The Design of Facial Expression Detection System to Determine the Level of Customer Satisfaction using K-Nearest Neighbor Method

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Abstract. Facial expressions are one of the ways humans communicate to convey personal emotions to their communication partner nonverbally. Therefore, human facial expressions can be used for various purposes, one of which is knowing customer satisfaction. So far, customers of Bank Rakyat Indonesia (BRI) provide feedback on service quality using only a polling system, namely by filling out a criticism and suggestion form and then entering it in a suggestion box which is distinguished between satisfied and dissatisfied. However, such a method is less effective because it can be easily manipulated by customers and customers are often indifferent to the feedback. So that the improvement of service quality tends to be less effective. This research will design a system that can recognize human facial expressions to determine the level of customer satisfaction with input data in the form of video data taken by a webcam camera with the viola-jones method to detect faces and determine facial patterns. Then the facial data will be classified using the K-Nearest Neighbor method to determine the type of facial expression. Determination of the value of k will determine the success rate of facial expression detection. The processed data will be displayed on a liquid crystal display (LCD) and then stored in a MySQL database. The results showed that the accuracy of facial expression detection was 80.77% from 52 facial expression data.

Keywords. Conventional System, Facial Expression, Customer Satisfaction, Viola-Jones, K-Nearest Neighbor

1 Introduction

In the world of banking, customer satisfaction is the company's priority. The level of customer satisfaction can be a benchmark for the credibility of a company, especially in the banking sector. The most important factor influencing the level of customer satisfaction is service quality. Dimensions of service quality that can be implemented properly is a key factor that has an influence on the success of a company in creating customer satisfaction [1].

Facial expressions are one way for humans to communicate in conveying one's emotions to their nonverbal communication partner. Micro-expressions are facial movements that can reveal the emotions someone is trying to hide. In 1969, Ekman analyzed video interviews of people with mental distress who had attempted suicide and found micro-expressions. Micro-expressions will appear in no time. The valid duration is 0.5 seconds. In addition, micro expression generally occurs at low intensity. Facial expressions are considered more than just emotional reactions. As is well known, facial expressions coordinate social interactions through information and motivational functions. According to Darwin's theory of natural selection (1872), emotions are universal because they have several forms of expression and function at the level of communication between humans, regardless of cultural prejudices [2]. Therefore, human facial expressions can be used for various purposes, one of which is knowing customer satisfaction.

2 Research Method

2.1 Hardware Design

The hardware used in detecting facial expressions includes a 3.5-inch TFT LCD screen, web camera, Raspberry Pi, switching adapter (5V 2.5A), and Micro SD. The micro SD used in this design has a capacity of 32GB. The LCD screen used in this design is a TFT type measuring 3.5 inches and a touch screen. Here is a single line for the hardware design used:

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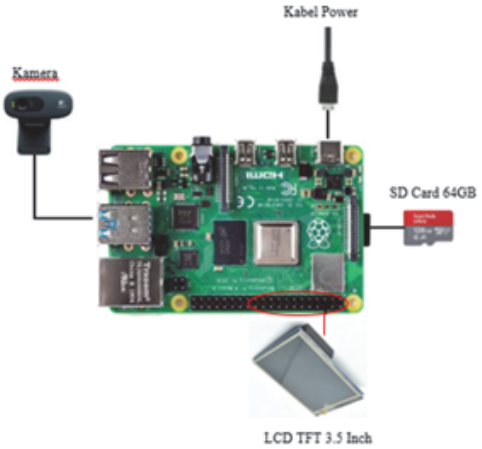


Fig. 1. Hardware Design

2.2 Software Design

On Figure.4 below is a flowchart of a program describing software that aims to detect a person's facial expression that has been designed in this study.

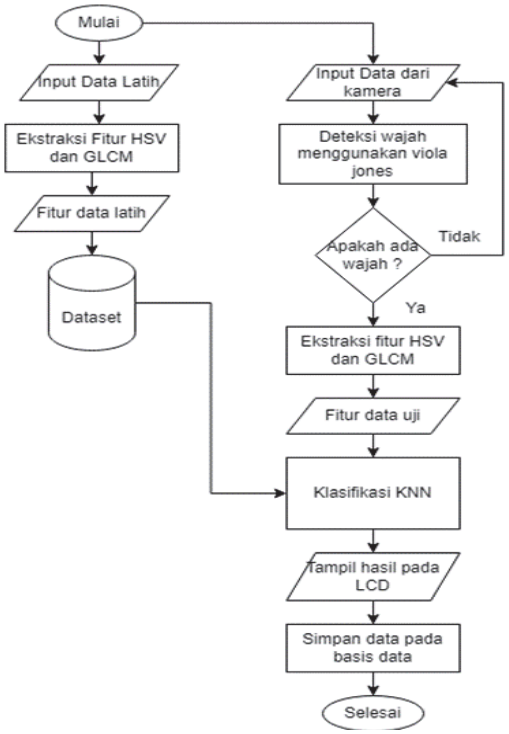


Fig. 2 Flowchart System

The system begins with the input of training data that has been provided. Then the training data were extracted using the HSV and GLCM methods. After obtaining the features from the data, the features or characteristics of the data will be stored as a dataset for the classification process. Then after the dataset is available, the program will turn on the camera and take the data in the form of a video image. The data is then identified using the viola jones method to find out whether there is facial data or not. If there is none, the process will be restarted with input data, then if there is facial data, the process will continue with the feature extraction process using the HSV and GLCM methods.

After the features are obtained, the next process is the classification process using the K-Nearest Neighbor (KNN) method based on the proximity of the test data to the training data based on the Euclidean distance. After the classification results are obtained, the results will be displayed on the LCD and stored in the MySQL database.

2.3 Design System

The tool frame design is made of plywood with a thickness of 9 mm and has a black color. The framework of the tool has a height of 20 cm and a width of 20 cm assuming a table height of 100 cm for customer service, because this tool will be placed on the customer service desk.

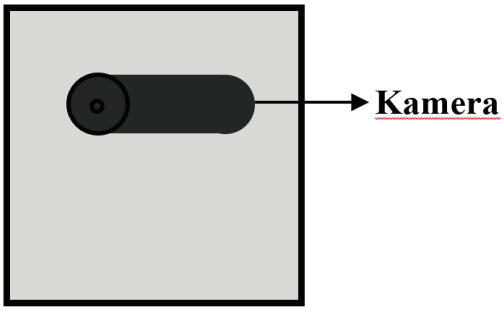


Fig. 3. Front View Design

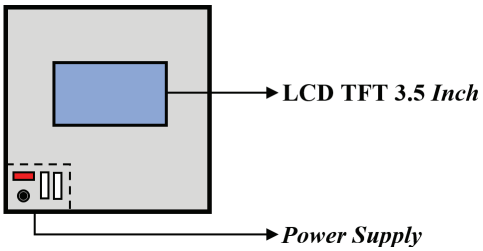


Fig. 4 Back View Design

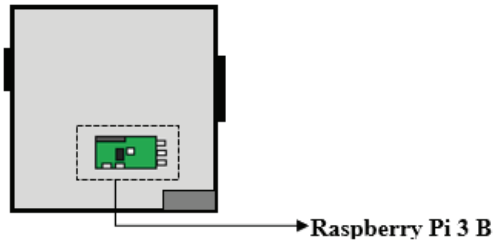


Fig. 5 Side View Design

3 Results and Discussion

3.1 Face Detection Test

3.1.1 Testing Based on Face Position

In the face detection test based on the position of the face, it is carried out in four positions, namely up, down, right side, and left side. The following is the result of the face detection test based on the position of the face.

Table 1. Face Detection Test Result Data Based on Face Position

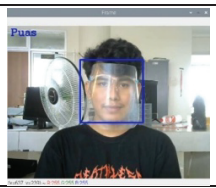
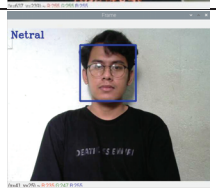
Position	Detection Result	Description
Up		Detected
Down		Detected
Right		Not Detected
Left		Not Detected

From the test data above, it is found that the system can only detect faces only in the front position. This is intended so that the facial expression detection process can work optimally so that the face detection process can only be carried out in the front position to get the overall facial expression detection. Then in the testing process, the level of lighting is very influential on the results detected by the system. Bright enough lighting can produce accurate detection results. And vice versa when lighting is lacking, the detected results tend to be less accurate (errors).

3.1.2 Testing Using Accessories

The face detection test using facial accessories is carried out under two conditions, namely using transparent glasses and using black glasses. The following is the data from the face detection test using facial accessories.

Table 2. Face Test Results Data Using Facial Accessories

Type of Accessories	Detection Result	Description
Face Shield		Detected
Glasses		Detected

In this test, when using facial accessories in the form of a face shield, there is a discrepancy in the results because there is light that reflects on the surface of the face shield and causes a glare effect so that the detection results are not optimal and less accurate. However, when using facial accessories in the form of transparent glasses, the face can be detected as a whole so that the detection process is much more optimal and accurate.

3.1.3 Testing Based on Effectiveness Distance

In the face detection test based on the effectiveness distance, it is used to determine the effective distance from the face detection system so that the optimal distance from the face detection system is obtained. The following is the result of the face detection test based on the effectiveness distance.

Table 3. Test Result Data Based on Effectiveness Distance

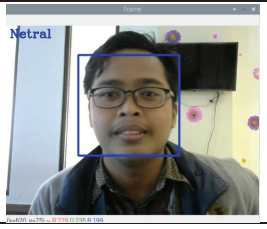
Distance (cm)	Description
32	Not Detected
33	Detected
100	Detected
150	Detected
187	Detected
188	Not Detected

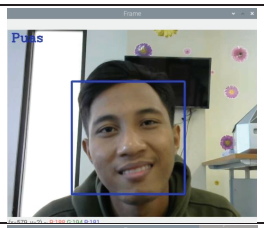
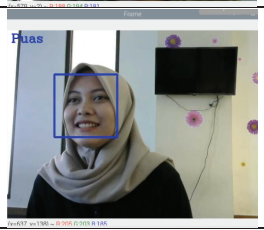
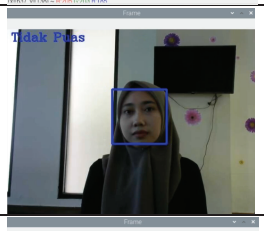
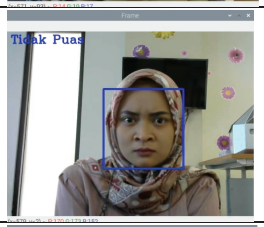
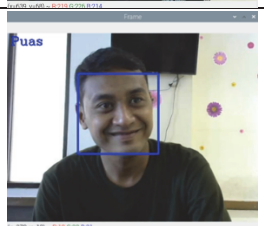
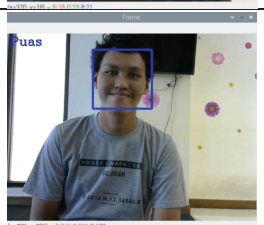
From the test data above, namely testing the effectiveness distance of face detection, the results show that the minimum detection distance on this tool is 33 cm and the maximum detection distance is 187 cm. If the face object is less than 33 cm or more than 187 cm, then the tool cannot detect the face object and greatly affects the detection results. Then the optimal distance from this tool is between 60 cm to 130 cm. If the face object is less than or more than the optimal distance, the tool can still detect. However, the accuracy of the detection results will be reduced because it is too close or too far away.

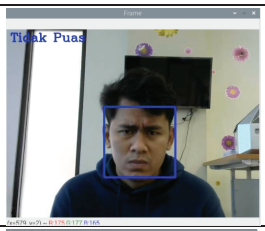
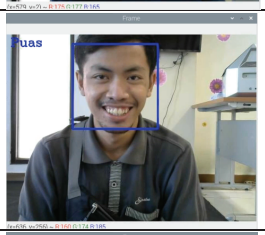
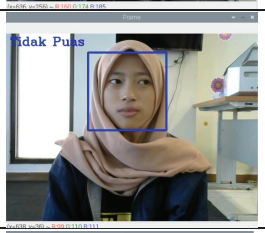
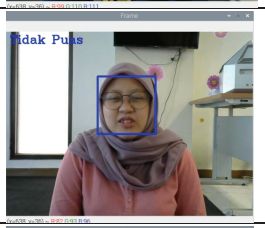
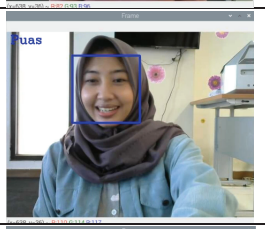
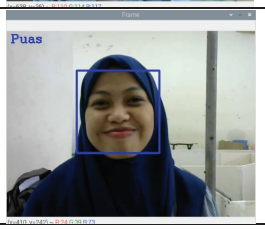
3.2 Facial Expression Detection Test.

In this facial expression detection test, there were 26 respondents to determine the expression of each respondent related to the quality of service at the Trunojoyo University library, Madura. From the expressions of respondents who have been detected, an expression that shows the level of satisfaction is shown in the following table.

Table 4. Facial Expression Detection Test Results Data

Detection Result	Expert Testimony	Description
	Neutral	Correct

	Satisfied	Correct
	Satisfied	Correct
	Not Satisfied	Correct
	Neutral	Incorrect
	Not Satisfied	Correct
	Not Satisfied	Correct
	Satisfied	Correct
	Satisfied	Correct

	Not Satisfied	Correct
	Satisfied	Correct
	Not Satisfied	Correct
	Not Satisfied	Correct
	Satisfied	Correct
	Satisfied	Correct

From the test data above, namely the facial expression detection test, the percentage of success was 80.77% and the percentage of failure was 19.23% from 52 facial expression data detected from 26 respondents. Facial expression data were obtained from interactions made by respondents when using library facilities at Trunojoyo University Madura. After the detection process is carried out and the expression is successfully detected, then the detected expression will be checked by experts who have the capacity to read facial expressions and the results will be compared with the previously detected expressions to determine the suitability of the system when reading expressions from respondents.

4 Conclusion

The conclusions from this research are described in several points below:

1. From the test results, it is found that the determination of the value of k in the classification process greatly determines the accuracy of the classification results obtained.
2. In the facial expression detection test, the percentage of success was 80.77% of 52 facial expression data detected from 26 respondents using the value of k = 13 as the number of neighbors in the KNN classification process.
3. The test results show that the minimum and maximum distances for facial expression detection are between 33 cm to 187 cm with the optimal distance between 60 cm to 130 cm.
4. In this study, there is a delay constraint when there is a fast object movement. This is due to the algorithm used to provide a heavy computing load so that there is a delay.
5. From the results of testing the entire system, the results show that good lighting quality is very influential with the results obtained.

Acknowledgment

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