating like fake attendance. With the help of this system, we can take attendance at any time. Automated attendance system is now also an individual research subject. We can now focus to make the method more efficient in real time scenario.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

All educational institutes need attendance to improve the quality of education. Nowadays it is compulsory. Attendance system is a great assistance for both teachers and parents. The corny approach is that the teacher calls everyone by their names and record the attendance. So teacher misuses time. In a short time such as one hour, a teacher has to maintain the attendance of a large number of learners such as hundred learners. And it takes like ten minutes. The misuses of time and effort create a huge loss for the learners. So we want to use a modern technique.

Science is developing day by day. Sufficient techniques are invented. Artificial Intelligence is one of them. It creates our lives easy. Nowadays everywhere in the world, we use Artificial Intelligence. So we can use Biometric Artificial Intelligence to solve the attendance problem. The characteristic of every human being is unique. So it is a great idea to take attendance using Biometric Artificial Intelligence. We can use fingerprint scan, iris scan, retina scan, hand scan. So, here we can use face recognition system.

Face recognition system is a Biometric Artificial Intelligence application. We can use this latest technique to prevent all the problems we have commented on before. We can collect an image of the classroom with all the learners who are present and raise their attendance for that day.

The process of the face recognition system is separated into different steps. But the most important steps are face detection and face recognition. Firstly we need an image from where we can detect all the faces and recognize the learners. Then we easily can update the attendance.

1.2 Motivation

There are a lot of educational institutes. In every institute, a large number of learners learn. It is so much difficult for an institute to maintain the attendance sheets. It is also difficult for the teacher. Attendance sheets can be lost at any time. That time both teacher and learners have to face a lot of problems. If the teacher wants to retake the attendance then possibly few learners get the attendance on that day when they are absent. It can also happen the opposite. There is also a way of cheating like fake attendance which is a tough problem. It is not possible for a teacher to detect the solution to this problem. During the exam time, it is also a misuse for a learner to pay the attendance in such a short time. It is also torture for a learner. So it is a large problem. To solve these problems, the best solution is an automated attendance system. A lot of automated attendance system is already available in our classrooms. To save time, we can use automated attendance system using face recognition which is a Biometric Artificial Intelligence application. In this system, there is no chance of cheating because everyone has unique characteristics. For both teacher and learners, it is very simple and here, there is no misuse of time. Also, the institute can pluck data easily.

1.3 Rationale of the Study

In the modern world, everything is now digitalized. Now our classroom is also digitalized. To stop the misuse of time and manual effort of the attendance, there comes a lot of modern methods such as fingerprint scan, iris scan, retina scan, hand scan. Not only for the classes but also for the exam time, it stressful for a learner. To avoid this problem we are going to use another Biometric system that is face recognition. In this process, we need less time. It is also a simple system to maintain a large number of students. Face recognition system also stops fake attendance that is very important for the institute. The characteristic of every human being is unique. A similarity with the different biometric systems, our system has a low possibility to cheat or any other fault.

1.4 Research Questions

We are going to build an automated attendance system for our classroom. To build the system we have to face a few questions. Such as

- Is the system capable to stop the misuse of time for the teacher?
- Is it ideal for learners to save time in their daily classes and exams?
- Can it stop cheat like fake attendance?
- Can the system perform in low configuration computer?
- Does it cost efficient?

1.5 Expected Outcome

In the system, an image is captured. Then the system detects all the faces from the image and identifies them. The recognized faces are updated in the attendance.

- The system stops the misuse of time and manual effort for the teacher.
- The system helps the teacher to maintain a large classroom.
- The system also stops the misuse of time for the learners in their daily classes and exams.
- The system stops fake attendance and also stops a broad number of learners from skipping the daily classes.

1.6 Layout of the Report

- Chapter one explains an Introduction of the project with introduction, motivation, rationale of the study, research questions and expected outcome.
- Chapter two will explain Background with introduction, related works, research summary, scope of the problem and challenges.
- Chapter three will explain Research Methodology with introduction, research subject and instrumentation, work flow, data collection procedure, statistical analysis and implementation requirements.
- Chapter four will explain Experimental Results and Discussion with introduction, experimental results, descriptive analysis and summary.

- Chapter five will explain Summary, Conclusion, Recommendation and Implication of Future Research with summary of the study, conclusions, recommendations, implication for further study.

CHAPTER 2
BACKGROUND

2.1 Introduction

Now everything is digitalized in the modern world. Modern world makes our lives easy. Automated attendance system was invented to make our lives easy and simple. Many methods were invented for automated attendance system. Such as Bar-code attendance system, Radio Frequency Identification attendance system, Bio-metric attendance system.

2.2 Related Works

An attendance system using barcode was manufactured by K.Lakshmi Sudha, Shirish Shinde, Titus Thomas and Aris Abdugani [1] and the barcode builds unique data such as roll number. Learners enter the institute showing the barcode to the barcode reader and the system updates the attendance. A barcode tag, a barcode reader, a computer with the software of the attendance system and a data server are needed in this system. It is a slow process. In this process, there is a lot of way of cheating.

Another process on the attendance system using Radio Frequency Identification (RFID) was declared by Ononiwu G. Chiagozie and Okorafor G. Nwaji [2]. RFID is a suppurate technology that incorporates the conduct of electromagnetic in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object or person. RFID builds unique data such as a roll. In this system, we need an RFID tag, RFID reader, a computer with attendance system software and a server. This system is faster than barcode because abundant entry is permitted at a time. But the main shortage is of cheating.

A Biometric attendance system using fingerprint was manufactured by O. Shoewu and O.A. Idowu [3]. The system scans the fingerprint and recognize the person. A fingerprint device, a computer with the attendance system software and a database

server are needed in this system. It has a great success rate but it is difficult to maintain a large line.

Another Biometric attendance system using Iris Recognition was manufactured by Teh Wei Hsiung and Shahrizat Shaik Mohamed [4]. In this process, we need a camera, an iris scanner, a computer and a database server. In this system, they used Hough Transform and Daugman's Integro Differential Operator to identify and recognize. In the iris recognition system, there are five main stages such as image acquisition, image segmentation, iris normalization, feature extraction and matching. The system scans the iris and recognizes the person. It is an expensive scheme.

Attendance system using face recognition is used by Borra Surekha, Kanchan Jayant Nazare, S. Viswanadha Raju and Nilanjan Dey [5]. A camera, a computer and a database server is needed in this system. They used Voila-Jones algorithm and MKD-SRC method of partial face recognition algorithm for a controlled and uncontrolled environment. There are mainly five stages of the system. In the uncontrolled environment, efficiency is very much low.

Classroom attendance system based on face recognition was manipulated by Ajinkya Patil, Mrudang Shukla [6]. A camera, a computer with the system and a data server are needed in this system. The Raspberry Pi module is used for face detection & recognition. For face detection, they used the Viola-Jones face detection algorithm and for face recognition, they used the hybrid algorithm from PCA and LDA. In their system, there are capitally seven steps.

Attendance for class students was manufactured by six researchers Muhammad Fuzail, Hafiz Muhammad Fahad Nouman, Muhammad Omer Mushtaq, Binish Raza, Awais Tayyab and Muhammad Waqas Talib [7]. They raised using real-time face detection algorithms integrated on existing Learning Management System (LMS) which automatically detects and registers the learners. A camera, a computer with the system and a data server are needed in this system. They picked HAAR classifier for face

detection. They implemented a server based module which is programmed in python to recognize the face.

Rapid Object Detection using a Boosted Cascade of Simple Features was invented by Paul Viola and Michael Jones [8]. They described a machine learning process for visual object detection which was capable of processing images extremely rapidly and achieving high detection rates.

Using a lot of positive and negative images to train Haar Cascades and then extract features from it and then used to detect objects in other images. Each feature contains a single value obtained by subtracting the number of pixels inside the white rectangle from the number of pixels inside the black rectangle. Haar Cascade is like our convolutional kernel.

A Convolutional Neural-Network in face recognition was manipulated by Steve Lawrence, C. Lee Giles, Ah Chung Tsoi and Andrew D. Back [9]. They invented a hybrid neural network.

The system is efficient for classification, normalization, preprocessing and better performance.

Convolutional Neural Network (CNN) is a deep learning approach which contains deep artificial neural network. CNN mainly used to classify images, cluster them by similarity and perform object recognition. Convolutional Neural Networks are designed to recognize visual patterns directly from pixel images with minimal prepossessing. Patterns with extreme variability (such as handwritten characters) can be recognized using robustness to distortions and simple geometric transformations. CNN arranged neural networks in three dimensions and they are width, height and depth. CNN contains multiple sequences of layers and every layer of a CNN changes one volume of activations to another through a differentiable function.

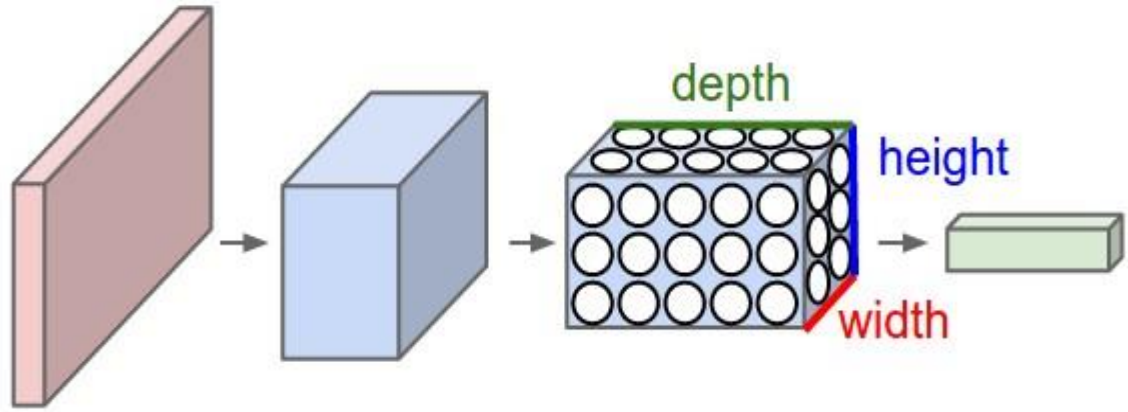

Figure 2.1: Neurons in three dimensions.

The below figure is a complete flow of CNN to process an input image and classifies the objects based on values.

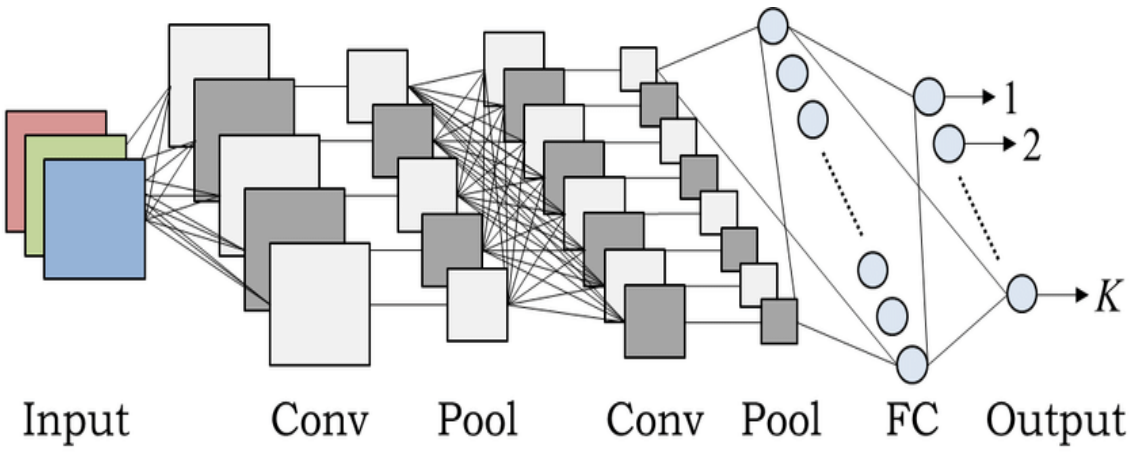

Figure 2.2: Architecture of a CNN.

This network has two identical subnetworks which both have the same parameters and weights.

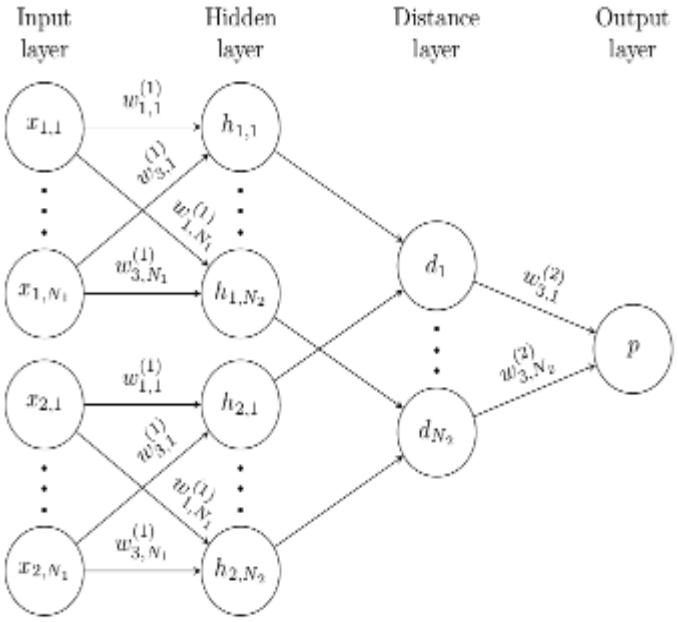

Figure 2.3: Siamese network with simple two hidden layers.

An article named One-Shot Learning of Object Categories was manipulated by Li Fei-Fei, Rob Fergus and Pietro Perona [11]. It is often stark to train a broad dataset. They used Bayesian One-Shot Algorithm. Given a training set, no matter how petty, they updated this knowledge and produced a posterior density which was then used for detection and recognition.

One-shot learning mostly found in computer vision and it is also called object categorization problem. In machine learning based computer vision problem most of the model requires large data sets but in the one-shot learning-based model requires small size data sets. At one-shot learning, once a Siamese network is optimized to master the verification task then the systems are ready to explain the discriminative potential of system's learned features. Suppose a test image x is given, some column vector is to classify into one of C categories as we wish.

Google manipulated a modern system called FaceNet and it was manipulated by Florian Schroff, Dmitry Kalenichenko, James Philbin [12]. Their system was based on learning a Euclidean embedding per image using a deep convolutional network. The network was trained such that the squared L2 distances in the embedding space directly correspond to face similarity. Faces of the same person have small distances and faces of distinct people have large distances. The model was trained a large number of faces. We need not retrain the system every time when we have faces being added.

FaceNet uses Siamese Neural Network which based on one shot learning algorithm. In the proposed model details we treat it as a black box. The most significant part of our goal lies in the end-to-end learning of the complete processes. In the end, achieving in face verification, recognition and clustering we use the triplet loss that directly reflects. In FaceNet they strived for an embedding $f(x)$ from an image x into a feature space R^d such that the squared distance between all faces independent of imaging conditions of the same identity is small whereas the squared distance between a pair of face images from different identities is large. In FaceNet they used triplet loss because, for face verification, the triplet loss is more perfect. The motivation of FaceNet paper is that from the loss encourages onto a single point in the embedding space, all faces of one identity to be projected. Each couple of faces from a single person to other faces, the triplet loss tries to enforce a margin. This approves the faces for one similarity to living on a numerous. It still enforcing the space and thus discriminability to other similarities. Our model consists of a batch input layer and a deep CNN used by L2 normalization which results in the face embedding and during training this used the triplet loss.

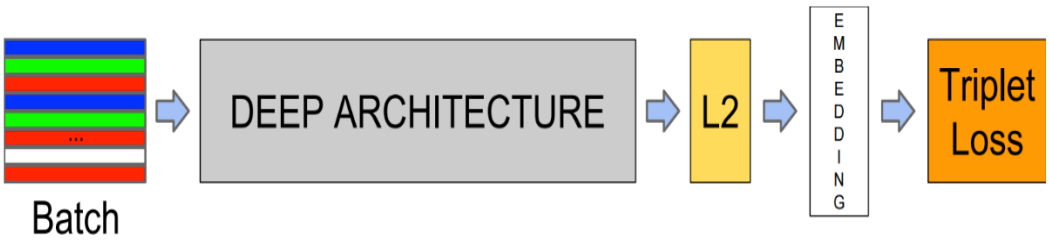

Figure 2.4: Model Structure of FaceNet.

The embedding is illustrated by $f(x)\varepsilon R^d$. It embeds an image x into a d-dimensional Euclidean space. They constrain this embedding to live on the d-dimensional hypersphere, i.e. $kf(x)k2$=1. This loss is motivated in the context of nearest-neighbor classification. They want to ensure that an image is x_i^p (positive) where x_i^a (anchor) of a specific person is closer to all other images of the same person and image is x_i^n (negative) where x_i^a (anchor) of a specific person is to all other people.

Thus we want,

$$||f(x_i^a) - f(x_i^p)||_2^2 + \alpha < ||f(x_i^a) - f(x_i^p)||_2^2$$
$$\forall(f(x_i^a), f(x_i^p), f(x_i^p)) \; \varepsilon \; \mathcal{T}$$

where α is a margin that is introduced between positive and negative couples. $\mathcal{T}$ is the set of all possible triplets in the training set and has cardinality $\mathcal{N}$.

The loss that is being minimized is then L=

$$\sum_i^N [\,||f(x_i^a) - f(x_i^p)||_2^2 + \alpha < ||f(x_i^a) - f(x_i^p)||_2^2 + \alpha\,]_+$$

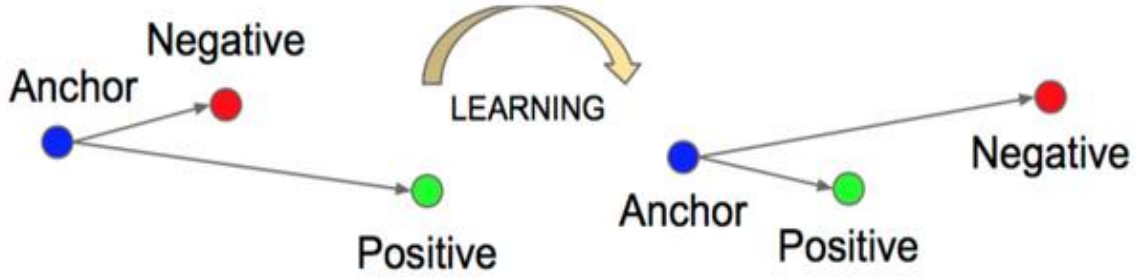

Figure 2.5: The Triplet Loss distance minimization procedure.

In order to ensure fast convergence, it is crucial to select triplets that violate the triplet constraint in Eq. (1).

This means that, given x_i^a, we want to select an x_i^p (hard positive) such that

$$\text{argma}x_{x_i^p} \; || f(x_i^a) - f(x_i^p) ||_2^2$$

And similarly x_i^n (hard negative) such that

$$\text{argma}x_{x_i^n} \; || f(x_i^a) - f(x_i^n) ||_2^2$$

It is infeasible to compute the argmin and argmax across the whole training set. Additionally, it might lead to poor training as mislabelled and poorly imaged faces would dominate the hard positives and negatives.

2.3 Research Summary

Table 2.1: Research Summary

SL	Author	Component	Description	Result
1.	K.Lakshmi Sudha, Shirish Shinde, Titus Thomas and Aris Abdugani.	A barcode tag, a barcode reader, a computer with the software of the attendance system and a data server.	The barcode builds unique data such as roll number. Learners enter the institute showing the barcode to the barcode reader and the system updates the attendance.	It is a slow process. In this process, there is a lot of way of cheating.
2.	Ononiwu G. Chiagozie and Okorafor G. Nwaji.	RFID tag, RFID reader, a computer with attendance system software and a server.	RFID is a suppurate technology that incorporates the conduct of electromagnetic in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object or person.	This system is faster because abundant entry is permitted at a time. But the main shortage is of cheating.

3.	O. Shoewu and O.A. Idowu.	A fingerprint device, a computer with the attendance system software and a database server.	The system scans the fingerprint and recognize the person.	It has a great success rate but it is difficult to maintain a large line.
4.	Teh Wei Hsiung and Shahrizat Shaik Mohamed.	A camera, an iris scanner, a computer and a database server.	The system scans the iris and recognizes the person.	It is an expensive process.
5.	Borra Surekha, Kanchan Jayant Nazare, S. Viswanadha Raju and Nilanjan Dey.	A camera, a computer and a database server.	They used Voila-Jones algorithm and MKD-SRC method of partial face recognition algorithm for a controlled and uncontrolled environment.	In the controlled environment, efficiency is very much high. But in the uncontrolled environment, efficiency is very much low.
6.	Ajinkya Patil, Mrudang Shukla.	A camera, a computer with	For face detection, they used the Viola-	In the environment,

		the system and a data server.	Jones face detection algorithm and for face recognition, they used the hybrid algorithm from PCA and LDA.	efficiency is not too much high.
7.	Muhammad Fuzail, Hafiz Muhammad Fahad Nouman, Muhammad Omer Mushtaq, Binish Raza, Awais Tayyab and Muhammad Waqas Talib.	A camera, a computer with the system and a data server.	They picked HAAR classifier for face detection. They implemented a server based module which is programmed in python to recognize the face.	The accuracy is not too high.
8.	Paul Viola and Michael Jones.	A computer and a lot of images.	They described a machine learning process for visual object detection which was capable of processing images extremely	Using a lot of positive and negative images to train Haar Cascades and then extract features from it and then used to

			rapidly and achieving high detection rates.	detect objects in other images.
9.	Steve Lawrence, C. Lee Giles, Ah Chung Tsoi and Andrew D. Back.	A computer and a huge number of images.	They invented a hybrid neural network. The system attaches local image sampling, a self-organizing map (SOM) neural network and a convolutional neural network.	The system is efficient for classification, normalization, preprocessing and better performance.
10.	Jane Bromley, Isabelle Guyon, Yann LeCun, Eduard Sackinger and Roopak Shah.	A computer and a lot of images.	A Siamese neural network contains two networks which accept different inputs but an energy function joined it at the top.	They invented it to solve signature verification as an image matching problem. Now it is also used for face recognition.
11.	Li Fei-Fei, Rob Fergus and Pietro Perona.	A computer and a few images.	They used Bayesian One-Shot Algorithm. Given a training	In machine learning based computer vision problem most

			set, no matter how petty, they updated this knowledge and produced a posterior density which was then used for detection and recognition.	of the model requires large data sets but in the one-shot learning-based model requires small size data sets.
12.	Florian Schroff, Dmitry Kalenichenko, James Philbin.		Their system was based on learning a Euclidean embedding per image using a deep convolutional network. The network was trained such that the squared L2 distances in the embedding space directly correspond to face similarity. The model was trained a large number of faces.	Faces of the same person have small distances and faces of distinct people have large distances. We need not retrain the system every time when we have faces being added.

2.4 Scope of the Problem

Mainly we used the system in our classrooms. But we can use the system where a group of people is involved. Moreover, we can use our system everywhere where attendance system is compulsory.

2.5 Challenges

Collecting the images of every student for training data. Head position is very important in the classroom image for testing data. Another challenge is image quality. One of the most important challenges is to detect twin.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Introduction

This section contains Research Subject and Instrumentation, Data Collection Procedure, Statistical Analysis and Implementation Requirements. In Data Collection Procedure we describe how we collect picture and how many pictures we collect. In Statistical Analysis we describe model accuracy. In the last part, we describe implementation.

3.2 Research Subject and Instrumentation

Research Subject:

- Automated Attendance System Using Face Recognition with one-shot learning and Siamese Neural Networks.

Instrumentation:

- Camera with good resolution. We use a camera for taking train and test data sets. We use a webcam for taking training data and DSLR(20-25 MP) for taking testing data.
- Computer with good configuration.
  Using computer we calculate all the processes.
  Configuration like:
  Processor: Core i5 or upper version.
  Ram: Four+.
  GPU: It will be faster if the GPU is enabled.
  Webcam: 2 MP+.

3.3 Work Flow

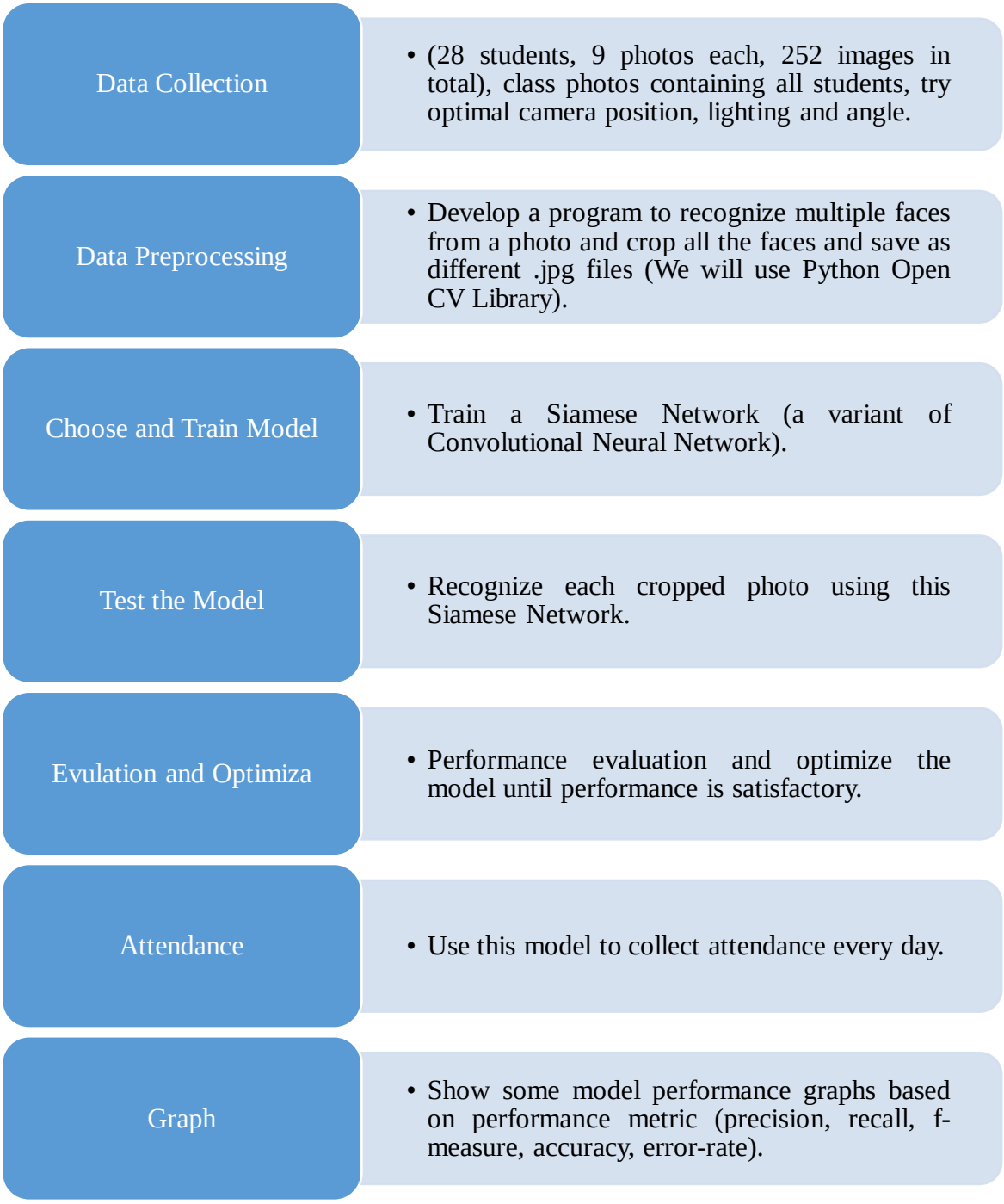

Figure 3.1: Work Flow of our system

3.4 Data Collection Procedure

In order to train a FaceNet model, we need a small dataset because FaceNet model contained One-shot learning algorithm. Small dataset but our dataset containing enough images to prevent potential overfit and there multiple people within the dataset since our face detection is specialized to detect multiple human faces in the scenes. In our project we used our own collected dataset which contained frames of one camera placed in a fixed place, every single person came in front of a camera and then the camera took nine pictures of every single person. The dataset consists of 28 subject (24 male and 4 female) having image resolution 200X200. After removing noise we collected five pictures of every person. A total number of images in our dataset was 28X5=140 which is a reasonably small number to train our FaceNet model. For data collection, we develop our algorithm on Python3. We also imported cv2 (OpenCV) for loading and writing images, drawing boxes and other small image processing method. In the time of collecting face, we detect a face using Haar Cascade Classifier.

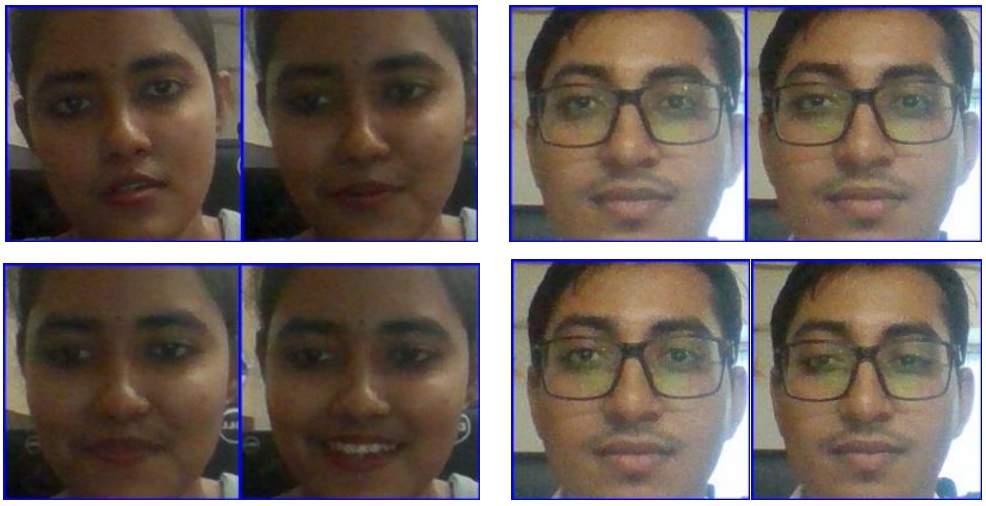

Figure 3.2: Training Dataset.

Figure 3.3: Testing Dataset.

3.5 Statistical Analysis

In this section, we calculate statistical analysis in two part.

Part: 1. One for the face detection after taking classroom images.

Part: 2. Another for the final result which depends on FaceNet model.

We consider all the images of a classroom or institution. Nobody shows up; somebody appears but none belongs to the group; one person from the group shows; more than one person shows up. For the first two cases, we classify it as 'others'. And for the last two cases, we count everyone belonging to the group and counted them as attended. For an attendance system, the most important feature is to correctly identify whether or not the person belongs to the group, so we will measure the false positive and false negative rates; the false positive is the probability that the people outside of the dataset get classified as the people inside the dataset while the false negative is the probability that people inside the dataset get classified as the people outside of the dataset. Since

we also want our camera to tell the ID number of the person, we introduced another metric named Accuracy to measure the classification accuracy.

Statistical Analysis of face detection:

The result of our measurement are shown below:

Table 3.1: Confusion Matrix of face detection

	Predicted: Yes	Predicted: No	
Actual: Yes	True Positive(TP): 9	True Negative(TN): 1	Total: 10
Actual: No	False Positive(FP): 1	False Negative(FN): 0	Total: 1
	Total: 10	Total: 1	Total: 11

- Precision= 90%
- Recall= 100%
- F-measure= 94.7%
- Accuracy= 81.8%
- Error-Rate= 19.1%

Statistical Analysis of face recognition**:**

The result of our measurement are shown below:

Table 3.2: Confusion Matrix of face recognition

	Predicted: Yes	Predicted: No	
Actual: Yes	True Positive(TP): 8	True Negative(TN): 0	Total: 8
Actual: No	False Positive(FP): 1	False Negative(FN): 0	Total: 1
	Total: 9	Total: 0	Total: 9

- Recall= 100%
- F-measure= 93.6%
- Accuracy= 88.8%
- Error-Rate= 11.1%

3.6 Implementation Requirements

Using a camera and computer, we develop our algorithm on Python3. We employ Keras (background Tensorflow and Thiano) to build the network, loss function and solver which save a lot of effort. We also used Numpy for array calculation and matplotlib for generating the graph. Sklearn is used for building SVC classification and Skimage and Imagio for image manipulation. We also imported OpenCV for loading and writing images. For generating the final result in CSV we use python CSV library function. We develop our whole processes in Jupyter Notebook.

CHAPTER 4
EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Introduction

In this section, we describe Experimental Results, Descriptive Analysis and Summary. In the experimental result, we discuss graph and in the descriptive analysis, we discuss the equation of calculating accuracy.

4.2 Experimental Results

Using various types of classroom images, we measure the performance of our proposed system. In our training dataset, we use 28 person's images. We measure the performance in two steps, one for face detection and another for face recognition.

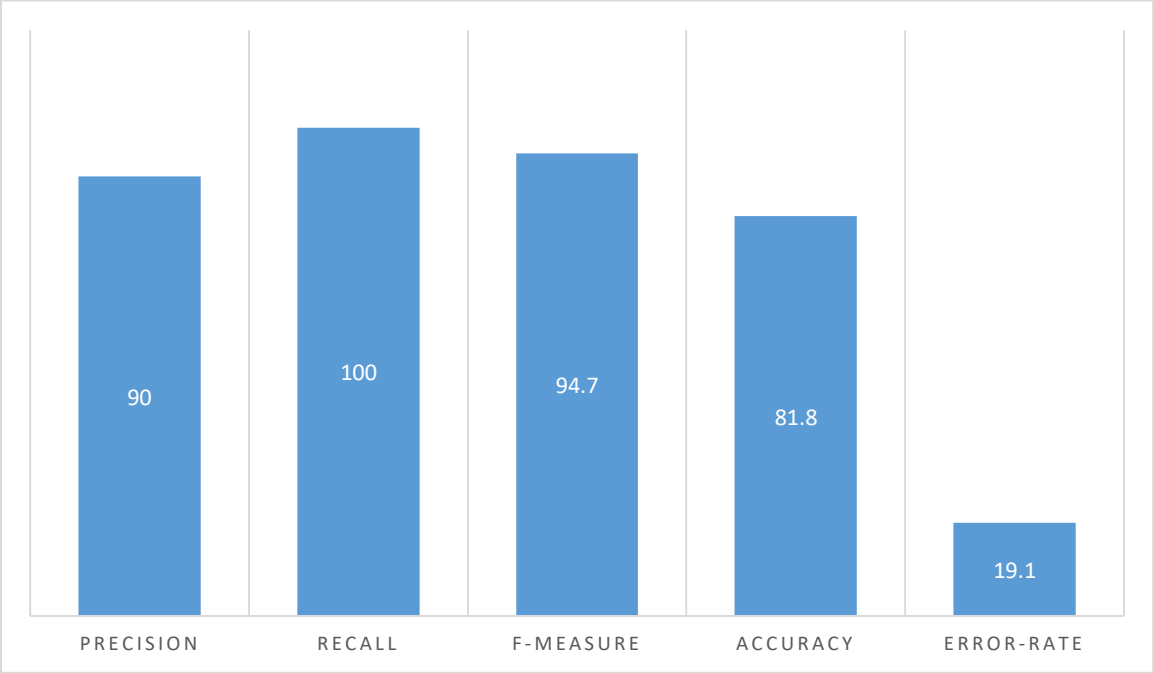

Figure 4.1: Graph of face detection analysis.

In first graph represent face detection analysis, we represent Precision= 90%, Recall= 100%, F-measure= 94.7%, Accuracy= 81.8%, Error-Rate= 19.1%. Our Error-Rate is fairly small and overall accuracy is sufficiently high which means in most of the cases our system can get each person's face.

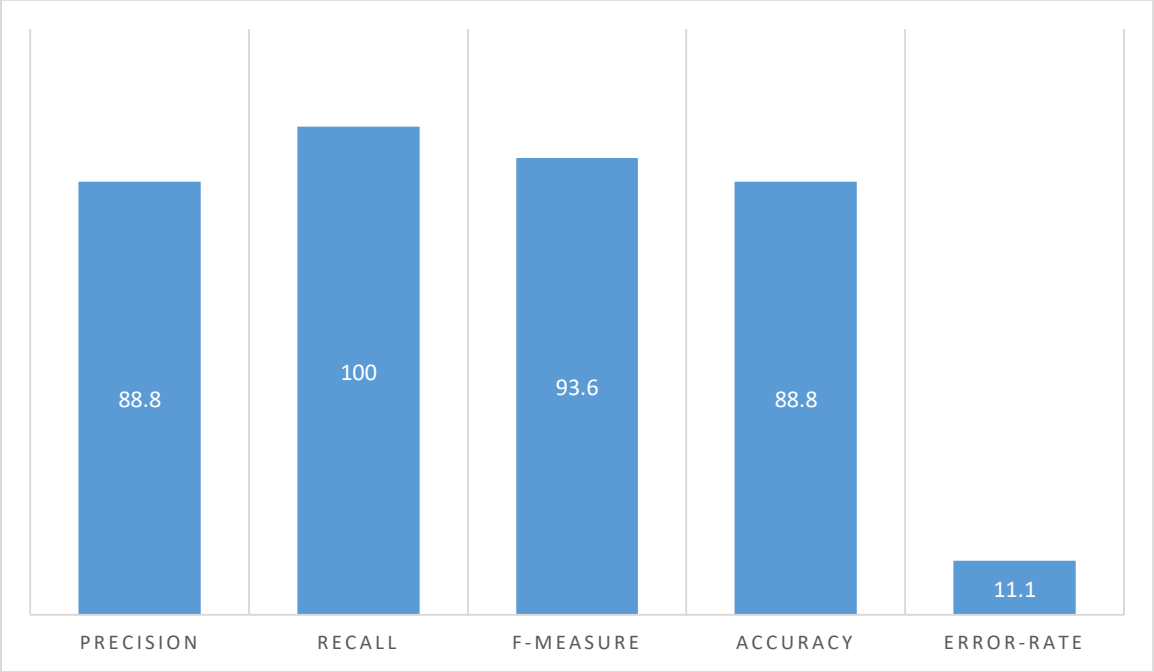

Figure 4.2: Graph of face recognition analysis.

In second graph face recognition analysis, we represent Precision= 88.8%, Recall= 100%, F-measure= 93.6%, Accuracy= 88.8%, Error-Rate= 11.1%. Our Error-Rate is fairly small and overall accuracy is sufficiently high which means in most of the cases our system can get each individual classified with his and her identity.

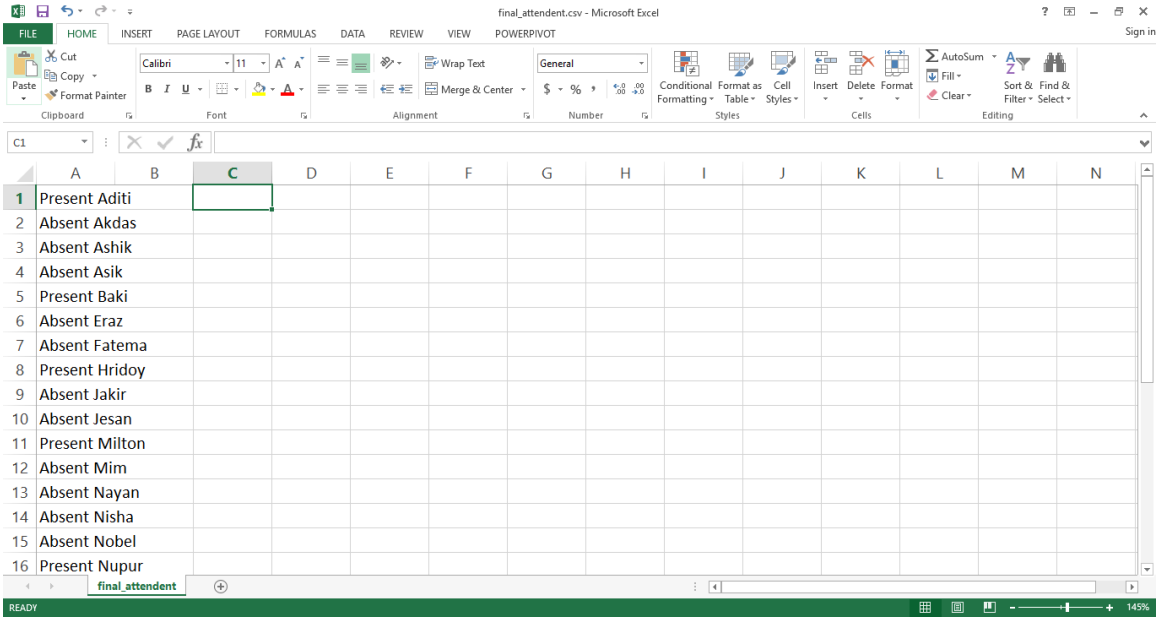

Figure 4.3: Attendance in CSV.

We got the final attendance result using the Python CSV module. Above figure represents the final result. Every time of processing the full process, the students who are attended in the classroom are given attended in the CSV.

4.3 Descriptive Analysis

Precision:

$$Precision = \frac{tp}{tp + fp}$$

Recall:

$$Recall = \frac{tp}{tp + fn}$$

F-measure:

$$F - measure = 2 * \frac{precision * recall}{precision + recall}$$

Accuracy:

$$Accuracy = \frac{tp + tn}{tp + tn + fp + fn}$$

Error-Rate:

$$Error - Rate = 1 - Accuracy$$

Descriptive Analysis of face detection:

Table 4.1: Confusion Matrix of face detection

	Predicted: Yes	Predicted: No	
Actual: Yes	True Positive(TP): 9	True Negative(TN): 1	Total: 10
Actual: No	False Positive(FP): 1	False Negative(FN): 0	Total: 1
	Total: 10	Total: 1	Total: 11

Depends on confusion matrix,

Precision = .90 = 90%

Recall = 1 = 100%

F-measure = .947 = 94.7%

Accuracy = .818 = 81.8%

Error-Rate = .191 = 19.1%

Descriptive Analysis of face recognition:

Table 4.2: Confusion Matrix of face recognition

	Predicted: Yes	Predicted: No	
Actual: Yes	True Positive(TP): 8	True Negative(TN): 0	Total: 8
Actual: No	False Positive(FP): 1	False Negative(FN): 0	Total: 1
	Total: 9	Total: 0	Total: 9

Depends on confusion matrix,

Precision = .888 = 88.8%

Recall = 1 = 100%

F-measure = .936 = 93.6%

Accuracy = .888 = 88.8%

Error-Rate = .111 = 11.1%

4.4 Summary

Our overall Error-Rate is small and Accuracy is significantly high which means in most of the cases our system can get each individual classified with his and her identity. Using various images we measure our system's accuracy and every step of measurement we get a good result. So that our system is capable to run in every environment.

CHAPTER 5
FUTURE REMARKS AND CONCLUSION

5.1 Summary of the Study

At first, to train our model we collected images of 28 students. In our dataset, every student has 5 images. We used a python code using Haar cascade classifier to collect the images for our train data set. Then we collected an image to test the model where 10 students were present. To detect all the students from the image, we used a python code using Haar cascade classifier. We detected 9 learners and the accuracy rate of detection was 81.8%. We used Google's FaceNet model to recognize every presented learner. The model was capable to recognize 8 people from 9 people and the accuracy rate was 88.8%. Then we updated our csv for daily attendance.

5.2 Conclusions

Automated attendance system can be proven as the best system for the classroom. There is a lot of automated attendance system. Among them, face recognition is the best system. By using the system, the chance of fake attendance can be stopped. Also, it needs less time than other available systems. In real time scenario, our system has better detection and recognition rate. A camera and a computer are sufficient for building the system. No other hardware device is required.

5.3 Recommendations

For better performance of our system

- A good camera is needed.
- A well-specified computer is also needed.
- Needed to focus every student on the camera.

5.4 Implication for Further Study

Our proposed method still lacks to detect and recognize every student present in the class. So, there are still many things to improve. We have a great leakage to recognize twin. We can improve different models until we get a 100% accuracy rate of detection

and recognition. Our system can be used in a new dimension of the face recognition system. Mobile-based automated attendance system using face recognition can be built, so that it will be much easier for the user like teacher, administration.

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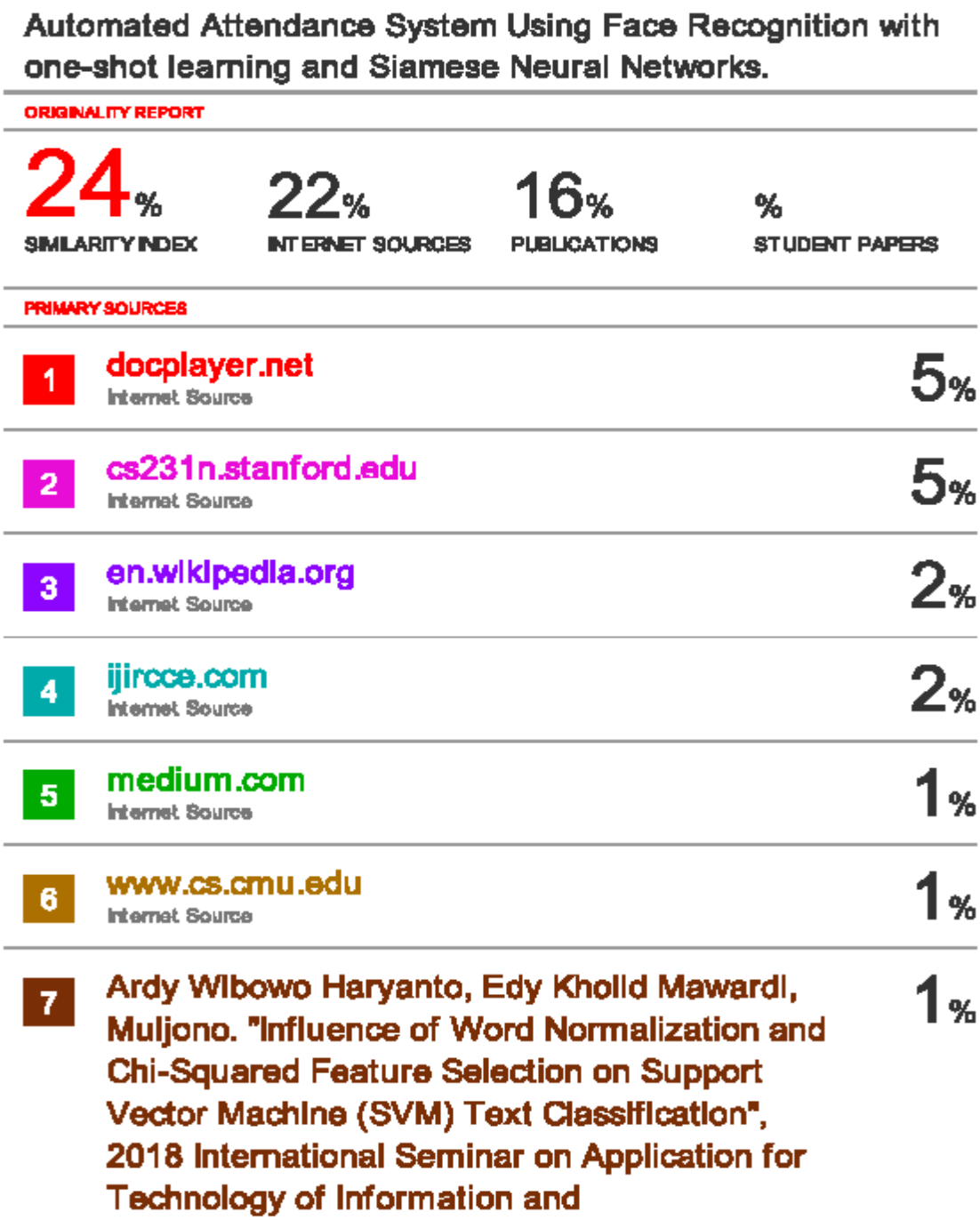

Automated Attendance System Using Face Recognition with one-shot learning and Siamese Neural Networks.

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