Human Face Identification Using Haar Cascade Classifier and LBPH Based on Lighting Intensity

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ABSTRACT
The problem in implementing online learning during the Covid-19 era is the lack of internet access for video streaming, especially in small towns or villages. The solution idea is to minimize the video bandwidth quota by only showing emoticons. The first step of the process is the system must be able to lock the face area to be translated. This study aims to identify areas of the human face based on camera captures. The research was conducted using the Haar cascade classifier algorithm to recognize the facial area of the captured image. Then the Local Binary Pattern Histogram algorithm will recognize the identity of the face. The lighting scenario will be used as a distracting effect on the image. The results showed that based on 30 sets of images tested in bright conditions, the system was able to recognize facial identities up to 62%, normal conditions 51% and dark conditions 46%.

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1. INTRODUCTION

The COVID-19 pandemic has triggered a change in normal learning methods to the new normal. Since the entry of the corona virus into Indonesia, the government has implemented a lock down, known as the Policy for Enforcement of Community Activity Restrictions (PPKM) [1]. The impact of this policy has made community activities in various fields of life experience drastic changes, including in the process of teaching and learning activities (KBM) in schools and universities [2]. Over time, the implementation of communication in the network (Online) has become an alternative solution as a change in the form of KBM in the classroom as has been done so far [3]. This change in learning habits is then known as the new normal.

The online communication process in the form of video and audio really requires the support of high enough internet connectivity in order to run smoothly. Some online applications such as Google Meet use videos with 2 image resolution options, namely 360 and 720 pixels, with bitrates up to a megabit per second scale. Meanwhile, if the video service is deactivated, the online class management will be disrupted where the teacher can no longer monitor the learning atmosphere that is being built [4]. Even though the government implements a quota assistance policy, the readiness of the telecommunications network to support this communication process is still questionable, especially in small urban and rural areas [5]. So the idea of solving the problem is to reduce bandwidth usage in the online learning process, by changing the video streaming quota requirement to display emoticons.

The initial step in implementing the emoticon application is to detect the face area (face detection) and recognize people's faces (face identification/authentication) captured by the camera based on image footage [6]. Research related to face detection is generally based on Eigen-face [7]. Although this method can reduce the dimensions of facial images with fewer variables, this method requires a large database. Previously, Linear Discriminant Analysis (LDA) and Independent Component Analysis (ICA) methods were also introduced [8], in the process of recognizing facial areas. But the two methods cannot have data dimensions that are much larger than the number of training samples [9]. The other method is the Haar Cascade Classifier, which can reduce the number of calculations needed so that it can detect in a faster time [10].

Meanwhile, in the face recognition process, several methods have also been introduced in various studies. Research related to the Principal Component Analysis (PCA) method has been carried out previously, but this algorithm has a weakness that is less than optimal in the separation between classes so that it can affect the accuracy of facial recognition [11]. Previously, the Invariant Feature Transform (SIFT) [12] and Convolutional Neural Network (CNN) [13] methods were also introduced. However, both of these methods require high computational resources beyond the capabilities of many mobile and embedded applications [13]. Another method used is the Local Binary Pattern Histogram (LBPH) which can detect objects with small data sets [14].

Although some have combined the Haar cascade classifier and LBPH methods in detecting and identifying faces, some scenarios have not been tested in research. In fact, the situation of taking pictures by the camera may be interfered with by the scenario of the user's atmosphere, such as the presence of light intensity. Through this research, the combination of these methods will be re-examined by providing lighting effects in three conditions, namely light, normal and dark

2. RESEARCH METHOD

PC vision Real human skeleton gets data about the three-dimensional design of the paying attention climate, processes it in the cerebrum, and then reaches specific determinations that depend on intelligence and experience, for example, determining number and shape, or shadows from articles which is noticed. The PC vision innovation was created by leveraging the numerical capacity to display three-dimensional data from actual articles in advanced images. Utilization of PC vision has penetrated into the field of item recognition innovation. Broadly speaking, the PC vision-based framework consists of three principle processes, specifically the image security process, computerized image handling and investigation or dynamic. A sufficiently bright sensor (usually a camera) takes a picture of the item for attention and converts it to an advanced setting [15].

2.1. Haar Cascade Classifier

Figure 1 shows how the Haar cascade classifier functions. One of them is grayscale. Haar classifier is a step to get more precise results by ensuring the value of Haar elements as much and repeatedly. shows the working process of the Haar Classifier. In the first stage setting, each sub-image will be marked with one element, if the results do not meet the model, then the results are dismissed at that time. In the second stage of setup, each sub-image will be renamed. If the value is the ideal limit, then at that time proceed to the next channel stage (third arrangement stage). Until the passing sub image will decrease until it is close to the image in the example [16].

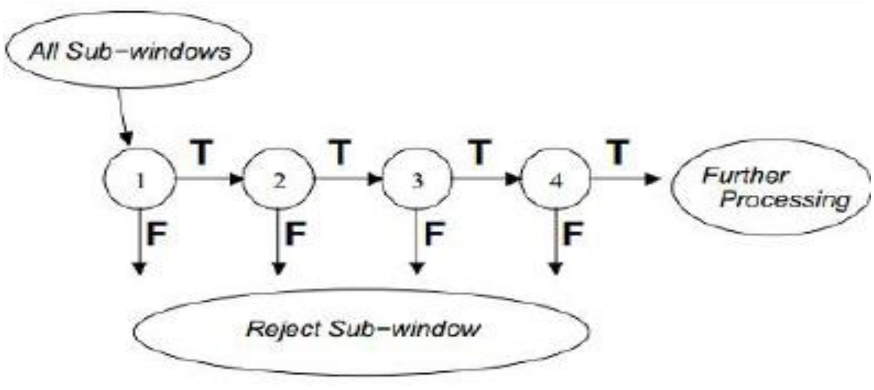

Figure 1. Stages of the Haar Cascade Classifier method [16].

2.2. Local Binary Pattern Histogram (LBPH)

LBP is a method used to separate people. In LBP a picture of a person is taken, each picture is taken. For face reveal or include extraction, the image is converted to grayscale as shown in Fig. 2. Since this image is converted to grayscale, the motivator for image pixels is between (0-255). Until now some of these image pieces were taken as 3x3 windows or 3x3 diagrams. The pixel value of the adjacent pixel at the focal point deviates from the pixel value of the center pixel. Assuming that the adjoining pixel values are more conspicuous than the center pixel, the neighborhood is subtracted by twice 1 other than 0. Then, the effect of these combined values is then converted to a decimal value and assigned to the center pixel. Moreover, it is continued by utilizing the idea of sliding windows. The new pixel grant for this image gives it more desirable properties than the main image [17].

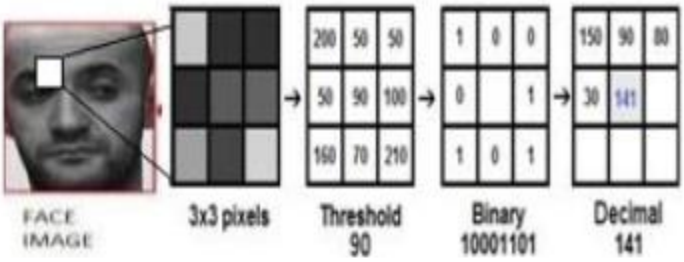

Figure 2. Local Binary Pattern Histogram Method [17].

2.3. Research procedure

Figure 3 describes the overall research scheme. The stages or flow of this research begins with a literature study which aims to find references and ideas in this research, as well as looking for similar research related to the current research. Next is the coding of the algorithm which aims to model the system, at this coding stage there are three stages to be made, the first is facial data recording, the second is facial data training and the third is face detection and recognition. Then proceed with the collection of facial data in the form of images as a collection of data to be trained. And so on to simulate bright, normal, and dark light intensity scenarios. Finally, analyze the results that have been obtained from the programs that have been made previously.

2.4. Data collection

Cascade data that can be obtained from Github, the training data used is facial data recorded directly by the webcam, faces will be recorded 30 times with various positions. The research was conducted by requiring a camera and laptop for experimentation. Asus x455LJ laptop specifications, Intel(R) Core(TM) i3-5010U CPU 2.10 GHz, 12 Gigabyte RAM, 64-bit operating system, x64-based processor, 240 Gigabyte SSD storage 500 Gigabyte memory and Nvidia Geforce 920m VGA. By using the Pycharm application, Python OS and using the library from OpenCV.

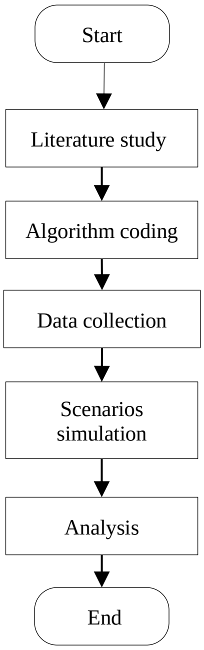

Figure 3. Research Flowchart

2.5. System planning

Figure 4 shows the flow of face identification using the Haar Cascade Classifier and Local Binary Pattern Histogram (LBPH). The human face is the first item to be recognized by the frame, and the basic system performed on the frame is to take a picture from the camera. Also, the image will be converted from RGB to grayscale, which is planned to handle the image using the Haar cascade technique, which will recognize the human appearance. When faces are distinguished, the outline will tick the face as a sky blue box. This is done to recognize objects that are not human faces. Next, the data collection must be done first because before the system sees the face, each face that you want to see will be stored in the database first so that the system can find out the value of the Twofold Example Histogram environment or histogram esteem which is commonly called an image. For the skeleton to see faces effectively, the skeleton must include about 30 images from the camera. The image information will be captured several times in different positions and points. The information will be saved as an image data set. Representations are put into folders, and each individual has their own special Id. Id is used to distinguish facial contours. What's more, a preparatory cycle is also carried out, in which the nearest histogram (LBPH) calculation is used, in which the histogram values of each face pixel in the data set will be outputted and then determined. This value will be stored in the setup organizer along with Personality Id as various information.

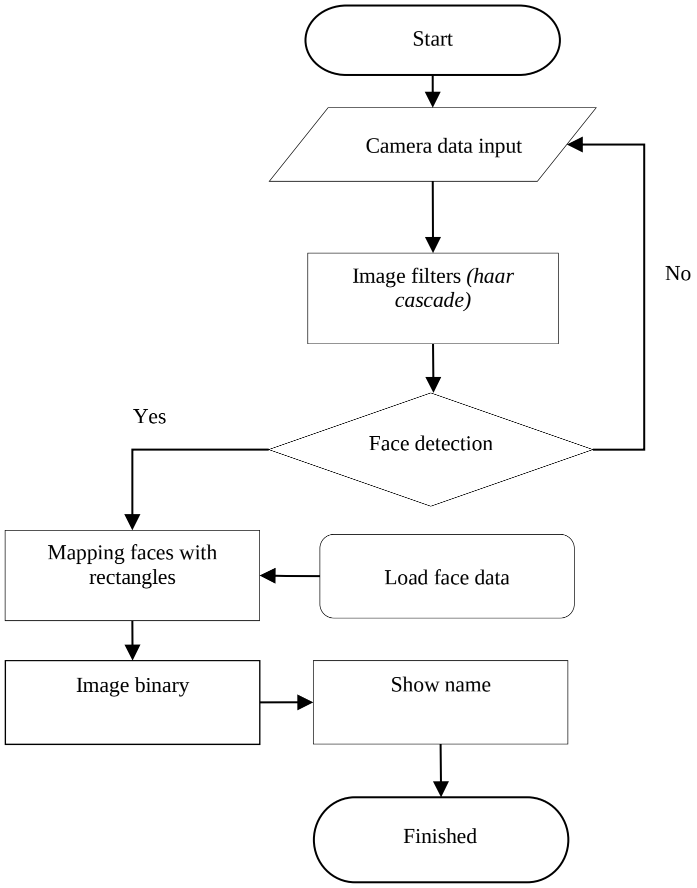

Figure 4. Algorithm Flowchart LBPH [10].

Next, perform the face recognition process. In the face location process, the camera will get input images of faces whose histogram values are distinguished. In this way, the framework can think of the histogram value of the info image recorded by the camera with the histogram value of the face image in the information base. The face will be considered as the substance that has the histogram value closest to the histogram value in the data set. The calculation used is a local binary pattern histogram in constant location framework. Local binary mode histogram (LBPH) calculations have been trained to generate histogram values, which are then directly detected by the camera (real-time). For images that have been stored in the database, it is necessary to compare two histograms between the detected image and the image in the database to find the distance to the nearest histogram value, so that the output of the algorithm changes the identification ID of each image with the name of the owner of the face, and finally displays it on the monitor [10].

3. RESULTS AND ANALYSIS

Local Binary Patterns Histogram (LBPH) is a method to detect and recognize a person's face. In LBP, first, the portion of the image that is in grayscale is taken as a 3x3 window size and neighboring pixel values are compared with the center pixel values and then assigned a binary value which is then converted to a decimal value. The LBP is then combined with the histogram and is called the LBPH algorithm. In the dataset there are 30 views taken from the camera in this review, this interaction may take several minutes, depending on the number of facial photos taken directly by the webcam. In Figure 5, it tends to be seen that the camera image is directly hued (RGB) into a grayscale image. This is the first step to detect and recognize faces by the system.

Figure 5. Convert from RGB to Grayscale

3.1. Scenario

(a) (b) (c)

Figure 6. Face Identification Based on Light Intensity

Table 1. Scenario Face Identification Based on Light Intensity

Data Training (Picture)	Condition	Light Intensity (%)	Accuracy (%)
30	Light	100	62
30	Normal	50	51
30	Dark	10	46

The test is completed by utilizing the lighting from the phone's spotlight to determine the precision value in percent (%). There are 3 tests that will be carried out, namely light, normal and dark conditions, the three tests are carried out with the same amount of training data. In table 1, it can be seen the results of testing the system of combining the Haar Cascade Classifier and Local Binary Pattern Histogram (LBPH) algorithms. Face identification using this merging strategy in Figure 6 (a) the framework of the system can identify human appearances with a 62% certainty level in bright light conditions. Then at that time, we tried to detect faces with normal or moderate light conditions as shown in Figure 6 (b), where the system framework can detect and recognize faces with a 51% confidence level. Furthermore, in Figure 5 (c) the scenario in very low light conditions with the least bright conditions, the frame can still recognize faces with 46% certainty. Based on the test results, it is known that the highest level of accuracy of 62% is obtained at 100% lighting level while at 50% lighting only gets 51% accuracy rate and at least 10% lighting only reaches 46%.

4. CONCLUSION

This review shows that the Haar Cascade Classifier strategy combined with LBPH can detect faces with a confidence level of 62% in bright conditions, then proceed with face detection in normal or dim light conditions, the system can still detect faces with a confidence level of 51%. Very minimal lighting conditions are also carried out where the least bright conditions are the system framework can still detect faces with a 46% confidence level. This paired algorithm can identify, recognize, and understand faces well, despite the fact that in very low light conditions it can still detect faces. The recognition speed is also very fast, which shows that the calculation of the framework is very interesting.

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