FACE RECOGNITION ATTENDANCE SYSTEM USING DEEP NEURAL NETWORK

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Special dedicated to my beloved parents for their caring, understanding and encouragement.

ABSTRACT

The project proposes facial recognition method to replace the conventional attendance system. This project provides a stress-free way to record the attendance in school and workplace. By using unique biometric information on human's face, deceitful action in taking attendance can be prevented. With the advancement of Deep Neural Network, face recognition can be done in a timely fashion, thus making the application of face recognition in attendance system possible. Other than continue improving the facial recognition accuracy of Deep Neural Network, a web-based graphical user interface (GUI) that can greatly help in boosting up the user experience of first responder in the handling of attendance taking event is proposed in this project. After detecting a person's face, the characteristics of the face would be used to compare with the data stored in database via the Deep Neural Network. On matched result, the system will automatically record the attendance of the individual. Attendance information can be viewed back easily with the interactive GUI.

ABSTRAK

Projek ini mencadangkan kaedah pengenalan wajah untuk menggantikan sistem kehadiran konvensional. Projek ini meringkaskan proses merekod kehadiran terutamanya di sekolah dan tempat kerja. Dengan menggunakan maklumat biometrik unik di wajah manusia, tindakan menipu dalam mengambil kehadiran dapat dicegah. Dengan perkembangan teknologi Deep Neural Network, pengenalan muka dapat dijalankan dalam masa yang singkas. Selain dengan meningkatkan ketepatan pengenalan muka melalui Deep Neural Network, Graphical User Interface (GUI) berasakan web telah diperkenalkan bagi meningkatkan pengalaman pengguna daripada pandangan orang pertama dalam pengurusan kehadiran. Selepas mengesan muka seseorang, ciri-ciri wajah akan digunakan untuk dibandingkan dengan data yang disimpan dalam pangkalan data melalui Deep Neural Network. Sistem akan secara automatik merakam kehadiran individu, sekiranya ciri-ciri wajah seseorang tersebut pandan dengan maklumat dalam pangkalan data. Rekord kehadiran dapat dijejak dengan mudah dengan pengguna GUI yang interaktif.

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LIST OF SYMBOLS AND ABBREVIATIONS

CNN	:	Convolutional Neural Network
CPU	:	Central Processor Unit
DNN	:	Deep Neural Network
FLOP	:	Floating Point Operation
FN	:	False negative
FP	:	False positive
GUI	:	Graphical User Interface
kNN	:	k-Nearest Neighbors
LBPH	:	Local Binary Patterns Histograms
LFW	:	Labeled Faces in the Wild
MQTT	:	Message Queuing Telemetry Transport
PCA	:	Principle Component Analysis
ReLU	:	Rectified Linear Unit
SGD	:	Stochastic Gradient Descent
UI	:	User Interface
TN	:	True negative
TP	:	True positive

CHAPTER 1

INTRODUCTION

The background of the project is explained in this chapter, followed by the problem statement, objectives, scope of project and thesis outline. The general idea of applying face recognition in attendance system is explained in the background of project, while the primary focus and things to accomplish at the end of the project is conclude in the objectives. The boundary and detailed set of deliverables of the project are defined in scope of project. Lastly, the outlines of the entire project from chapter 1 until chapter 5 are highlighted in the project outline.

1.1 Background of Project

Human face carries a huge amount of valuable information which can be used for multiple purposes and one of the uses is to identify a person, namely face recognition [1]. While face recognition is used in multiple real-life applications, identification of

individuals for the purpose of attendance recording is one of the examples of the usage of face recognition. Face recognition attendance system automates the conventional attendance system by removing those troublesome manual inputs by the users and thus improves the user experience [2]. It has been a challenge to obtain a quality result in face recognition until the recent years, where the Deep Neural Network (DNN) comes in [3]. However, the lack in robustness in adversarial settings and general inability to rationalize predictions in DNN making it less suitable to work alone in recognize large set of known people. Thus, k-Nearest Neighbors (kNN) is often used together with DNN to perform an accurate face recognition [4]. To put the attendance information to display, a web-based user interface is used. A web-based user interface is chosen due to cost effective development, easily accessible and customizable. The paper aims to introduce face recognition attendance system using Deep Neural Network which can yield an accuracy of 99.38% using dlib pretrained model and to design a web-based user interface to display the attendance information as recorded by the system.

1.2 Problem Statement

Real-time system has become a must with the rapid pace of globalization, but in contrary, conventional attendance system requires troublesome manual inputs and the processes are time consuming. This can affect the quality of the service being delivered especially for a larger organization or company, where delay in every second can cause a huge lost.

Besides, the conventional attendance system uses non-unique attendance taking methods which allow deceitful action in taking attendance. For an instance example in the company which uses the punch card attendance system, the attendance of the workers can easily manipulate by one another if their punch cards are accessible.

Keeping and organizing the attendance records for analysis purpose can be troublesome without a proper database to store all the attendance information. Manual labors are needed to analyze attendance information in the conventional way and the chance of mistake will be increased when during with large amount of information manually.

1.3 Objectives

i. To design a facial recognition attendance system using Deep Neural Network.

ii. To analyze and evaluate the performance of facial recognition attendance system using Deep Neural Network.

1.4 Scope of Project

The project will only emphasize on facial recognition using Deep Neural Network approach, others image processing method would not be discussed in detail in the paper. The project used the pretrained DNN model for feature extraction, no training is involved in the process. User need to stay in a uniform lighting area where all the features on the face can be captured clearly via the camera. Next, the size of the face taken by the camera need to be at least 180 * 180 pixels (roughly 0.2 m to 1 m away from the camera) for the system to recognize the person accurately. The system cannot recognize a person correctly if there is any blockage of the features (eyes, nose and lips) on the face. The face recognition still cannot differentiate a spoof face and a real face of a person, future improvements are needed to eliminate this drawback of the system. An interactive user interface was created for the prototyping purpose at the end of the project.

1.5 Thesis Outline

This thesis is organized into five chapters to cover the research work that is related to face recognition attendance system using Deep Neural Network. The outlines of the thesis are described as follows. Chapter 2 presents the literature review of face recognition attendance system using Deep Neural Network. Chapter 3 is the research methodology of face recognition attendance system using Deep Neural Network. Chapter 4 is mainly focused on the analysis and discussion on the results of face recognition attendance system using Deep Neural Network. Chapter 5 provides an overall conclusion of face recognition attendance system using Deep Neural Network and future improvement that can be done to the system.

CHAPTER 2

BACKGROUND STUDY

The background study and the literature review of face recognition system together with its application in attendance system are discussed in this chapter. Various methods for face detection like Viola and Jones algorithm and Histogram of Oriented Object Gradient (HOG) is explained in the first part of the chapter. Next, the process of face recognition is justified. Native application and web-based application are compared in term of their reliability and efficiency specially for attendance system application. The studies of attendance management are discussed, and a conclusion is drawn at the end of the chapter.

2.1 Face Detection

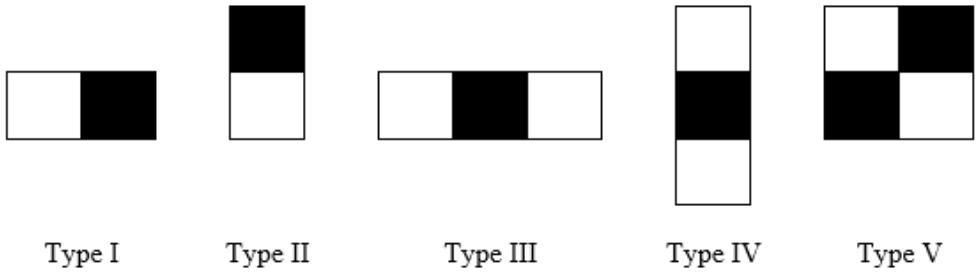
The first part in the pipeline of face recognition is to detect or to locate where is the faces in a single frame of image. This process is called the face detection. The area of

the face will be used later on for the feature extraction and the classification in the later part of the pipeline.

2.1.1 Viola and Jones Algorithm (Haar Cascade)

L. N. Soni, A. Datar and S. Datar (2017) suggested the use of Haar Cascde Classifiers (Viola and Jones algorithm proposed in 2001) for face detection due to its fast computation speed and high accuracy [5]. Besides, based on the experiment carried out by Singh V., Shokeen V., and Singh B. (2013) using Haar Cascade Classifiers for face detection on both simple and complex background, their result strongly suggested this method can be applied on real time face detection [6]. The distance, the size and the number of the faces have very minimum effect of the detection rate of Haar Cascade. Using a testing sample of 200 images for three groups of people: children, youngster and senior citizen, the algorithm achieved an average accuracy of 97.41% and the computation time is roughly 2.89456 seconds. Besides the use of Viola and Jones algorithm in face detection also supported by its robustness as mentioned by Yi-Qing W. (2014) in her paper of “An Analysis of the Viola-Jones Face Detection Algorithm” [7].

Haar Cascade algorithm is a machine learning based approach proposed by Paula Viola and Michael Jones. A huge amount of positive and negative images is needed to train the cascade function. In the case of training Haar Cascade classifier in face detection, the positive images will be those images that contain the face of a person, while negative images can be anything else without the human face. The next step is to extract the features of the positive images. Similar with the convolution kernel, every feature is obtained by subtracting the sum of pixels under the white rectangle from the sum of pixels under the black rectangle.



Source: Adapted from S. Mittal and C. Shivnani, "Face Detection and Tracking: A Comparative study of two algorithms." [8]

Figure 2.1: Example of Haar Features

However, every sizes and location of each kernel are used to calculate lots of features, and many of these features are irrelevant to the training. Adaboost or Adaptive Boosting improves the performance of Haar Cascade by highlighting only those known features that can improve the accuracy of detection, making the computation time much faster. A weak classifier means those features that considerably okay to be included as a face rather than a random guessing, while a strong classifier is constructed by a linear combination of all weak classifiers obtained by Adaboost, given by the formula below.

$$F(x) = \alpha_1 f_1(x) + \alpha_2 f_2(x) + \alpha_3 f_3(x) + \cdots$$

Cascade classifier is introduced at the last stage of the Haar cascade algorithm. Instead of applying all the features on a window, the strong classifiers are grouped in several stages and only one stage is applied at a time. If the sub-window failed at any one of the stages, it will be discarded immediately, which speed up the whole process of checking every feature.