IMPLEMENTATION OF FACE RECOGNITION ATTENDANCE SYSTEM FOR PT. SUMBER KURNIA ALAM WITH MTCNN AND FACENET ALGORITHM

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ABSTRACT

Attendance taking is an essential and recurring task in many organizations. Traditionally, ttendance is recorded manually using pen and paper, which can be time-consuming, prone to erros, and inefficient. With advancements in computer vision and machine learning, the process of attendance taking can be automated using face recognition technology. This project presents the implementation of a face recognition attendance system for PT. Sumber Kurnia Alam. The system is designed to replace the traditional manual method for attendance taking and to improve the accuracy and efficiency of the attendance recording process. The face recognition attendance system uses MTCNN and FaceNet algorithms, which are widely used in the field of computer vision and machine learning for face detection and recognition. The implementation of the system involves gathering a dataset of employee faces. To provide accurate detection, dataset needs to be preprocess using whitening and EXIF transformation methods. Preprocessed dataset then being used to train the smart attendance system to generate facial embeddings. The attendance recording process works by comparing facial input that has been captured using webcam by the help of OpenCV library with facial embeddings generated earlier when the training process occured. This project will provide a faster and more accurate attendance recording system with average time of 6,57 seconds difference from real time.

Keywords: face recognition, facenet, mtcnn, smart attendance system

CHAPTER 1 – INTRODUCTION

1.1. Background

Attendance taking is an essential and recurring task in many organizations. Traditionally, attendance is recorded manually using pen and paper, which can be time-consuming, prone to errors, and not very efficient. With the advancements in computer vision and machine learning, the process of attendance taking can be automated using face recognition technology.

This project presents the implementation of a face recognition attendance system for PT Sumber Kurnia Alam. The system is designed to replace the traditional manual method of attendance taking and to improve the accuracy and efficiency of the attendance recording process. The face recognition attendance system uses MTCNN and Facenet algorithms, which are widely used in the field of computer vision and machine learning for face detection and recognition.

The implementation of the system involves the collection of a dataset of employee faces, the face detection using MTCNN or Multi Task Convolutional Neural Network, and the face recognizer using FaceNet algorithm. The system is developed using the Python programming language and OpenCV library for image processing.

The system is expected to provide a reliable and efficient method for attendance taking and to reduce the administrative burden of manually recording attendance. The project also discusses the potential benefits and limitations of the system and provides recommendations for future improvements.

Overall, this project aims to contribute to the field of computer vision and machine learning by demonstrating the practical application of face recognition technology in attendance taking and providing insights into the implementation process for other organizations that may wish to adopt similar systems.

1.2. Problem Formulation

1. Does the face recognition attendance system faster and more accurate than the manual attendance using pen and paper?
2. In terms of attendance system security, can the face recognition attendance system can be manipulated using photos?

1.3. Scope

1. This project comparing results from face recognition attendance system using MTCNN and FaceNet and manual attendance system using pen and paper, in terms of speed, accuracy, and security.
2. This project comparing FaceNet image preprocessing result and Eigenface image preprocessing.
3. This project only recording attendance from manual attendance system and MTCNN-FaceNet attendance system.
4. This project conducted in eight business day for recording attendance data.
5. The final attendance data will be only containing seven employee because some of the employees are not physically attend on the place where this project is being held.
6. This project will be covering subject's name due to privacy reason, replacing their name with generic alphabet.

1.4. Objective

Prove that face recognition attendance system using MTCNN and FaceNet is more robust in terms of speed, accuracy, and security, than manual attendance system using pen and paper or even similar facial recognition algorithm, in this case Eigenface, and also improving efficiency in terms of collecting attendance data for employee salary calculation.

CHAPTER 2 – LITERATURE REVIEW

After determining the project title, I look for some scientific journals, research papers, and another researcher's projects, to strengthen the result of my project.

Sawhney, et al. [1] stated that a manual attendance system that is done by using hand can cause many problems. To counter the problem, smart and auto attendance management system is much needed. Biometrics are the key to successfully operating smart attendance system, therefore, to improve the attendance system, face recognition is being used as a primary biometric. Algorithms that being used for face detection and recognition are Eigenface values, Principle Component Analysis (PCA) and Convolutional Neural Network (CNN). To make an attendance marking, recognized faces are being compared to the database containing student's faces. This method resolves the main problem of manual attendance system, that is removing proxies on false attendance data.

Rahman, et al. [2] has shown that biometric based attendance system can use another algorithm to answer challenges in recent security system. The algorithm they used is Backpropagation face recognition. Backpropagation algorithm works by counting the distance between facial features, e.g. distance between eyes and mouth or nose. After getting the results, those features becoming the input layer to the algorithm, then adding output target will giving result of the identity from the image. This algorithm can giving accurate result with 80% accuracy, while being tested with 10 images.

Karmakar [3] stated that in today's workspace, facial detection and recognition is a revolutionary technology and can help reducing the effort when working. He explains that facial detection and recognition works by capturing any facial image in surveillance camera or webcam as input then match and compare it with the data contained in database. His project using a deep learning model for the purpose of improving the system performance in detecting and recognizing face. He also stated that his project can be updated to meet future standards, like Automatic Speech Recognition, Emotion Detection, and many more.

Indra, et al. [4] stated that attendance is a proof for college student to attend their study. This paper also explain the method for manual attendance by using pen and paper and distribute them across all college student. He also notice that manual attendance can cause problem like manipulation in attendance data. For resolving the issue, he created face recognition based attendance system using Haar-Like Feature method. He made the system to run in a Raspberry Pi or other microcontroller devices. His system can be used online because the system is web based. The results are decreasing number of unauthorized people giving attendance data and efficiently managed and processed attendance data that used to be having 6 – 8 days to processed, became only 3 – 4 days.

Sugeng and Mulyana [5] stated that in the pandemic era, to prevent Covid-19 exposure while queue up for giving attendance, a real-time, fast, easy to operate face recognition based attendance

system is needed. Because of the current situation, employees are often considered late to come and their discipline value is decreased. Their system needs to be fast, real-time, accessible, but still applies health protocols so reducing queue line and not getting crowded. Their system is LAN-based attendance system that using DLib as face recognition library. The reason why they used dlib as the face recognition library is dlib face recognition has 98.3% accuracy. They tested the system using 15 faces from employee registered into the attendance system. From their system test, they are getting all faces recognized.

Anitha, et al. [6] stated that by using a system that can identify and recognize an individual by comparing live capture or digital image to the person's data stored inside the system, tedious process, management and maintenance data of manual attendance can be resolved. They built the system to be a mobile application. They hoped that academic staff can capture the entire training hall to mark all attendance for that session. The result of their project, their system works practical, reliable, and removing time loss of manual attendance system.

Schroff, et al. [7] has shown in their journal how effective FaceNet as a face recognizer. They stated that FaceNet directly learns a mapping from face images to a compact Euclidean space where facial features distances directly correspond to a measure of face similarity. After Euclidean space has been created, face recognition and classification can be easily implemented with embeddings from facial features vectors. They proved that FaceNet can achive 99.63% accuracy in face recognition with LFW (Labeled Faces in the Wild) dataset.

Bustomi and Hariyanto [8] stated that to counter attendance data manipulation, a better attendance system should be applied in academic institutions. They use Haarcascade as their main face recognition algorithm and they use LBPH for changing face input into new and improved characteristic, also they use Raspberry Pi as face recognition attendance system. They stated that students can upload their face photo themselves to the website, then using the student's face photo to train the system and save it to the database as image references. Their dataset being trained to get LBPH value and saved it to a file. That file will be the main comparison on the system. Their attendance system give 95,5% accuracy with 10,98 seconds in average processing time per face image.

Fu R., et al. [9] has shown that facial recognition attendance system can be used to detect and recognize multiple person. They use MTCNN algorithm as face detection and Center-Face as face recognition for their system. Their system built also for detecting violation that is happening in the classroom, such as absence, lateness, and leaving early. Their attendance system also produced high accuracy rate with 98.87%, TP or True Positive number with 1/1000, and FP or False Positive rate in 93.7%, using LFW or Labeled Face on the Wild dataset.

Zhang K., et al. [10] stated that by using deep cascaded multitask framework that exploits the inherent correlation between face detection and face alignment, face detection system can boost up their performance in both accuracy and speed. From their research, they achieved high accuracy

rate over other well-known face detection algorithm by using their own hard sample mining strategy. Their strategy works by predicting face and landmark location in a coarse-to-fine manner, using three stages of deep convolutional networks.

The difference between my project than previous implementation and research is MTCNN and FaceNet is not commonly being used as face recognition attendance system despite it's accuracy rate. Some implementations are using more known algorithms like Eigenface, Haarcascade, and other. While the other algoritms are good enough to be used in attendance system, MTCNN and FaceNet can give a really high percentage of accuracy because the algorithm built specifically to improve efficiency and accuracy in face detection and recognition.

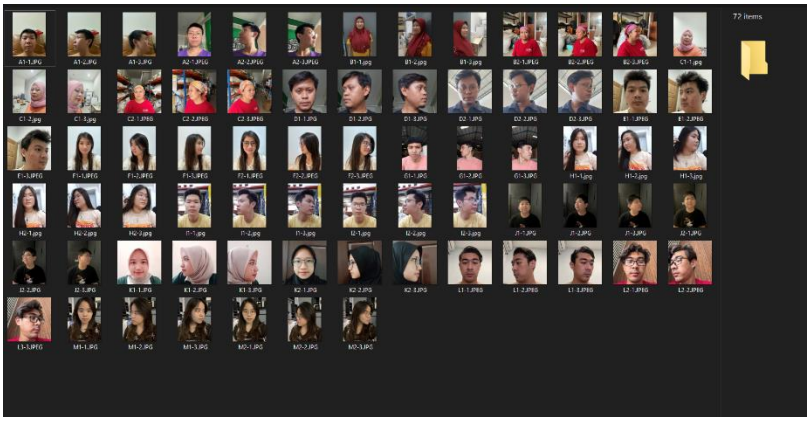
CHAPTER 3 – RESEARCH METHODOLOGY

3.1. Literature Study

Topic of this research was created due to the problem of traditional attendance method using pen and paper. According to some journals, traditional attendance method can be manipulated and time consuming, which can lead to data inaccuracy.

3.2. Dataset Collection

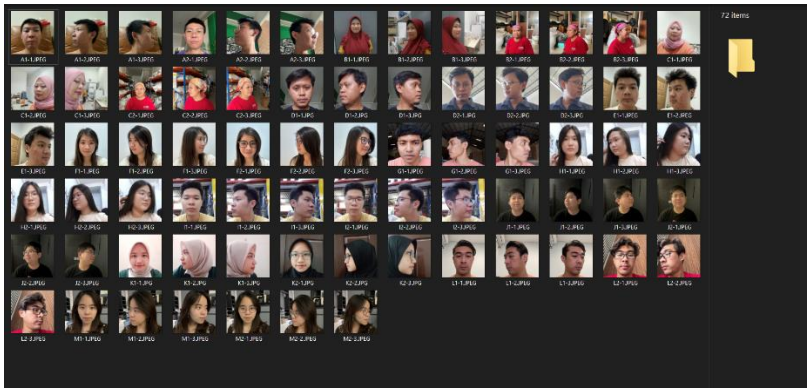
Dataset for this project uses face photos with 3 different facial angles from 7 employees and 6 of my friends, with a total of 13 dataset. All of the people will submit 2 set of photos, which mimicking a low light environment and natural lighting environment. Also, for everyone using glasses will be asked for taking photos with glasses and without glasses. This dataset will used to train the algorithm to detect and recognize face more accurate. They will take photos using front facing camera from their own phone. Any variables, like lighting condition, weather condition, camera's pixel density, and more, that affecting the photos will be ignored. This will make the face photos taken more natural, mimicking the real-world facial scanning. Example of dataset collection will be provided in Gambar 1.



Gambar 1. Dataset collection

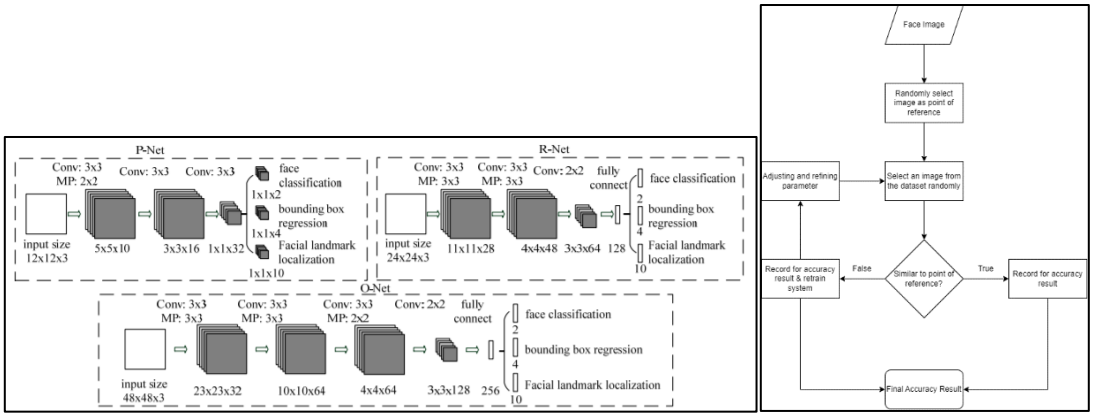
3.3. Image Preprocessing using FaceNet and MTCNN

To have a similar data for detection and recognition learning, facial photos will be cropped into 1:1 or square aspect ratio. This step will be taking out most of non-face object that can disturb training phase. Gambar 2 below is the example of cropping the gathered dataset.



Gambar 2. Dataset image cropping

Pretrained FaceNet model will be used for face recognition training and MTCNN will be used to face detection training. MTCNN or Multi Task Convolutional Neural Network is an algorithm that using 3-layers of neural network to processing image pyramid. These neural networks are known as P-Net or Proposal Network, R-Net or Refine Network, and O-Net or Output Network. After the image has been resized, forming a pyramid, those images will go into the first layer, that is P-Net. P-Net or 'Proposal Network' will be processing images to obtain the bounding box regression vectors. In this first step, there will be many misses detection, e.g. detecting nose as a face because of the smaller size full face image. This is a common output to begin with, as long as the original size image gets the bounding box correctly. This result then being sent to the second step, that is R-Net or 'Refine Network'. R-Net is part of the MTCNN to refine the result from P-Net, by removing the incorrect face detection using NMS or Non Maximum Suppression, such as misdetection of face in eye area of the original face image. Also, in this step, the bounding box will be calibrated to accurately detect faces. For the last step and the last neural network, the O-Net or 'Output Network' will propose a facial features. Gambar 1 (a) below will illustrate the workflow of MTCNN.



Gambar 3. (a) MTCNN workflow and (b) FaceNet learning flow

FaceNet works by taking person's face, extracting the face pictures, and giving a vector of 128 numbers as the output. This vector of 128 numbers representing the unique features from the face picture, also called embedding. FaceNet trained using triple loss method to recognize face accurately. Gambar 1 (b) illustrates the learning flow of FaceNet.

3.4. Face Recognition Attendance System using FaceNet and MTCNN

This step will be recalling all the function from the training phase, that is the face recognition function, so the system can be preprocessing live feed from webcam. To open webcam, I will be using OpenCV. The system works by comparing live captured images with the facial database, called dictionary. If the person captured are registered in the dictionary, the system will record attendance as "Present". If the system doesn't detect any face, it will not registering any attendance record. Tabel 1 below are the example of result in spreadsheet format.

Tabel 1. Example format of the attendance report

Name	Status	Present
Person-A	Present	01/01/2000 00:00

CHAPTER 4 – CONCLUSION

This project proved that FaceNet and MTCNN based face recognition attendance system can be faster and more accurate than manual attendance system using pen and paper. Although this project only contains a small amount of dataset, it is confident enough to detect and recognize subject's face. This project unfortunately still lack in security due to it's vulnerable to manipulating face detection using digital photos.

For future research, improving similar project in terms of security can be done by implementing another biometric detection, diversing and allocating more images to the dataset, or image preprocessing fine tune.

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