FACE DETECTION FOR ATTENDANCE RECORDING SYSTEM

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Abstract - This research presents the time recording system by using the face detection and recognition method to solve the delay problem of identity verification by fingerprint scanning of the Department of Mineral. The Haar Feature-Based Cascade Classifiers algorithm is used to detect the face from the camera and convert the image to Gray Scale. Then, the Local Binary Pattern algorithm will be predicting the face. From the testing results, the measurement of system performance by detecting and recognizing the faces of five participants, each of 400 frames of the camera, recording a total of 2,000 images, with an average recall value of 98.55%, average precision value of 98.59% and average F-Measure value of 98.54%, and can prevent the error of time recording. The system can detect multiple faces simultaneously. Therefore, the proposed model can be solved the problem of delay in confirming the identity of the original system effectively.

Keywords - Face Detection, Face Recognition, Recording System, Identity Verification

I. INTRODUCTION

At present, the Department of Mineral Fuels uses a time recording system with fingerprint scans. Everyone has to line up to scan fingerprints at various points. The problem is that the recorded time does not match the time that actually entered the job. Sometimes makes it late for work In fact, came in time which affects the performance evaluation. The fingerprint scan will take approximately 1 to 5 seconds per person. Resulting in an urgent time when civil servants and employees arrive at the same time that will not be able to make time to work as is true. From the delay problem of identity verification, the researchers is proposed the idea by using the technology of identity authentication, face recognition system to identify, which is faster and more convenient than the fingerprint scanner in the current use. Therefore, it is possible to be used to solve such problems [1]. In this paper, the face detection for attendance recording system is proposed by using the face detection and recognition method. The Haar Feature-Based Cascade Classifiers algorithm is used to detect the face from the camera and convert the image to Gray Scale. The Local Binary Pattern algorithm is used to predicting the face. The performance of proposed model is evaluated by using the confusion matrix such as recall, precision and F-Measure. The remainder of this paper is organized as follows: Section II presents the theory and related works, Section III describes research methodology, Section IV illustrates the experimental results and Section V presents the conclusion.

II. THE THEORY AND RELATED WORKS

This section presents the theory of face detection, Haar Feature-Based Cascade Classifiers, Local Binary Pattern and Software and Programming Language in many research areas as following.

A. Face Detection

Facial recognition [2], [3] is to detect or analyze the structure of the face and adjust the face image automatically by using image processing technology for analyzing the structure of the face. There is a simple work principle: checking the human face for a face that matches the database or not. The measurement points are focus point, color, light, eye distance, nose distance, mouth shape, cheek. The scanned data will be compared with the original sample or face data, which may compare the whole face or just some depending on the technical or method used to detect.

B. Haar Feature-Based Cascade Classifiers

Haar Cascade [4], [5] is a machine learning algorithm used to identify objects in images or videos proposed by Paul Viola and Michael Jones in a 2001 article. The algorithm has 4 steps as following:

1) Haar Feature Selection

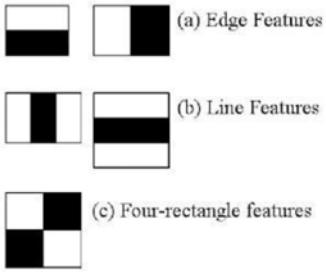


Figure 1. Explaining the operation of Haar Feature Selection

The first step is to collect the properties of the Haar, which will consider the adjacent squares in the position specified in the detection window. Calculate the sum of the pixel intensity of each boundary and calculate the differences between these totals as shown in Figure 1.

2) Creating Integral Images

Integral Images are used to make the Haar Feature Selection process extremely fast. It is a table that combines values based on areas that are data structures and has an algorithm for quickly and efficiently creating the sum of values in a square.

3) Adaboost Training

How to choose the best property from more than 160,000? This can be done by using a concept called Adaboost, which selects the best qualities and learns to classify.

4) Cascading Classifiers

The Cascade Classifier consists of a set of steps in which each step is a group of weak learners. Weak learners are simple classifiers called stump decisions. Each step is trained using a technique called promotion. Adding the ability to create highly accurate classifiers by weighting average decisions made by weak learners. The procedure is designed to reject negative samples as soon as possible. The assumption is that most windows do not have interesting objects. On the other hand, real interesting things are rare and should take some time to investigate.

C. Local Binary Pattern

Local Binary Patterns [6], [7] are based on 2D surface analysis. The basic idea of Local Binary Patterns is to summarize the local structure in an image by comparing each pixel to the adjacent area. By using one pixel as the center and determining the surrounding neighbors. If the intensity of the neighboring pixels is greater than or equal to the middle pixel, then substitute 1 and 0 if not, then the binary number will be given for each pixel, so with eight surrounded pixels. There will get 28 or 256 possible combinations, called Local Binary Patterns or sometimes referred to as LBP code as shown in Figure 2.

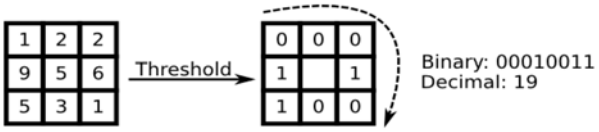


Figure 2. Explain the concept of Local Binary Patterns

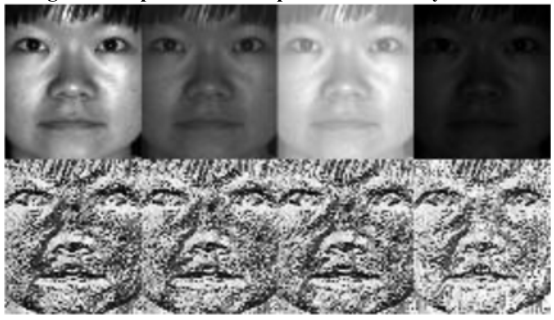


Figure 3. The result of the LBP operator from the Gray Scale image at different brightness values.

To convert the image to Gray Scale, the results of the LBP operator from the picture that has adjusted the brightness to the top row. The result is the bottom row as shown in the figure 3.

D. Software and Programming Language

Python is a Dynamic Object-Oriented Programming language that was developed by Guido von Rossum in 1990 and now is supervised by the Python Software Foundation (PSF) (Te, 2018) without any platform attachment. Python can be run on Windows, Unix, Linux, or even FreeBSD and is open source, so everyone can use Python to develop free programs at no charge. Open CV stands for Open Source Computer Vision. It is a library that combines many functions for image processing and computer vision. Open CV supports the development of programs on various programming languages such as C / C ++, Python, Java etc. and Open CV can still run on Windows, Linux, Android, and Mac operating systems. Microsoft SQL Server is a Relational Database Management System (RDBMS) developed by Microsoft. It is the Client / Server database runs on Windows operating systems that use the T-SQL language to retrieve information. The .NET Framework is a program development platform that Microsoft developed with the aim of being able to be used on different hardware or operating systems, and able to develop new programs in any language as well as a program development tool to easily connect to various Microsoft programs. There is a large library for programming Including program execution management on the .NET Framework. Visual Basic.NET is the language used for program development. It is a language that Microsoft developed which is based on BASIC language and works on the .NET Framework as an object-oriented programming language (Object-Oriented Programming) ASP. NET is a Web Application Framework for creating websites. Web application and ASP.NET web services are the next generation of Active Server Pages (ASP). Microsoft has created a whole new version of ASP .NET based on Common Language Runtime (CLR), which allows developers to choose any language that supports the .NET Framework, such as C # and VB .NET etc. JavaScript is a computer language for programming on the internet using Client-side Script. It was developed by Netscape Communications Corporation called Live Script. It was released with Netscape Navigator 2.0 to create a webpage by connecting to a Live Wire server. Then Netscape cooperate with Sun Microsystems to improve the browser system to be able to use Java and improved Live Script in 1995 and renamed to JavaScript, and was set to be standardized by the ECMA (European Computer Manufacturers Association). The main obstacle that reduces the confidence of the face detection system is the diversity

of lighting conditions. The expression of people's feelings that the background image and the uncertainty of other are factors [8].

III. RESEARCH METHODOLOGY

A. System Development

Development of operation time recording system by face detection, the researcher used Microsoft SQL Server 2017 to store the data, and use the Python with Open CV to develop face detection and facial recognition systems. And using Microsoft Visual Studio 2017 to develop ASP. NET web applications using Visual Basic. NET language for viewing time attendance and exit reports. The development process starts with creating a program to store data and user faces. By recording 150 faces of each user to create a face recognition model. After obtaining the face image of the user, then create another program to use the data and face image of the user to create a face recognition model. In which the face image of the user is used before creating the model, the image processing must be processed by converting the image to Gray Scale and then modeled with the Local Binary Patterns algorithm. After getting the face recognition model next, the program will predict the face image from the camera. By using the Haar Feature-based Cascade Classifiers algorithm to detect the face from the camera and take the image from the camera through the Image Processing process by converting the image to Gray Scale and then predicting the face with the Local Binary Algorithm Patterns. An additional technique used in addition to increasing accuracy with Image Processing and adjusting various settings is to reduce errors. By not allowing duplicate faces to be detected in each frame from face detection and re-checking before recording time. The time recording system will record the time only when the face of the person who wants to record the time of 20 frames of the camera is detected continuously, meaning that if there are at least 20 frames in the frame where the face of the person cannot be found that wants to record time or found but incorrectly predicted as someone else, the system will count 1 again to prevent the recording of the time error. For duplicate faces checking, the test criteria will use 2 testers to create the model and 1 in 2 will be the face tester. The test will be conducted in the form of 2,000 frames, for every 20 frames If all predictions are correct, 100 times will be recorded. The tester can move the face naturally in any direction, freely. (Face movements must have direction and angle of inclination not greater than the face recording in the modeling process) and count how many times the algorithm can prevent the time recording error. The test criteria is the number of testers in modeling and predicting faces is not based on any benchmarks. Because it is an algorithmic test that the researchers thought of themselves Just want to show the results of the time recording errors reduction.

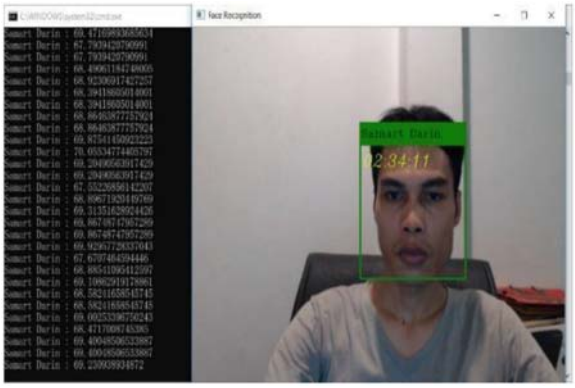


Figure 4. Screen of program while working tells the amount of working time in real time

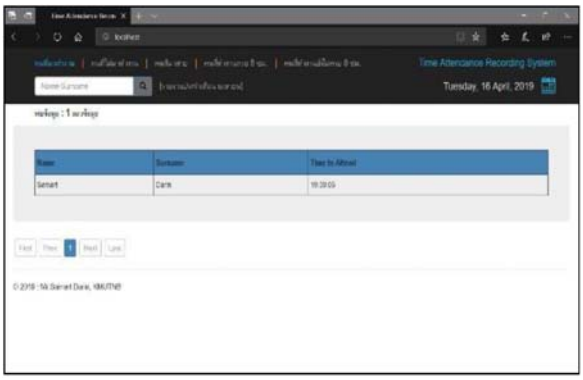


Figure 5. Screenshot of the program for viewing the time of entry and exit

B. Testing and measuring system performance

We use system performance measurements by creating a program to use to measure Recall, Accuracy, Precision and F-Measure.

1) Recall is a measure of the efficiency of a system that pulls out the right information. By calculating the ratio between the amount of data that is correct and the total amount of data as in the equation 1.

$$Recall = \frac{TP}{TP + FN} \quad (1)$$

Then,

TP : The amount of data that is predicted to be correct and the results are correct.

FN : The amount of data that is predicted to be incorrect but the result is incorrect.

2) Precision is a measure of the efficiency of a system that removes incorrect information. By calculating the ratio between the amount of data that is correct and the total amount of data as in the equation 2.

$$Precision = \frac{TP}{TP + FP} \quad (2)$$

Then,

TP : The amount of data that is predicted to be correct and the results are correct.

FP : The amount of data that is predicted to be correct but the result is incorrect.

3) F-Measure is a measure of the overall efficiency of the system. Which can be calculated from the equation 3.

$$F = \frac{2(Precision\ x\ Recall)}{Precision + Recall} \quad (3)$$

IV. EXPERIMENTAL RESULTS

A. Performance and Accuracy Measurement

From testing to measure system performance by detecting and recognizing faces, the participants from the Department of Mineral Fuels were 5 people, each of 400 frames of the camera, recording a total of 2,000 images by measuring Recall, Precision and F-Measure. The test method allows the tester to move the face naturally in any direction freely. The results of running the program for testing are shown in Figure 6.

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Recall[Natthakorn Luangkaew] : 1.0
Precision[Natthakorn Luangkaew] : 0.9975062344139651
F-Measure[Natthakorn Luangkaew] : 0.9987515605493134
Recall[Pattana Kongkim] : 0.995
Precision[Pattana Kongkim] : 1.0
F-Measure[Pattana Kongkim] : 0.9974937343358395
Recall[Sakchai Saguansubsiri] : 1.0
Precision[Sakchai Saguansubsiri] : 0.9779951100244498
F-Measure[Sakchai Saguansubsiri] : 0.9888751545117428
Recall[Samart Darin] : 0.9325
Precision[Samart Darin] : 0.9946666666666667
F-Measure[Samart Darin] : 0.9625806451612904
Recall[Siam Khonrak] : 1.0
Precision[Siam Khonrak] : 0.9592326139088729
F-Measure[Siam Khonrak] : 0.9791921664626683
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Figure 6. The result of running the program to measure system performance

Performance measurement	*Average*
Recall	0.9855 x 100 = 98.55%
Precision	0.9859 x 100 = 98.59%
F-Measure	0.9854 x 100 = 98.54%

Table 1. Summary of test results to measure system performance

B. Error of Time Recording



Figure 7. Error recording protection test

From the Figure 7, tested with 2,000 frames of pictures, every 20 frames. If the face prediction system is all correct, 100 times will be recorded. The test results have 93% accurate time recording and can prevent time recording errors 7% without recording the wrong time.

V. CONCLUSION

This research presents the development of facial time recording system to solve the delay problem from finger scanner using Python language in development with Open CV Library using Haar Feature- algorithm based on Cascade Classifiers to detect faces from cameras and to predict faces using the Local Binary Patterns algorithm. The system is divided into 2 main parts, which are face detection and facial recognition to record time. And the section for viewing reports of entry and exit times developed as an ASP.NET web application using Visual Basic . NET language and Microsoft SQL Server 2017. When the program is complete, the test is performed to measure the efficiency and accuracy of 5 testers, each 400 frames of the camera. A total of 2,000 images were recorded. The test method allows all testers to move their faces naturally in any direction freely. The result is an average Recall of 98.55%, the Precision aveage of 98.59% and the F-Measure average of 98.54% and can prevent recording time error. The system can detect many faces at once. Therefore, it can effectively solve the problem of delays in verifying the identity of the old system. What must be done in the future is to make the system accurate in different lighting conditions, because it is considered a weakness of the face detection and recognition system.

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