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“Palm Print Authentication Attendance Monitoring System using OpenCV”

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Palm Print Authentication Attendance Monitoring System using OpenCV

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Biometrics is widely used nowadays for personal identification or verification based on physiological and biological features. In old times, biometrics were only used for signing on an agreements or for taking a prisoner's identity by stamping its features, dipped on an ink, if it is a fingerprint for example, on a paper or on a document. Now, it is easy to acquire and it is unique for every individual. By using a biometric scanner, a biometric feature can easily be extracted and saved into a database, which can then be used for personal identification or authentication later on. There are various biometric features such as iris, fingerprint, face, palm print and etc., and among them, fingerprint is the most widely used biometric feature. Many access control systems adopt biometric features to replace digit-based password, which can be stolen in some cases or even be forgotten, to strengthen security or to promote privacy. In some cases, biometrics are implemented on laptops or computers to have a tighter security in logging in. By using this technology, this paper aims to provide an automated attendance monitoring system.

The research aims to develop an automated attendance system with the help of the palm print biometric features, not with the use a biometric scanner but with a camera. Using OpenCV/EmguCV, an open source computer vision and machine learning software library, to implement the image processes and algorithms in C# language.

For testing and evaluation, a live feed on a camera is processed in the application to detect or reject a match on an individual's palm print. It should not detect a match if an individual's palm print is not enrolled in the system.

1. INTRODUCTION

1.1 Background of the study

The previous approach in monitoring attendance was manually taking and maintaining attendance records which was a very inconvenient task. Then later on, biometric scanners and bar code scanners are developed but these have its drawbacks. In most attendance monitoring system uses fingerprint biometrics and it is a very reliable in personal authentication but it requires fingerprint scanners that cost a lot. These scanners, in later use, will start to have hardware defects and if in great damage, it can't be used anymore and a new scanner will be needed. Also, since these scanners are used by different people, health issues might come into place. Diseases or viruses can be easily transmitted because physical contact is needed in scanning fingerprint. The bar code scanner also is not that reliable. Bar codes can be obtained from a person's ID and it can be easily lost or stolen from the owner. Like fingerprint, palm print is also a reliable biometric since its features are also unique in each individual. More importantly the details of the ridges are permanent. Compared with other physical biometric characteristics, palm print authentication has several advantages: low-resolution imaging, low-intrusiveness, stable line features (Kah Ong, M. et al.).

The goal of this research is to introduce a palm print biometric system with computer vision. This research also aims to produce a basic automated attendance monitoring

system by using the palm print biometric created.

1.2 Significance of the study

This will introduce a biometric attendance monitoring system that uses another biometric feature which is the palm print, is reliable and can be used in different organizations such as in school or a business company. Open source computer vision library (OpenCV) and EmguCV, a .NET wrapper to OpenCv, will be used in authenticating a student or an employee's identity, through image processing from the monitoring attendance record. The acquisition of the palm print is made with a digital camera, not with the aid of a scanner. In the field of biometrics, a high quality image is really important to successfully extract its features, and this is usually obtained using scanners. Few studies are made in testing the capabilities of various devices used in biometrics, such as mobile camera and digital camera. Successful use of digital camera will prove its reliability in biometrics.

1.3 Technology Application Context

Image Processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. In this research, a camera is used to capture on a live feed the palm print images.

The research is done using Emgu CV, a cross platform .NET wrapper which allows OpenCV library functions to be called

from .NET compatible languages such as C++, VB.NET, and C#.

In this research, image processes such as the conversion of an image into grayscale, adjustments on its brightness, contrast, hue, saturation, sharpness, gamma, and exposure are used, to produce a fine quality of image capable for matching. The live feed will undergo these methods through OpenCV functions before an image is considered ready for matching. The live feed will have a rectangle drawn on the center and the palm print region inside the rectangle will be cropped and will serve as the region of interest (ROI) of a user's palm where the matching algorithm can then be applied

1.4 Objectives of the study

General Objectives:

- (1) To implement the project in OpenCV/EmguCV in C# language
- (2) To successfully recognize and authenticate a user's palm print region of interest
- (3) To automatically update the attendance system

Specific Objectives:

- (1) Integrate OpenCV/EmguCV image processing library to a development platform
- (2) To Use an integrated development environment in developing the system using C#
- (3) Capture or detect a palm print image on a fixed light condition and fixed camera position
- (4) Enable to detect a user and automatically update attendance

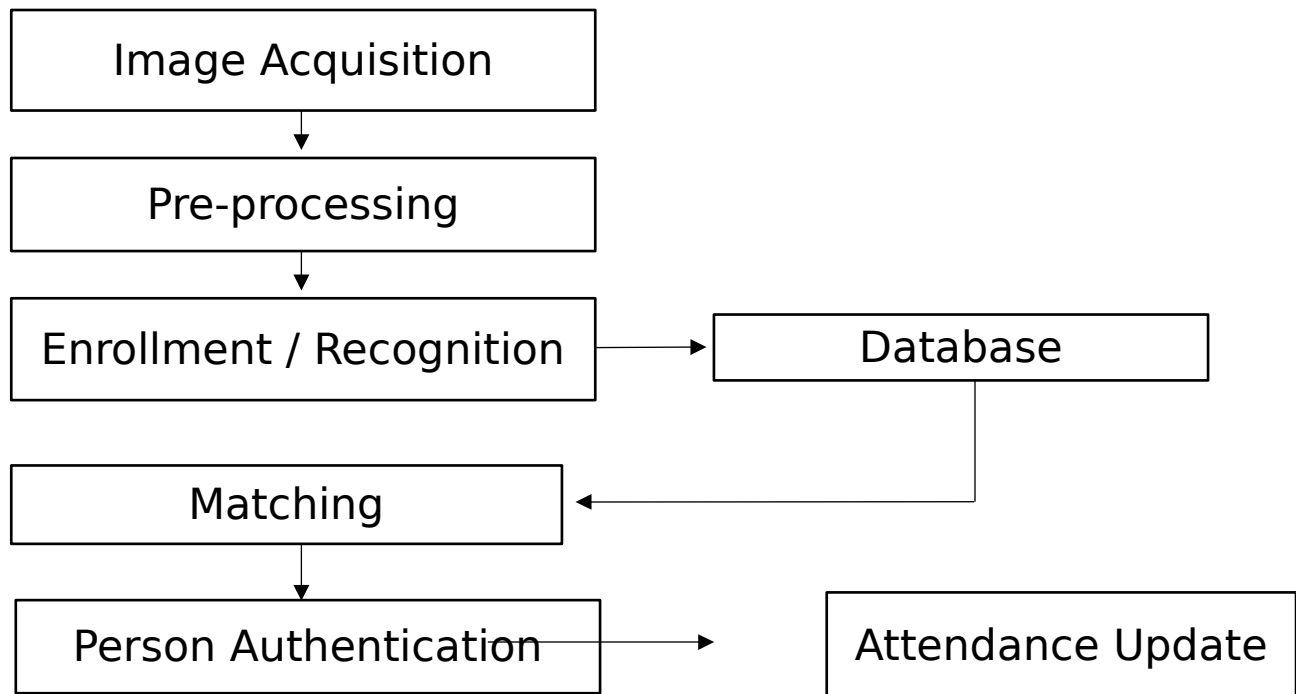


Figure 1.a: Conceptual Framework

1.5 Conceptual Framework

The application takes input from the camera's live feed. Images acquired during the live feed will be passed on to pre-processing. First, the frames are adjusted to a specific values of camera specification to produce a fine palm print image. Next, the frame is converted to grayscale. Then, on enrollment or recognition stage, the processed frame will be saved as a bitmap file. Finally, during matching, if the same

palm print image is recognized, it confirms

the person authenticated and then updates the attendance system.

1.6 Scope and Limitations

The scope of this project is to capture palm hand region and recognizes a match from the database for automated attendance monitoring system. The attendance is updated if a match is found during authentication. Its update includes details such as the number of absences and daily time records of a particular person. The

limitation of this research includes the lighting conditions of the picture and the position of the hand. Unwanted noise on the picture, such as a callus or a wet hand, has a big impact on the application's

performance. Moreover, if minor obstructions on the hand is detected, it lessens the probability to find a match.

2. LITERATURE REVIEW

2.1 On-line Palm Print Identification

David Zhang, Wai-Kin Kong, Jane You. On-line Palm Print Identification.

The article presented a new biometric approach to on-line personal identification using palm print technology. In contrast to other existing methods, the on-line palm print identification system employs low-resolution palm print image to achieved effective personal identification. The system consists of two parts: a novel device for on-line palm print image acquisition, and an efficient algorithm for fast palm print feature extraction and representation. A robust image coordinate system is defined to facilitate image alignment for feature extraction. In representing a low resolution palm print image and match different palm print images, 2-D Gabor phase coding was used. In conclusion the system achieved good performance in terms of speed and accuracy.

2.2 Personal Authentication using Palm Print Features

Chin-Chuan Han, Hsu-Liang Cheng, Chih-Lung Lin, Kou-Chin Fan. Personal Authentication using Palm Print Features. *Pattern Recognition* 36 (2003) 371 - 381.

In this paper, a novel approach was presented to authenticate individuals by using their palm print features. The hand image was captured from a scanner without any, fixed peg. The mechanism is very suitable and comfortable for all users. Propose two verification mechanisms, one is

the template matching method and the other is neural network-based method, to verify the palm-print images. In the template-matching method, the linear correlation function is adopted as the metric measurement and showed above 91% accuracy rate. In the neural network-based method, the backpropagation mechanism and the scaled conjugate-gradient algorithm was used to build-up a neural-network-based verifier and obtained 98% and above accuracy rate. Experimental results reveal that our proposed approach is feasible and effective in personal authentication using palm-print features.

2.3 Personal Verification using Palm Print and Hand Geometry Biometric

Ajay Kumar, David C.M. Wong, Helen C. Shen, Anil K. Jain. Personal Verification using Palm Print and Hand Geometry Biometric.

The objective of this work was to investigate the integration of palm print and hand geometry features, and to achieve higher performance that may not be possible with single biometric indicator alone. Unlike other bimodal biometric systems, the users do not have to undergo the inconvenience of using two different sensors since the palm print and hand geometry features can be acquired from the same image, using a digital camera, at the same time. Each of these gray level images are aligned and then used to extract palm print and hand geometry features. These features are then examined for their individual and combined performances. The image acquisition setup used in this work is inherently simple and it does not employ any special illumination nor does it use any pegs to cause any inconvenience to the users. The achieved results are significant since the two biometric traits were derived from the same

image, unlike other bimodal biometric systems which require two different sensors/images. The results also show that the decision level fusion scheme, with max rule, achieves better performance than those for fusion at the representation level.

2.4 Image Alignment Based on Invariant Features for Palm Print Identification

Wenxin Li, David Zhang, Zhuoqun Xu. Image Alignment Based on Invariant Features for Palm Print Identification. Signal Processing: Image Communication 18 (2003) 373 - 379.

This paper introduces a new palm print alignment method for dealing with image rotation and shifting. By this alignment operation, a certain palm print sub-area can be easily obtained so that the corresponding palm print feature matching will be carried out satisfactorily. In order to align palm prints, two invariant features, outer boundary direction and end point of heart line, are introduced. The key point in this paper is to propose a new automatic invariant-feature-based palm print alignment method, which is able to deal with various image distortions such as image rotation and shift. This method provides a foundation for further feature extraction and matching. Based on the proposed alignment method, up to 13% correct identification rate can be improved. The experiments illustrate the effectiveness of the proposed method.

2.5 An Attendance Monitoring System Using Biometrics Authentication

Seema Rao, Prof.K.J. Satoa. An Attendance Monitoring System Using Biometrics Authentication. International Journal of Advanced

Research in Computer Science and Software Engineering Volume 3 Issue 4, April 2013.

The main aim of the paper is to develop an accurate, fast and very efficient automatic attendance system using fingerprint verification technique. We propose a system in which fingerprint verification is done by using extraction of minutiae technique and the system that automates the whole process of taking attendance. The study was conducted using a quantitative approach by designing a questionnaire as the data collection instrument based on fingerprint matching biometric technologies. The results however show that fingerprint biometric identifier was found suitable for the employee attendance management system of the organization.

2.6 Palm Print Recognition across Different Devices

Wei Jia, Rong-Xiang Hu, Jie Gui, Yang Zhao, Xiao-Ming Ren. Palm Print Recognition across Different Device. Sensors 2012, 12, 7938-7968.

In this paper, the problem of Palm print Recognition Across Different Devices (PRADD) is investigated, which has not been well studied so far. Since there is no publicly available PRADD image database, a non-contact PRADD image database containing 12,000 grayscale captured from 100 subjects was created using three devices, i.e., one digital camera and two smartphones. Due to the non-contact image acquisition used, rotation and scale changes between different images captured from a same palm are inevitable. A robust method to calculate the palm width was used, which can be effectively used for scale normalization of palm prints. On this PRADD image database, the recognition performance of three different methods was

evaluated, i.e., subspace learning method, correlation method, and orientation coding based method, respectively. According to experiments results, several meaningful conclusions were obtained: Three popular consumer electronics products including one digital camera and two smart-phones were used to create palm print image databases, and good recognition performance was obtained on these databases. Therefore, these consumer electronics products are suitable for use in the technique of palm print recognition.

2.7 Camera based Palm Print Recognition

Chhaya Methani. Camera based Palm Print Recognition

In this paper, a design of a biometric system used for unconstrained and unsupervised camera based palm print recognition system was proposed. It presents a new pose transformation algorithm that can identify individuals even after seeing the hand being presented in a pose different than that stored in the database. The method can robustly estimate and correct variations in pose, and compute a similarity measure between the corrected test image and a reference image. The method is able to correct for pose variation even in degraded images having variable illumination. Since, this is the first attempt at creating an unconstrained palm print recognition system, we created two in-house databases to model the pose and illumination variations related to the palm image capture process used by us. The first database contains images of 100 users, having 5 images each having variable poses. The second database captures 6 videos each for 100 subjects captured using a regular web camera. Both the datasets have been captured under natural illumination conditions. Experimental results on the first

dataset using the pose correction algorithm show a reduction in Equal Error Rate from 22.4% to 8.7.

2.8 Touch-less Palm Print Biometric System

Michael Goh Kah Ong, Connie Tee, Andrew Teoh Beng Jin. Touch-less Palm Print Biometric System

This paper presents an innovative touch-less palm print recognition. The proposed touch-less palm print recognition system offers several advantages like flexibility and user-friendliness. A novel palm print tracking algorithm to automatically detect and locate the ROI of the palm was proposed. The proposed algorithm works well under dynamic environment with cluttered background and varying illumination. A new feature extraction method has also been introduced to extract the palm print effectively. In addition, a modified PNN was applied to tailor the requirement of the online recognition system for palm print matching. Extensive experiments have been conducted to evaluate the performance of the system. Experiment results show that the proposed system is able to produce promising result. Apart from that, another valuable advantage is that the proposed system could perform very fast in real-time application. It takes less than 3 seconds to capture, process and verify a palm print image in a database containing 12, 800 images.

Identifier	Objective	Methodology
On-line palmprint identification David Zhang, Wai-Kin Kong, Jane You	To develop an on-line palmprint identification system for real-time personal identification	<ul style="list-style-type: none"> On-line palmprint acquisition Pre processing Feature extraction and coding

	n by applying a novel CCD camera based palmprint device to capture the palmprint images	<ul style="list-style-type: none"> • Palmprint matching 	Zhuoqun Xu	various image distortions such as image rotation and shift	
Personal authentication using palm-print features Chin-Chuan Han, Hsu-Liang Cheng, Chih-Lung Lin, Kou-Chin Fan	To propose a palm-pint-based technology to identify the individuals in the entry control systems	<ul style="list-style-type: none"> • Pre processing • Feature extraction • Modeling • Verification 	An Attendance Monitoring System Using Biometrics Authentication Seema Rao, Prof.K.J. Satoa	To develop an accurate, fast and very efficient automatic attendance system using fingerprint verification technique	<ul style="list-style-type: none"> • Fingerprint scanning and registration • Fingerprint recognition or authentication • Attendance update
Personal verification using palmprint and hand geometry biometric Ajay Kumar, David C.M. Wong, Helen C. Shen, Anil K. Jain		<ul style="list-style-type: none"> • Image acquisition and alignment • Feature extraction • Information fusion and matching criterion 	Palmprint recognition across different devices Wei Jia, Rong-Xiang Hu, Jie Gui, Yang Zhao, Xiao-Ming Ren	To investigate the problem of palm print recognition across different devices (PRADD), which has not been well studied so far.	<ul style="list-style-type: none"> • Subspace learning method • Correlation method • Orientation coding based method
Image alignment based on invariant features for palmprint identification Wenxin Li, David Zhang,	To propose a new automatic invariant-feature-based palm print alignment method, which is able to deal with	<ul style="list-style-type: none"> • Palm print identification • Palmprint alignment 	Camera based palmprint recognition Chhaya Methani	Propose the design of a biometric system used for unconstrained and unsupervised camera based palm print recognition system	<ul style="list-style-type: none"> • Image capture • Image preprocessing • Feature extraction • Matching
			Touch-less	Propose to	<ul style="list-style-type: none"> • Hand

<p>palm print biometric system Michael Goh Kah Ong, Connie Tee, Andrew Teoh Beng Jin</p>	<p>use a low-resolution web camera to capture the user's hand at a distance for recognition</p>	<p>tracking and ROI extraction</p> <ul style="list-style-type: none"> • Image preprocessing • Feature extraction • Matching
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Figure 2.a: Summary of Related Literature

3. METHODOLOGY

Biometrics refers to technologies that measure and analyze human body characteristics, such as fingerprints, eye retinas, facial patterns and hand measurements for authentication purposes.

3.1 Research Methods

This research will follow a step by step procedure in completing the study. The first part is the predevelopment and development stage where the gathering of data and research papers are done. Then, the analysis for the software to be used will follow. Lastly, after creating an algorithm for a biometric authentication, matching will come after, then testing and evaluation for the processes.

3.2 Predevelopment and Development

The gathering of data and research papers related to the field of study is the first step before the implementation of the system is done. This will determine which processes or methods will be used or will be applied for the study.

After the gathering of information from the predevelopment stage. The next step will be

the development stage, which will be the analysis for the data gathered and as well as the software and the hardware to be used for the implementation.

3.3 Software and Hardware

a. Software

OpenCV is an open source computer vision library. This library supports real-time capture, video file import, basic image treatment, object detection, blob detection and etc. This library is capable of recognizing real time captures and images and will be used for the creation the algorithm for biometrics. This research will formulate an algorithm that will match the palm images since OpenCV has the capability to recognize objects

EmguCV is a cross platform .NET wrapper to the OpenCV image processing library. Allowing OpenCV functions to be called from .NET compatible languages such as C#, VB, VC++, IronPython etc.

b. Hardware

A 1080p a4tech web camera is used to take the pictures with the help of a small lightbulb and a customized box, where you can place your hand for steady capture.

3.4 Implementation

This application is made with Microsoft Visual Studio in .NET platform with OpenCV and EmguCV libraries and C# for its program language.

The live feed capture will undergo image processing. Once a palm is captured, the region of interest is cropped then saved into the memory. Then, the matching algorithm follows for personal authentication

a. Image Processing

The captured frames are processed first to capture the region of the

palm. It is then adjusted to a specific image specification (brightness, contrast, etc.) in order to produce a fine quality image. Afterwards, the image is cropped and is converted to grayscale and saved into a file for the matching.

b. Matching

Cropped images are then matched on the templates in the database. If the images matched an image in the database, a text label will appear saying that a match is found. Then, the attendance system is updated.

4. TECHNOLOGY BACKGROUND

In order to complete the goals of this study, the computer vision technology is applied for a biometric attendance monitoring system using OpenCV and EmguCV libraries.

4.1 Software

This application is made with Microsoft Visual Studio 2013 in .NET platform with OpenCV and EmguCV libraries and C# for its program language. Both OpenCV and EmguCV are computer visions which are fields that includes methods for acquiring, processing, analyzing, and understanding images and high-dimensional data from the real world in order to produce numerical or symbolic information. EmguCV will be used as the computer vision library for completing the processes in capturing the palm print image. EmguCV along with the OpenCV libraries, is the key for conducting this research for it has the capability to work with images, especially on real-time captures and image processing. In image processing, it includes image acquisition, which is to capture an image from a live camera feed, and other image processes such as the conversion of the image into grayscale, adjusting image specification

(brightness, sharpness, etc.) and etc., it is usually necessary to process the data in order to assure that it satisfies certain assumptions implied by the method.

4.2 Hardware

There are many kinds of computer vision systems, nevertheless all of them contain these basic elements: a power source, at least one image acquisition device (i.e. camera, ccd, etc.), a processor as well as control and communication cables or some kind of wireless interconnection mechanism. In addition, a practical vision system contains software, as well as a display in order to monitor the system. Vision systems for inner spaces, as most industrial ones, contain an illumination system and may be placed in a controlled environment. Furthermore, a completed system includes many accessories like camera supports, cables and connectors. In this project, a 1080p a4tech web camera is used for the image acquisition. The camera is placed inside a customized box with a small lighting, where a hand can placed for steady capture. The position of the camera is fixed in order to produce a uniform position of the hand during image acquisition.

4.3 What is Computer vision

Computer vision is a field that includes methods for acquiring, processing, analyzing, and understanding images and, in general, high-dimensional data from the real world in order to produce numerical or symbolic information. This image understanding can be seen as the disentangling of symbolic information from image data using models constructed with the aid of geometry, physics, statistics, and learning theory.

Sub-domains of computer vision include scene reconstruction, event detection, video tracking, object recognition, object pose

estimation, learning, indexing, motion estimation, and image restoration.

for image processing for either enrollment or recognition.



Figure 5.b: Image acquisition

5. RESULTS AND DISCUSSIONS

5.1 Image acquisition

```
using System;  
using System.Collections.Generic;  
using System.ComponentModel;  
using System.Data;  
using System.Drawing;  
using System.Linq;  
using System.Text;  
using System.Threading.Tasks;  
using System.Windows.Forms;  
using Emgu.CV;  
using Emgu.CV.Structure;  
using Emgu.CV.CvEnum;  
using MySql.Data.MySqlClient;
```

Figure 5.a: Imported Libraries

Figure 5.a shows different libraries used in order to run the application. One of the libraries of this application is EmguCV, EmguCV Structure, and EmguCV CvEnum this libraries is needed in order to run the Opencv in C# language which is the programming language of this application. This libraries are used for the image acquisition and image processing. During the acquisition of an image, a 1080p a4tech web camera lighted with a small lightbulb is used. A frame is captured on the live camera feed and saved into the memory. Figure 5.b shows the actual frames when captured. A frame captured is then ready

5.2 Image Processing

In processing the images, capturing an image is the most significant part of the study. The clearer the hand means the better for the matching stage since we are dealing with pixels. The captured frames are processed first to get the region of the palm. It is then adjusted to a specific image specification (brightness, contrast, etc.) in order to produce a fine quality image. Afterwards, the image is cropped and is converted to grayscale image and saved into the memory for the matching. After converting to grayscale, it is converted again into bitmap for easy manipulation of every pixels of the image. Once everything is complete, it is passed for the matching algorithm.

```

public void Process_Frame(Image<Bgr, byte> imgProcess)
{
    Rectangle rect;
    Image<Bgr, byte> grayFrame = imgProcess.Convert<Bgr, byte>();

    if(register)
        rect = new Rectangle(250, 100, 200, 200);
    else
        rect = new Rectangle(250, 100, 200, 200);

    frame.Draw(rect, new Bgr(255,0,0), 1);
    CvInvoke.cvSetImageROI(grayFrame, rect);

    imageBox2.Image = grayFrame;
    roi = grayFrame;

    train_save(roi);

    if(!register)
        compare_kamot(roi);
}

```

Figure 5.c: Region of interest algorithm

Figure 5.d shows the cropped image from the image captured. Captured frames are processed in the function called the Process_Frame. Here, the area of the palm are extracted and cropped and then they are converted into grayscale and undergo image specifications (brightness, sharpness, etc.). The processed frame is then saved into the memory for matching for later.

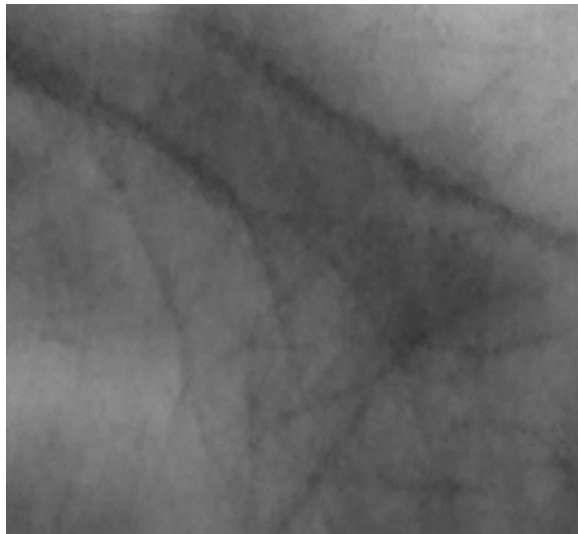


Figure 5.d: Cropped ROI and conversion to grayscale

5.3 Matching

```

void compare_kamot(Image<Bgr, byte> roi)
{
    if (scan)
    {
        if(run == 2)
        {
            run = 0;
            scan = false;
            label1.Text = "No Match";
            return;
        }
        int count1 = 0;
        int id_num = Int32.Parse(scan_id.ToString());
        label1.Text = "" + id_num;
        Image<Bgr, byte> openImage = new Image<Bgr, byte>(@"C:\Users\wasterbert_2\Desktop\palm_files\thesis non\NusduoKamot\TrainingImages" + scan_id + ".jpg");
        img1 = openImage.Convert<Cv_1, byte>().Bitmap;
        img2 = new Bitmap(roi.Convert<Cv_1, byte>().Bitmap);
        img1_ref = new Color();
        img2_ref = new Color();
        int cx = 0;
        int cy = 0;
        img1_ref = img1.GetPixel(cx, cy);
    }
}

```

Figure 5.e: Compare Algorithm

```

int largestCount = 0;
for (int i = 0; i < img2.Width; i++)
{
    for (int j = 0; j < img2.Height; j++)
    {
        img2_ref = img2.GetPixel(i, j);
        if (img1_ref == img2_ref)
        {
            count1 = scan_kamot(i, j);
            if (count1 > largestCount)
                largestCount = count1;
        }
    }
}

```

Figure 5.f: Compare Algorithm continued

Cropped and processed images are then matched on the templates in the database. If the image matched an image in the database, a text label will appear saying that a match is found. Then, the attendance system is updated. If no image matched, a text label will appear saying that no match is found.

figure 5.e and figure 5.f shows the algorithm for comparing. The algorithm is built to locate the first pixel (0,0) of the saved image from the real time image capture, if it finds a match, it starts comparing starting from that pixel until the end of the saved image pixel. Although it is possible to find more than one match for the first pixel(0,0) of the saved image, the algorithm used is designed to loop over if ever a lot of pixel matched the first pixel(0,0) of the saved image. Moreover, if the first pixel(0,0) matches a pixel which is already at the bottom of the real time image, the program will ignore that pixel and ends the compare algorithm.

```

if (largestCount >= 2300)
{
    Label1.Text = "Matched ID: " + scan_id;

    string str = "select count(*) as count from attendance where student_id=" + scan_id + ";";

    MySqlConnection con = new MySqlConnection();
    MySqlDataAdapter ad = new MySqlDataAdapter();
    MySqlCommand cmd = new MySqlCommand();
    cmd.CommandText = str;
    ad.SelectCommand = cmd;
    con.ConnectionString = "host=localhost; database=studentattendance; username=root; password=root;";
    cmd.Connection = con;
    DataTable ds = new DataTable();
    ad.Fill(ds);

    int count = 0;
    for (int i = 0; i < ds.Rows.Count; i++)
    {
        DataRow dr = ds.Rows[i];
        count = Int32.Parse(dr["count"].ToString());
    }

    MySqlConnection myClient = new MySqlConnection("localhost", "studentattendance", "root", "root");
    myClient.Update("attendance", "status=1", "student_id=" + scan_id + " and date_today=curdate()");

    scan = false;
    //return;
}
else
    run++;

```

Figure 5.g: Matching and database update

After finding a match in the database, the program proceeds to attendance system update, figure 5.g shows the code used for matching and updating the attendance system. The program is designed to automatically update a registered person's status into "present" if a match is found. The time and date will also be saved in order to keep track of what time a person has been authenticated. Lastly, it creates a log file which records everything done by the system.

5.4 Testing Results

In testing, a registered and an unregistered hand was tested. In the process of matching after 2 frames of matching, if the qualification of pixels does not meet the given condition, the system will display a text label saying that no match is found. On the other hand, if the condition is met after the scan duration, the text label will display a message saying that it has found a match. Afterwards, it automatically updates the attendance system.

Users / User IDs	Number of Correct detection	Number of False detection
------------------	-----------------------------	---------------------------

1. 109445	4	0
2. 00000	4	0
3. 1234123 5	3	2
4. 109945	5	0
5. 109394	5	0
6. 108828	4	0
7. 108665	3	1
8. 108398	3	1
9. 99999	4	1
10. 50596	3	1
11. 33333	4	0
12. 11111	4	0
13. 22222	4	0

Figure 5.h: Test Results

During the test, on figure 5.h, the image is tested 10 times, 5 with the user's palm and 5 with an unregistered palm.

5.5 CONCLUSION

The study developed an application for palm authentication for an attendance monitoring system. Based on the tests made, the accuracy of authentication for the palm is not so high, and since one of our related topics that compared 3 biometric features (palm print, fingerprint, face) with computer vision shows that the palm print has the lowest authentication accuracy. At the end, the research is implemented with a novel algorithm that uses the pixels of an image for the comparison of the images.

6. RECOMMENDATION

The following recommendations have been proposed for future studies similar to this paper:

- The application is built with a fixed image specification and so, lessens the accuracy when exposed to a different lighting conditions. The proponent suggests that future studies

implement algorithms that can authenticate a hand on different lighting conditions.

- The proponent also suggests that an automatic ROI extraction would be implemented for future studies, so a fixed ROI can be taken for image capture and matching.
- Obstructions on the images results to a lower accuracy. The proponents suggests that an algorithm that clears out noise that can affect the hand is implemented during future studies.

DEFINITION OF TERMS

Biometrics – refers to technologies that measure and analyze human body characteristics, such as fingerprints, eye retinas, facial patterns and hand measurements for authentication purposes.

Grayscale – Images composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest.

Noise – Unwanted or unnecessary artifacts found in the image.

ROI(region of interest) – a selected area identified for a particular purpose. In this research, the ROI is the palm image of the hand which is used for enrollment or recognition.

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