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Attendance System with Face Recognition Based on Raspberry Pi using Viola Jones Algorithm

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KEYWORDS

Attendance; Face Recognition; Viola Jones; Raspberry Pi

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A B S T R A C T

In the process of recording attendance at the company, there are many ways that can be used, such as using an attendance card, employee ID (Identity) and fingerprints. However, the existing methods still have the potential for fraud to occur, such as entrusting attendance cards or ID cards to other co-workers, manipulating time on attendance cards, doubling fingerprints etc., so we need another more precise method such as face recognition. This method was chosen because it is considered the most appropriate and very effective than other methods. This study builds a presence system using Raspberry Pi as an image processing controller, a camera to capture facial images and an ultrasonic sensor to detect the presence or absence of people, then the system will perform face recognition using Viola Jones algorithm, followed by validation where the input data will be matched with the data contained in the database and the resulting output in the form of attendance records used for recapitulation. After testing, accurate detection results were obtained when taking the right employee face data that with perpendicular position to the camera so that attendance can be recorded

INTRODUCTION

Currently, various methods are used to record attendance in companies, such as using attendance cards, employee ID cards and also fingerprint scanning. These methods are expected to provide accurate employee attendance data, making it easier to recap. However, the existing methods still have the potential for fraud, such as entrusting attendance cards or ID cards to other coworkers, manipulating the time on attendance cards, duplicating fingerprints, etc., so other more appropriate methods are needed. Attendance recording using facial recognition can be used as an appropriate solution to deal with the frauds mentioned.

Previous related research conducted by Komang Setia Buana, the study discussed the application of facial recognition in attendance recording. In this study, researchers used the Viola Jones algorithm as a face detection algorithm and the Local Binary Pattern Histogram algorithm as a face recognition algorithm which was then combined into a system that could detect a person's face which was used as a verification medium. The results of this study state that the results of face detection can be influenced by distance and tilt, where a distance that is too close to the camera can cause the face to not be detected and vice versa. While the level of face tilt from perpendicular around 20° can still

be detected and at a degree of tilt more than that it is difficult to detect [1].

Research conducted by Astrid Nabila Prima, Cipto Prabowo and Rasyidah discusses the student attendance system using facial recognition and Raspberry Pi. This research produces a face recognition system, which uses the eigenface algorithm, where this system has worked well with upright face conditions. The facial recognition system successfully detects faces well when detecting each student. When detecting faces, the system can read three student faces at once in one frame at a distance of 30-90 cm [2].

Research conducted by Munawir, Liza Fitria and Muhammad Hermansyah discusses the implementation of facial recognition on student attendance using the Haar Cascade Classifier algorithm. This system has the ability to recognize multiple faces, which is not suitable for many students at once, because there are many errors in facial recognition. The level of accuracy in performing facial recognition using the Haar Cascade Classifier algorithm with a multi-face test is 33.33% [3].

Research conducted by Dwi Iskandar, Norma Puspitasari and Muh Alif Fathoni discusses electronic attendance lists based on facial recognition at Kodekiddo Solo. Previously, recording teacher attendance lists at Kodekiddo still used Google forms or

signing attendance sheets by coming directly to the office. Based on this, there were several problems such as, incompatibility of the Google form with the signature sheet form, no recapitulation related to payroll. The results of this study are in the form of an electronic attendance system using facial recognition at KodeKiddo Solo [4].

Research conducted by Prince Richard Setiono and friends developed an attendance system that can detect students' faces using a camera that can recognize students who are present sitting in class. This research resulted in a face recognition application for a class attendance system using Raspberry Pi. Based on the tests conducted, it was found that the face recognition algorithm successfully recognized one to two students, based on tests conducted in five trials. The results of the 3-5 student tests showed that the face recognition test conducted in 5 trials had problems recognizing students' faces who could not find a good head pose [5].

Research conducted by Indah Purnama Sari and Ismail Hanif Batubara discusses the use of Raspberry Pi in managing student attendance using face recognition. Facial recognition is done using the HaarCascade algorithm. With this system, it can reduce cheating that is committed and make it easier for parents to control their children's attendance. Attendance recapitulation is more effective and makes administrative work easier and minimizes errors [6].

Based on the problems explained previously, this study designed an attendance system using the Viola Jones algorithm with Raspberry Pi as a controller that regulates the system so that each facial data that has been captured by the camera will be stored and as comparative data to be matched when employees record attendance, if it matches or is appropriate then the system will record the time when employees enter and leave work. Existing time data can also be processed again and a monthly attendance recap is made as one of the considerations in assessing the discipline of each employee.

METHOD

The facial recognition system is built using the Raspberry Pi controller because, compared to other controllers such as Arduino, Raspberry Pi has much higher specifications and has many features such as higher system-on-chip clock speeds, memory and RAM with much larger capacities, and more flexible programming languages (C, C++, Python, Linux). This is related to image processing which will require qualified hardware. The Raspberry Pi will be equipped with a Logitech C270 camera module with a resolution of 3.0 megapixels so that the quality of the captured images will be much better and is expected to be more accurate in detecting faces. The HC-SR04 ultrasonic sensor is used to detect whether there are people around the device, so that if there are no people, face detection will not be carried out. An illustration of the system created can be seen in Figure 3.

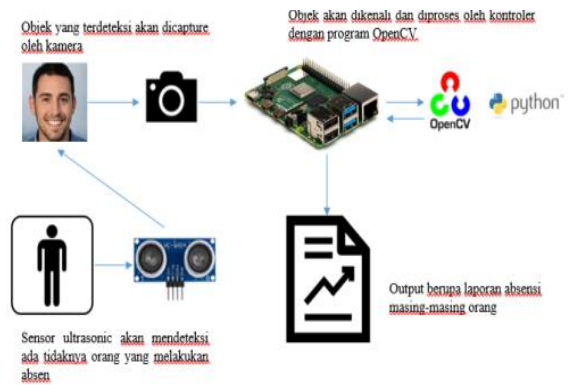


Figure 1. Ilustrasi dari sistem yang dibuat

The block diagram is used to describe the system with its main functions and consists of input, process and output blocks from the device created. It can be seen in Figure 5 that the input from the ultrasonic sensor and camera will be processed by the Raspberry Pi, then a validation process is carried out whether the input data and existing data match or not. If so, there will be an output in the form of an attendance record.

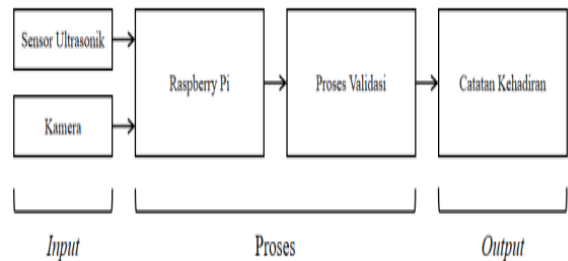


Figure 2. Block Diagram

Tool Chain

The hardware used in this facial recognition attendance system is an ultrasonic sensor, camera, and Raspberry Pi micro-controller. The series of tools or hardware in this study can be seen in Figure 3 and the electrical circuit in Figure 4.

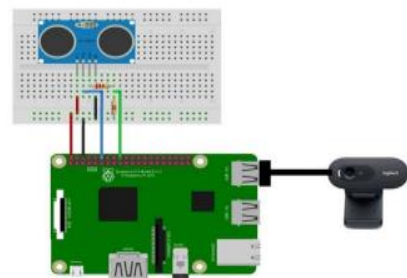


Figure 3. Tool Chain

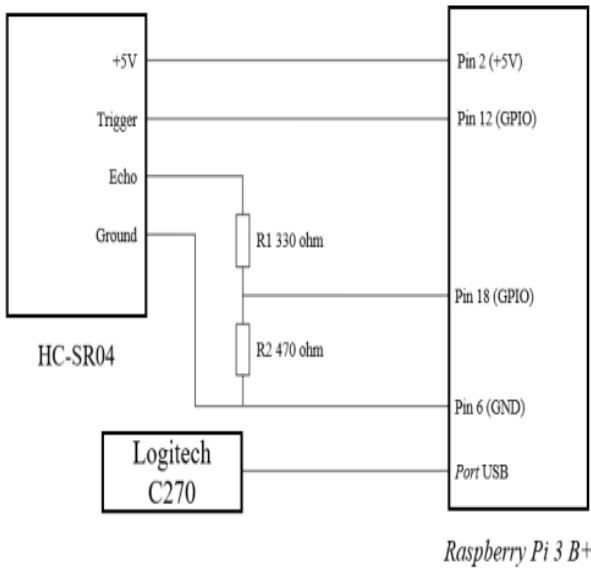


Figure 4. Electrical Circuits

RESULTS AND DISCUSSION

Appearance

1. Dashboard View

The dashboard page display is a display that displays the main page of the application, where there are several menus that can be used by the admin such as the user menu, employee menu, employee dataset menu, attendance test menu, attendance list menu. The dashboard display can be seen in Figure 5.

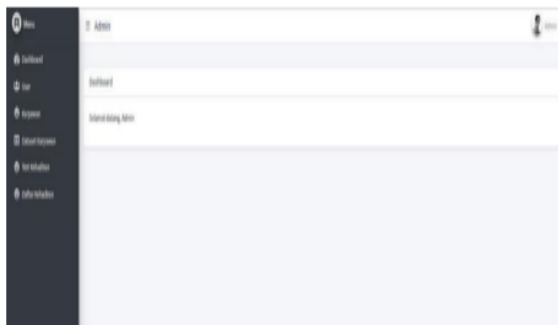


Figure 5. Dashboard View

2. User View

User view is a view used to display user data. On this page, the admin can manage user data. The user data display can be seen in Figure 6.

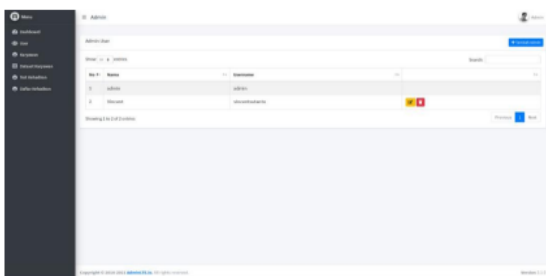


Figure 6. User View

On the employee data page there is an add button used to display the page to add user data. On this page there are several forms that can be filled in by the admin, namely the name form, username form and password form and a save button to save user data. On the user data page there is a change button used to display the page to change registered user data. On this page there are several forms that can be changed by the admin, namely the name form, username form and password form and a save button to save user data. On the user data page there is a delete data feature. This feature can be used by the admin when wanting to delete user data, but before the system deletes the data, the system reconfirms by displaying a confirmation message.

3. Employee view

Employee view is used to display employee data, where on this page the admin can manage employee data. The employee data display can be seen in Figure 7.

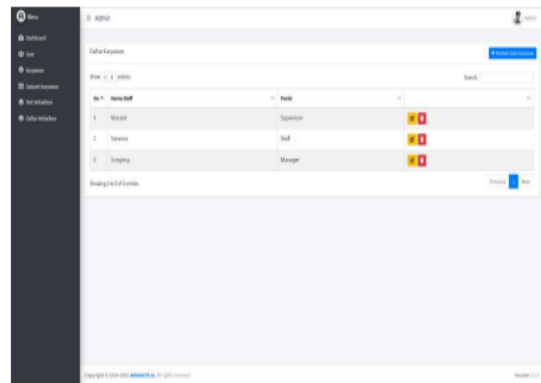


Figure 7. Employee View

On the employee data page, there is an add button that is used to display the page to add employee data. On this page, there are several forms that can be filled in by the admin, namely the staff name form, position form and the save button to save employee data. On the employee data page, there is a change button that can be used to display the page to change registered employee data. On this page, there are several forms that can be changed by the admin, namely the staff name form, position form and the save button that can be used to save employee data. On the employee page, there is a delete data feature. This feature can be used by the admin when they want to delete employee data, but before the system deletes the data, the system reconfirms by displaying a confirmation message.

4. Employee Dataset View

The employee dataset view is a page used to display registered employee data. The employee dataset view can be seen in Figure 8.

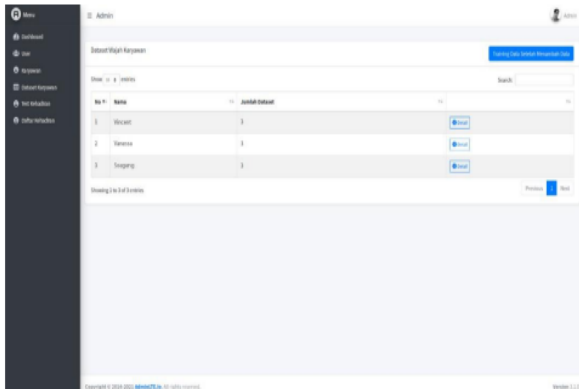


Figure 8. Employee Dataset View

The detailed view of the employee dataset is a view that displays a list of employee faces, where the list of faces on this page will be used as data to verify employee faces when taking attendance. In addition, on this page there is a function to add facial data either automatically or manually. The detailed view of the employee dataset can be seen in Figure 9.

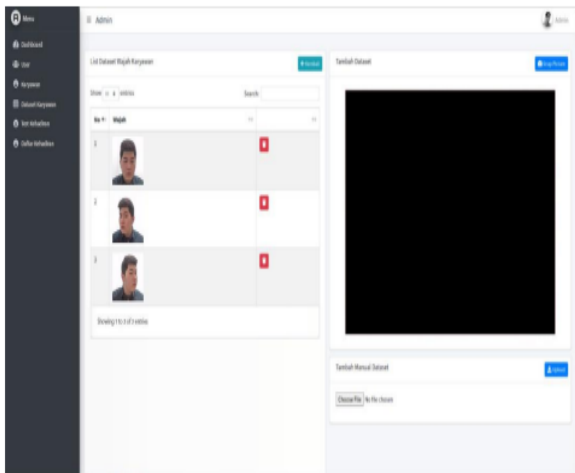


Figure 9. Employee Dataset Detail View

5. Attendance List View

The attendance list display is a display used to display a list of employees and can be seen the date, employee name and position of the employee who has made the recording. The attendance list display can be seen in Figure 10.

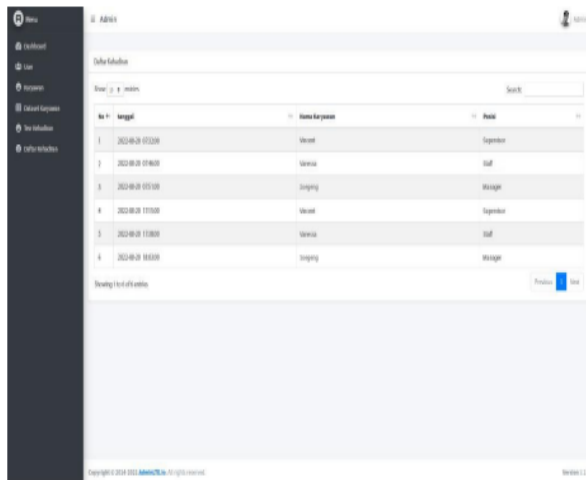


Figure 10. Attendance List View

Testing of Validation Process and Attendance Recording






In this testing process, validation will be carried out on the facial results that have been captured by the camera and matched with the dataset owned by the employee concerned, whether it is appropriate or not, if so, a message box will appear that provides information that the attendance has been successfully saved and if not, a message box will appear explaining that the face was not detected and please try the process again, as can be seen in Table 1 below:

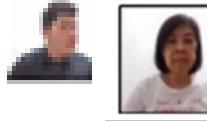
Table 1. Attendance Validation

No	System Condition	System Validation	Description
1	Camera capture results employee dataset	Your attendance has been successfully saved	Attendance recording process successful
2	Camera capture results do not match employee dataset	Face not detected please try again	The attendance recording process failed, and employees are expected to try again

After knowing the system validation, the employee's face will be tested and the results will be seen. In the attendance testing process, each employee has 3 datasets and will be tested with various facial variations, namely: perpendicular to the camera, tilted to the right, tilted to the left, and using the face of another employee, the test is carried out several times and examples of testing are shown in Table 2.

Table 2. Employee Attendance Recording Testing

No	Dataset	Camera Capture	Target	System Validation	Result
1			Presence Detected	Your attendance has been successfully saved	Appropriate
2			Presence Detected	Your attendance has been successfully saved	Appropriate
3			Presence Detected	Face not detected please	Not Appropriate

			try again
4		Fail	Face not detected please try again
			Appropriate

From Table 2, the results for Vincent's employee with the Supervisor position are 3 out of 4 results are in accordance with expectations, so the accuracy level for employee (1) can be calculated as:

$$\text{Vincent's accuracy level} = \frac{\text{Jumlah Kesesuaian}}{\text{Jumlah Pengujian}} \times 100\%$$

$$\text{Vincent's accuracy level} = \frac{3}{4} \times 100\%$$

$$\text{Vincent's accuracy level} = 75\%$$

After conducting the attendance recording test, the following conclusions were obtained:

1. In the first condition (face facing perpendicular to the camera) all test results showed 100% accuracy and could record
2. In the second and third conditions (face tilted to the left or right) only 2 out of 8 trials were in accordance with expectations or an accuracy level of 25%
3. In the fourth condition (using another employee's face) all test results showed results in accordance with expectations and no recording was carried out because the data taken and the dataset tested did not match.

The results of employee attendance records can be seen in Table 3 below:

Table 3. Employee Attendance Record

No	Date	Employee Name	Position
1	2023-08-20 07:32	Vincent	Supervisor
2	2023-08-20 07:46	Vanessa	Staff
3	2023-08-20 07:51	Soegeng	Manager
4	2023-08-20 17:15	Vincent	Supervisor
5	2023-08-20 17:38	Vanessa	Staff
6	2023-08-20 18:03	Soegeng	Manager

CONCLUSIONS

The attendance system with Raspberry Pi-based facial recognition is designed using UML modeling and then built using python as a programming language and using MySQL as a database, where the input starts from the camera then the system will detect the face using the Viola Jones algorithm then the data that is matched is the data contained in the database has been running well The test results show that the position in taking pictures/face data perpendicular to the camera produces an optimal level of accuracy, namely 100%. While taking pictures/face data with the face tilted to the left or right cannot

detect the face correctly. For further research, this attendance system can be developed using other algorithms as a comparison.

The conclusion should be linked to the title and objectives of the study. Do not make statements not adequately supported by your findings. Write the improvements made to industrial engineering field or science in general. Do not make further discussions, repeat the abstract, nor only list the results of research results. Do not use bulleted points, use paragraphed sentences instead.

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