

Development of a Facial Recognition-based Attendance System using Binary Patterns Histograms Method and Telegram Bot Notification

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ABSTRACT

In carrying out attendance activities, most schools still use the manual attendance method, which utilizes the attendance book as a medium. However, the presence of the manual still causes some problems that arise when using this method. With the aim of this study, a "Facial Recognition-Based Attendance System" was created. This study used the Local Binary Pattern Histogram (LBPH) method to detect and recognize faces. The system is made to recognize the student's face and name, which the attendance system will then carry out along with the student's identity in the form of Name and Absence Number in real time to find out that the student is present in the class. The names that have been diabase can be saved through the XLS format. The result of this study is a facial recognition-based attendance system using the LBPH (Local Binary Pattern Histogram) method. The system is web-based, so users can easily access it through the internet. This research method uses research and development methods. This research stage consists of research and information collection, planning, and product draft development. The results of this study showed the feasibility level of facial recognition-based attendance systems. The eligibility rate obtained showed a score of 78.98%. From these results, this system is worthy of being used as an attendance system.

Keywords: Face Recognition, LBPH, OpenCV, Presence, Python

1. INTRODUCTION

Along with the development of information technology, progress in programming has also increased in complexity and function. One of the developing fields is biometrics. This field processes a person's exceptional physical characteristics that can be used as an identification and security system [1]. Facial image recognition is related to objects that are never the same because there are parts that can change. These changes can be caused by facial expressions, light intensity, shooting angle, or changes in facial accessories. Face detection or face Detection is a computer technology to detect human faces by determining the position and size of the human face in a digital image [2].

According to Suprianto [3], facial recognition involves many variables, for example, source image, image processing image, extracted image, and profile data of a person. It also requires a sensing tool in the form of a camera sensor and a method to determine whether the image captured by the webcam is classified as a human face or not, as well as to determine the profile information that matches the image of the face in question. Facial recognition has been developed for many security applications, attendance applications, and population data collection applications. Using the face as an identifier has many benefits, especially its practicality because it requires an image for identification.

The face recognition system works by comparing the input face image with the face image recorded and stored in the previous database and finding the match or similarity of the face that best fits the previously imported input data. Each pixel on a facial image is a feature in itself. The larger the image's dimensions, the more features will be processed for facial recognition and the higher the computation time [4]. The greater the amount of training data will also increase the computational time [5]. It has thus been discovered that the

problem of facial recognition can be solved using algorithms or classification methods [6]. Face recognition here is intended to measure facial characteristics used in biometrics. This facial recognition system has real-time properties and can be a technological need for the future [7]. One of the biometric system implementations is the development of a presence system. The presence of a presence system was developed based on several types of physical recognition, including fingerprint, face, retina, voice, palm, behavioral biometrics, multimodal biometrics, and biometric modalities. Among all those that are often used for identity recognition are fingerprints and faces [8].

Local Binary Pattern Histograms, commonly called LBPH, are one of the methods used to process facial features, such as face detection and face recognition. This method will change the texture of a face image to a binary value, representing the part of the pixels of a face that forms a circle and has a center as a reference for those values. The distance between the densities of these binary values is called neighbors.

Telegram is one of the social media platforms that exist today. Telegram is a free and non-profit, multiplatform instant messenger service application. Users can send texts, images, videos, and files in telegram messages. Telegram also supports various platforms, such as smartphones and desktops/computers. It also has a bot feature to perform a search, reminder, liaison, as a teacher, and so on. This Telegram Bot feature is just an account in Telegram that has been operated by software that already has the AI feature.

Some schools still use a manual attendance system in which the teacher calls the students' names individually to find out which students are not present in class. Some problems often arise when the process is done manually [9], namely:

1. Possibility of manipulation of attendance data.
2. Missing attendance book (manual).
3. Difficulty in recapitulating attendance data.

So the solution to this problem is to conduct research to produce a better attendance system. The attendance system created is a facial recognition attendance system that uses the Local Binary Pattern Histograms (LBPH) method, which will later send notifications to parents about the attendance and return time of their children.

2. RESEARCH METHOD

The procedure in this study uses the stages described by Akker et al. (2006). Some of these stages are:

1) Product Analysis, 2) Product Design, 3) Evaluation. The explanation of some of these stages is as follows:

1. Analysis Phase (Gap Closure)

System analysis is the decomposition of a complete information system into its parts to identify and evaluate problems, opportunities, obstacles that occur, and expected needs so that improvements can be proposed. The analysis is performed to understand how to target a design. This stage is critical since errors in this stage lead to errors in the later stages. The system is analyzed to determine how far it has reached its goals. If the system has any weaknesses, it must be repaired immediately. Because of these problems, the system must be developed until it reaches its target.

2. Product Design Stage (Prototype)

The product design stage is the stage after the analysis stage of the system development cycle. This stage is in the form of stages of depiction, planning, and creation by uniting several separate elements into a whole unit to clarify the shape of a system. The purpose of design research, in general, is to give users an overview of the system to be created. At this stage, in general, the components of the information system are designed to be communicated to the user.

3. Evaluation Stage

The evaluation stage is a process of explaining, obtaining, and providing valuable data to assess an action or a program that has been running. After the prototype is completed, it must be tested, implemented, and repeatedly evaluated until the user can accept it. System testing aims to find errors that occur in the system and revise the system. This stage is essential to ensure that the system is error-free. With evaluation, the achievement of activities can be known, and further actions can be planned to improve the performance of a system. In other words, evaluation is used to test the system's usability and function (functionality). Evaluation

is used to see whether the design results with the system trial process that have been made are following user requests.

In this stage, data collection is carried out utilizing interviews and questionnaires. The interviews in this study aim to discover the problems that must be studied. In addition, the interview also aims to determine the need for various materials to develop the attendance system. The questionnaire used in data collection is a closed statement questionnaire using a Likert scale. The respondent will fill in the answers that have been provided. The questionnaire will also be equipped with questions and comments or suggestions from respondents. In addition, it is also carried out by taking pictures of the face from the camera, which will then be saved into the dataset folder for the face recognition process.

3. RESULT

1. System planning

At this stage, the system will be described and designed. The application work process starts from the application input stage, namely the camera, the camera will continue to turn on as long as the application is run. Then go to the next stage to the registration stage, at this stage enter all data information from students into the database and face dataset.

1. Providing Cascade Classifier

In this study, it took the template that has been provided by OpenCV, namely the cascade classifier. The cascade classifier used is to use the `haarcascade_frontalface_default.xml` syntax, where this cascade classifier has been programmed by OpenCV to help us more easily detect faces.

2. Providing Dataset

The dataset in question is a dataset for facial recognition, where the collection of this dataset the researcher collects about 10 people and takes facial images of 20 facial images per person with a total of 100 images which are then carried out training using the coding trainer that the researcher prepares to facilitate the training process because this process is separated from the main coding and the process in the main coding is just calling the training process that has been made separate.

3. Provide Database for data information

In this process, it functions as data that has been inputted into the database which then after the face image image passes the second pre-processing process after being detected, it will automatically store the information contained in the database and displayed it into the attendance system table.

4. Face Detection Process

In this process, several steps are described before and after during the face detection process.

a) Student Registration Process

Before carrying out the face detection process on the image, it is necessary to fill in the data first before starting the face detection, filling in this data is necessary so that the attendance process can run. In Figure 1 of this process, we fill in personal data according to the identity that has been provided on the system then by pressing the Registration button, the data storage process on the face image and student identity has been stored.

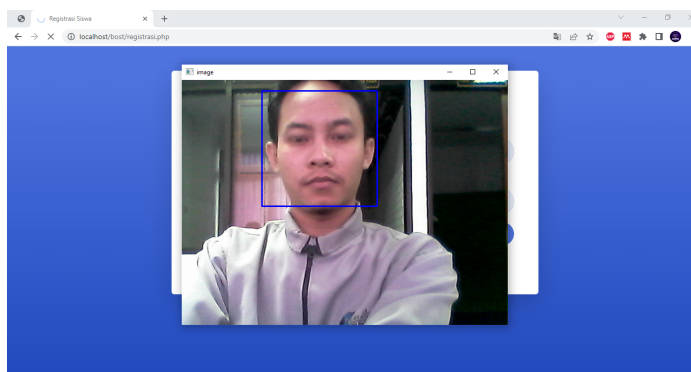


Figure 1 Student Registration Process

b) Convert Image to Grayscale

After the result of the RGB conversion, it is then converted to a grayscale image using the `gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)` method. `COLOR_BGR2GRAY`) which makes the image of the image that was previously colored is converted to a gray image. Here is an example of the image stage of image conversion to grayscale. The face image above is an image that already uses the haarcascade feature process from the OpenCV library which will then be converted to grayscale image using the local binary pattern histogram (LBPH) method as shown in Figure 2.



Figure 2 Image Grayscale Image

Figure 2 is an image that has been cropped and converted to grayscale. The histogram referred to here is a form of visualization of the sharpness and brightness of the image on the face.

5. Face Recognition Process

In this study, a facial recognition algorithm was used with the Local Binary Pattern Histogram (LBPH) algorithm, which began with preparing a dataset with facial image images and a database for student data information. Furthermore, the LBPH algorithm is implemented using the OpenCV library. If you want to get an image from LBPH, the `Trainer.py` function is used, which has been filled with the `cv2.face.LBPHFaceRecognizer_create()` function. Then the recognizer class is used for facial recognition trained from the data face training. `Py` and the database name all use the `predict()` function to determine the facial recognition of ID and Confidence. In this case, the `FUNCTION ID` is from the database that is the benchmark in the facial recognition function to determine the name that will come out as a recognized student. In the example of Figure 3 in the facial recognition process, a face and the identity of a student named Qois and the identity of Name and Nim have been obtained.

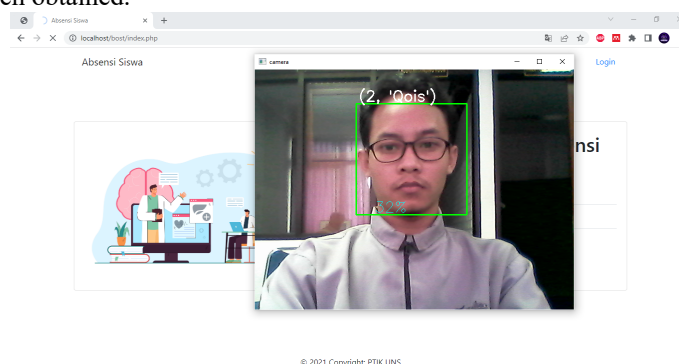


Figure 3 Face Recognition Process

6. Telegram Bot Send Text

After the face recognition process is able to be carried out, then the system will send daily results in the form of group notifications through the telegram application to parents / guardians of students. The notification uses one of the telegram features, namely the telegram bot, where this telegram bot can be used automatically to send notifications using the `def telegram_bot_sendtext(bot_message):` function. In this function, some information from telegrams is needed in the form of

bot_token and bot_chatID to be able to send messages into groups containing parents / guardians. Bot_token needed to identify which telegram bot to use as a messenger to the parent/guardian of the student. Bot_token itself is obtained when users create new bots on Telegram. While bot_chatID is which chat room the Telegram bot will send messages to.



Figure 4 Telegram Bot Send Text

2. Testing Attendance Data

This test was carried out by a number of student volunteers who had participated voluntarily in this study. In the study for now using 5 male students who have taken facial data of 20 face images per person each and have been saved into a dataset with varied faces and a database by conducting 5 experiments.

Figure 5 shows the image image that has been registered with their data through the system that has been run, from the image image that has been prepared, the detection and facial recognition system is ready to be used for the attendance system.

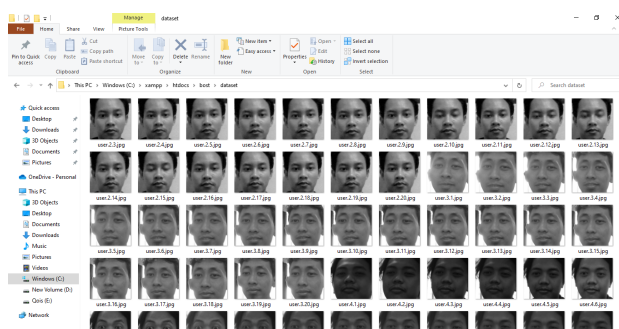


Figure 5 Image of Face Dataset

In this test, 5 experiments were carried out on each student to determine the success rate of machine learning in recognizing the facial objects of each person. Table 1 shows that some faces cannot be recognized properly and resulted in an accuracy value of 64%. The test carried out obtained a statement that in this test there were still many shortcomings in recognizing the faces of students.

Some of the factors that influence the test results that are not able to recognize / detect faces properly are the distance between the camera and the face, interference from other objects covering the face, light reflection, camera angles in shooting that are not quite right, similar faces. There is also a case of false positive, in this case it occurs in the name above the face detection frame showing results that are not the actual name of the student. This can also be influenced due to the results of the trained dataset image.

Table 1 Results of Testing Attendance Data

No	Name	1st try	2nd try	3rd try	4th try	5th try
1	Qois	✓	✗	✗	✓	✓
2	Edi	✓	✓	✓	✗	✗
3	Fariz	✓	✓	✓	✓	✓
4	Aditya	✗	✗	✓	✓	✓
5	Pradana	✗	✗	✗	✓	✓

✓ = Detected / Recognized

✗ = Detected / Recognized

3. Expert due diligence

Expert due diligence is used to obtain a statement from an expert that the developed system is feasible to use. In this study, feasibility testing refers to aspects in accordance with ISO 25010. The respondents on this test were one person as a system expert, namely Mr. Nurcahya Pradana Taufik Prakisyia, S. Kom., M.Cs. This test includes several aspects, namely Functional Suitability, Usability, Reliability, Security, Maintainability, and Portability. The following are the results of feasibility testing:

Table 2 Limited Assessment by System Experts

No	Rated aspect	Percentage (%)
1	Functional Suitability	82.5
2	Usability	71.4
3	Reliability	70
4	Security	80
5	Maintainability	80
6	Portability	90
	Average	78.98

Based on the results of the system feasibility test given to the system expert, a diagram of the results of the feasibility test can be obtained as follows:

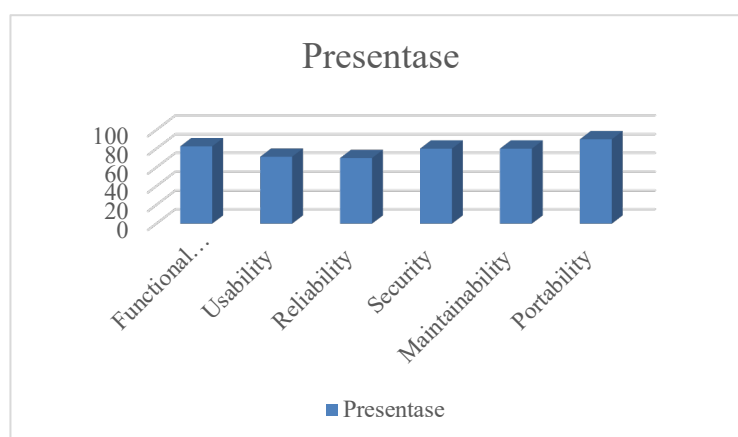


Figure 6 Diagram of Feasibility Test Results by System Experts

Discussion of the results of research and testing obtained presented in the form of theoretical descriptions, both qualitatively and quantitatively. The results of the experiment should be displayed in either a graph or table. For charts can follow the format for diagrams and drawings.

4. CONCLUSION

The result of this study is a face detection-based presence system using the LBPH (Local Binary Histogram Pattern). This system is web-based, so users can easily access it via the internet. This research method uses research and development methods. This study adopts the model developed by Borg and Gall [11]. This research stage consists of research and information gathering, planning, and product draft development.

This presence system is done by scanning the face with the help of face recognition as face detection. This system has been tested to measure the level of feasibility. In the feasibility given by the system expert, the aspects tested consist of the suitability of functionality, usability, reliability, security, maintenance, and portability. The presentations obtained from all these aspects have an average of 78.98%. From these results, it can be concluded that this system is feasible to be used as a presence system.

Although this system is included in the decent category, this system still has several things that could be improved. One of the drawbacks of this system is that it is still possible to do attendance several times in/out a day. This allows students to make attendance more than once, which is encapsulated in daily attendance. In addition, there are detections on faces whose names listed need to match the faces being tested.

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