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By Fahrizal Darmawan

Application Of the Eigenface Method in The Presence System Using Web-Based Face Recognition

(Study At E-learning Marketplace in Bandung)

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Abstract

The swift progress of technology has yielded numerous advantages, particularly for organizations engaged in vocational education, such as E-learning Marketplace in Bandung (Luarsekolah). One of the advantages of technology in vocational education is the use of attendance system technology. Luarsekolah's attendance system employs a conventional fingerprint recognition method, which frequently encounters difficulties when employees attempt to clock in, as their fingerprints are occasionally not acknowledged.

Hence, creating a system that facilitates and streamlines employee attendance without requiring physical interaction is imperative. To address this, a facial recognition system utilizing the eigenface approach, with a development methodology based on the waterfall method, is suggested. Using the Eigenface PCA (Principal Component Analysis) technique, this system can function in real time. The research findings demonstrate the efficacy of the eigenface approach in real-time applications.

The eigenface approach incorporates multiple validations to ensure the system's accuracy when employees utilize it. The approach incorporates several validations, such as presenting a message when an employee's face is near the camera and indicating a message when the employee's face is not directed toward the camera. If the camera misses adequate lighting, the system will automatically modify the lighting conditions to enable the camera to capture the employee's facial features.

Keywords : face recognition, eigenface, waterfall, vocational education

INTRODUCTION

The swift advancement of technology in the present era of globalization has yielded numerous advantages for advancement in diverse social domains. (Ismail, 2022; Seal et al., 2020) For instance, organizations involved in vocational education must confront the advancement of information technology that can streamline different technological aspects of company operations.

The utilization of information technology in vocational education organizations is varied, including adopting attendance system technology to streamline employee time tracking, permit requests, leave applications, and the compilation of employee attendance data, among other functions.

E-learning Marketplace in Bandung, operating under the Luarsekolah brand, is an online vocational education and self-development marketplace platform. It offers flexible access and allows users to complete courses according to a predetermined timetable. Its purpose is to support the new generation of Indonesia.

The Eigenface Method

The eigenface method, as described by Ennaama and referenced from Turk, is among the earliest effective techniques for facial identification (Ennaama et al., 2022). Zhang asserts that the eigenface approach is a highly renowned accomplishment in global facial recognition using photographs. The proposed approach involves initially applying Principal Component Analysis (PCA) to decrease the

dimensionality of the original image. Subsequently, the reduced image is used for training and recognition (Zhang & Yan, 2023). The Eigenfaces approach identifies distinctive facial attributes and expresses them as a linear combination of eigenfaces derived from the feature extraction procedure (Rudraraju et al., 2020, p. 240).

Facial recognition

Face recognition is a technological method that can accurately detect and identify an individual's face from video recordings by comparing it with a facial database. (Hasta Yanto et al., 2022) ID verification services often employ this technology to authenticate users (Budiman et al., 2023). The face recognition method entails identifying an individual by comparing various characteristics of a fresh person (input sample) with those of known individuals in the database. (Emily Sing Kiang Siew et al., 2023) The face recognition workflow comprises four primary stages: face region detection, alignment, feature extraction, and classification (Zafar et al., 2019, p. 1). During the 1960s, Woody Bledsoe, Helen Chan Wolf, and Charles Bisson introduced the concept of face recognition. They achieved this by manually identifying and labeling facial features such as the eyes and mouth and then using a computer for the necessary computations. Significant advancements were not achieved due to the prevailing technical constraints throughout that period. During the 1970s, Goldstein, Harmon, and Lesk expanded the range of identifiable characteristics to include 21 distinct attributes, such as hair color and lip thickness. Despite some improvement in accuracy, the process of face recognition remained relied on the manual identification of facial features, resulting in a

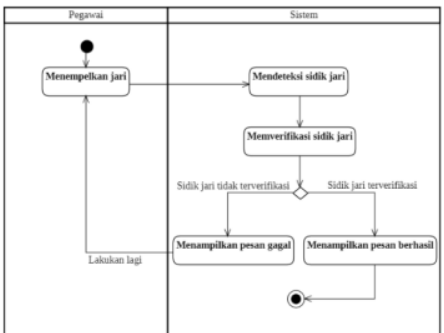
significant expenditure of time and effort (Wang et al., 2022). Umarani Jayaraman outlines three distinct stages in the process of face recognition: 1. Facial detection and extraction 2. Extraction and Representation of Features 3. Facial recognition. Face detection commences by verifying the existence of a face inside the provided image. Subsequently, the subsequent action is to identify the facial region within the image and isolate the area of interest. The process of representing the face in segments is carried out by employing a suitable feature vector that emphasizes the distinct attributes of the face (Jayaraman et al., 2020).

Hence, it is imperative to construct a supplementary system that aids employees in clocking in. Specifically, this system should apply a facial recognition mechanism utilizing the eigenface approach.

METHOD

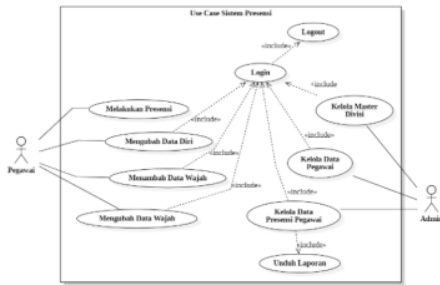
a) Analysis of the Current Attendance System

The activity diagram describes how employees perform attendance on the running system.



b) Analysis of the Proposed System

i. Use Case Diagrams



ii. Use Case Scenarios

Presence Scenario

<i>Use Case</i>	Making Presence
<i>Aktor</i>	Employee
<i>Precondition</i>	The system displays the page login
<i>Postcondition</i>	Displays success information presensi

Step Main	Actor	System
	Step 1 : Choose knob "Presence Face"	Step 2: Displaying camera pop-up
		Step 3: Recording and verify that face seen in camera
		Step 4: Succeed verify face
		Step 5: Displaying message entrance presence"
Step Alternative	Step 3: When there is no face visible on the camera for 30 seconds, then the system will display the message "Failed to verify" Step 4: If the employee's face is not	

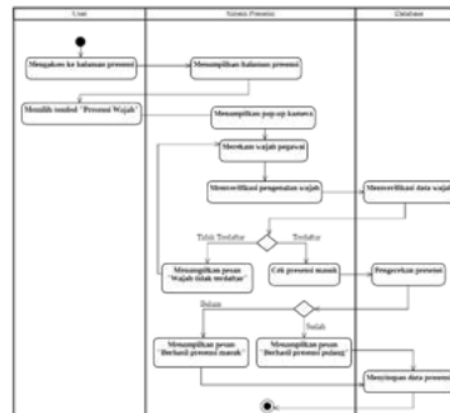
When verification is successful, the system displays the message "Verification Failed"

Step 5:
If an employee ever perform entry attendance, then when the camera successfully verifies the face, the system will display the message "Successful home attendance"

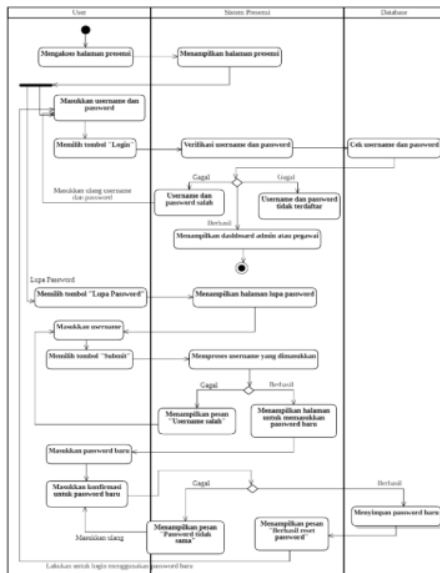
Login Scenario

<i>Use Case</i>	Login	
<i>Aktor</i>	Admin, Employee	
<i>Precondition</i>	The system displays the page login	
<i>Postcondition</i>	User identified as Admin or Employee	
Step Main	Actor	System
	Step 1: Admin or Employee enter n username	Step 2: System do verification

iii. Presence Activity Diagram

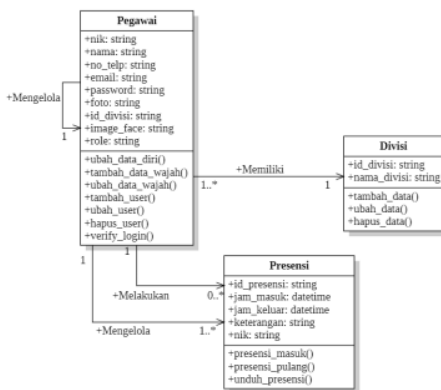


iv. Activity Diagram Login



c) Perancangan Sistem

i. Perancangan Database



Presence Table Structure

Field	Type Data	Length	Extra	Primary Key	Foreign Key
id_presensi	Varchar	2		*	
date enter	Date_time				
date go out	Date_time				
description	Varchar	15			
nik	Varchar	10			**

User Table Structure

Field	Type Data	Length	Extra	Primary Key	Foreign Key
nik	Varchar	10	Unique	*	
Name	Varchar	20			
telephone number	Varchar	13			
email	Varchar	30			
username	Varchar	6			
password	Varchar	10			
foto	Varchar	20			
id_divisi	Varchar	2			**
role	Char	2			
image_	Varchar	200			

Division Master Table Structure

Field	Type Data	Length	Extra	Primary Key	Foreign Key
id_divisi	Varchar	2		*	
nama_divisi	Varchar	20			

ii. Interface Design

Facial Presence Design

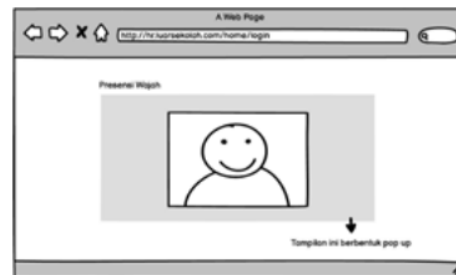


Figure 1. Facial Presence Design

Login Page Design

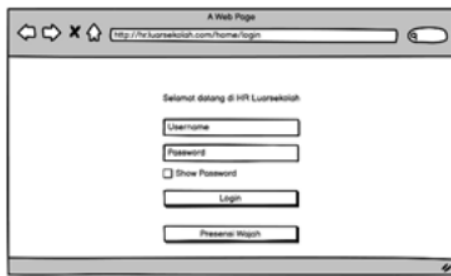


Figure 2. Login Page Design

RESULT AND DISCUSSION

a) Implementation of the system

This attendance system is created with PHP programming language version 7.4.8 with the Codeigniter 3 framework. The system that has been developed is a web-based system. Each process within the system operates in real time and is designed to be easily comprehensible.

Administrative dashboard for all users

The user management page exhibits comprehensive user data encompassing administrative and employee duties. On this page, the administrator can input facial data for employees, as depicted in Figure 3.



Figure 3. Manage All Users Page

Create a page for collecting facial data

Upon selecting the "Add Face" button, the admin will have a camera pop-up on this page.

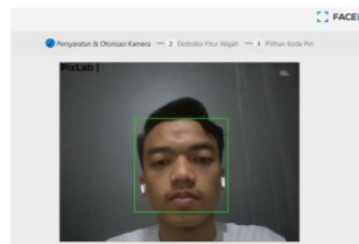


Figure 4. Add Face Data page

The web page establishes a connection to access the camera by utilizing the onclick event function in HTML, which is seamlessly integrated into JavaScript.

```
<button
onclick="enrollNewUser()">Tam
bah Wajah</button>
```

Upon triggering the onclick event, the instruction will be sent and subsequently implemented by JavaScript to facilitate adding face data. This process is specific to the user ID associated with the added facial data, as depicted in Figure 5.

```
"userConsent":
false,

"payload": {
```

```

        "whoami":
123456,
        "email":
"john.doe@example.com"
    }
    }).then(userInfo => {
        $.ajax({
            type : "POST",
            url :
"<?=base_url()>admin/update_
face",
            data : {
image_face :
userInfo.facialId,
id_user:<?= $this->uri-
>segment(3) ?? },
            success:
function(res){
                console.log(u
serInfo);
            }
        });
    }).catch(errCode => {
        handleError(errCo
de);
        faceio.restartSes

```

Figure 5 Javascript code for Adding Face Data

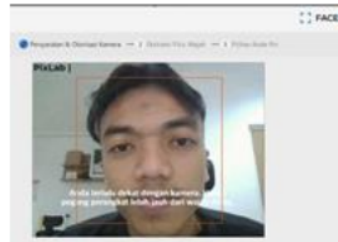
System testing

Conducting tests on this system uses the black box methodology. The testing phase commences by utilizing face recognition as a dataset, where the outcomes of the facial recognition procedure are compared with pre-existing facial data stored within the system. This

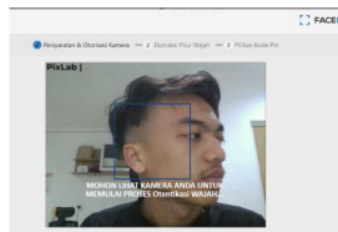
entire process is executed instantaneously. To enhance comprehension, refer to the image provided below:

When including facial data, the eigenface technique undergoes numerous validations, which are as follows:

a. Face position is too close to the camera



b. The employee's face is not turned towards the camera



c. The camera does not detect faces for 30 seconds



In addition to including facial data, the camera page also undergoes additional validations to ensure its presence, as outlined below:

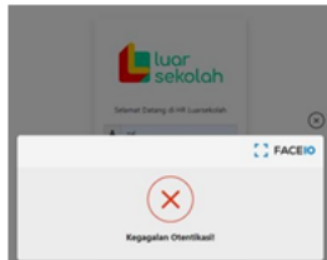
a. The proximity of the face to the camera is excessive.



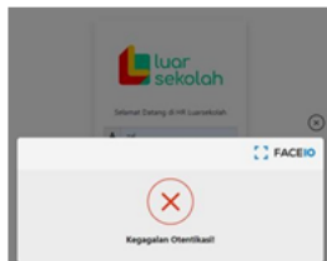
b. The employee's face is not turned towards the camera



c. The face has not been registered in the system



d. The camera does not detect faces for 30 seconds



CONCLUSION

This research aims to enhance the attendance system used outside of school by eliminating the requirement for physical touch, as is the case with the current fingerprint method. The conclusions drawn from the implementation of the system employing the eigenface approach for face recognition are as follows: Employees can record their attendance without the requirement for physical interaction. The face recognition system can operate in real time by utilizing the eigenface PCA (Principal Component Analysis) technique. The eigenface technique incorporates multiple validation measures for employee usage, which are as follows: The system will notify if the employee's face is close to the camera. b. The system will notify if the employee's face is not directed towards the camera. If the camera does not catch enough light, the system will make necessary adjustments to ensure that the camera can record the employee's face. The system can detect only one face, and the maximum distance at which the camera can detect a face is limited to 50cm.

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