Sign Language Learning based on Android For Deaf and Speech Impaired People

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***Abstract*—People who have physical limitations often encountered in life. Deaf and speech impaired have limitations in terms of communication. Researchers are keen to develop a technology translator is able to translate sign language into written language. Growing technology is still limited to the PC-based translator. Researchers are interested in developing the mobile translator shaped because of its simplicity that can be brought in mobile. This research is making an Android-based application that can directly interpret sign language submitted by deaf speech into written language. Translation process begins from the hand detection using Opencv and translation of hand signals with the K-NN classification. Tutorial features added in this application with the aim to train intensively to users in the use of sign language.**

Keywords: sign language tutorial, android mobile devices, K-NN.

I. INTRODUCTION

Impaired speech defect is one disease that is widely available in Indonesia, both of which experienced it innate or acquired due to disease or accident. Based on data from Gerkatin (Movement For Deaf Welfare Indonesia) that the number of handicapped is 6% of the Indonesian population of 2.9 million, or approximately 1.25% of the total population of Indonesia is deaf. (Http://www.gerkatin.org). While data on students with disabilities who are scattered in SLB ("Sekolah Luar Biasa" or extraordinary School) according to the Ministry of National Education Republic of Indonesia in 2009 on SLB deaf by 5610. (MOH, 2010)[6]. Children with hearing and speech impaired have limitations on the sense of hearing, among others, to talk and communicate. Until now there are many who feel reluctant to communicate with normal people. This is based on their inability to deliver something that they mean well. This gap makes the deaf indirectly be eliminated from people in general. Statistical data over the course of each year will change, be increased or reduced. Good communication between the disabled impaired speech with normal people is essential to the relationship between the two could stay in touch with the good.

Indika et al making Hand Gesture identification for Safe Security System using Fuzzy C-Means[7]. American Sign Language Translation through Sensory Glove was designed for deaf/mute people to enable them to communicate, the data train using PCA[10].

A sign language translator technology is one of several attempts to resolve the issue that gap. This translator is able to quickly interpret sign language delivered with disabilities impaired speech into written language. However, translator that has been developed is based PC (personal computer) so it is not easy to carry anywhere.

Based on this background, the researchers are interested in conducting a study of PC-based translator and want to develop it into a translator based mobile smartphone with android operating system using Indonesia Sign Language Systems, SIBI stands for Sistem Isyarat Bahasa Indonesia, so that it can be easily utilized in various places in Indonesia.

II. RESEARCH CONTRIBUTION

Contributions of this research is the prototype hand gesture recognition system in the form of sign language as an alternative mobile-based sign language translator. It is intended as the basis for the development of research-based translator mobile, especially on android devices. This study is intended to help deaf and speech easier to communicate with others and helping the public to understand what is implied by a deaf and tunawicara. In addition, research is also intended as a starter so that future developers more easily develop this application so that its function is more complex. The comparison is Learn American Sign Language Application. Learn American Sign Language is a simple and fun way to learn signing, covering such useful topics as Greetings, Emergency Situations and more. In 9 easy-to-follow video lessons, professional sign language interpreter Renee Moore will teach you the basic skills needed to communicate with deaf friends, family, customers and co-workers[10].

III. METHODOLOGY

A. Object Detection with Viola-Jones

Viola – Jones Algorithm is used for the detection of objects in the form of a hand. Object detection procedures at the Viola-Jones algorithm based on the value of the feature image. Detection using image feature values faster than the detection based on the value perpiksel of an image. In a simple search feature values using a function - a function that has

been widely used Haar. There are 3 types of features used, namely two rectangles, three rectangles and rectangles. As shown in Figure 1[1].

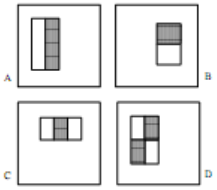


Fig. 1. Haar Feature[1]

Description:
a) and b) features two rectangles image
c) features three rectangular image
d) features a rectangular image

How to calculate the value of this feature is by subtracting the value of pixels on black area with pixels that are in the white area. To simplify the process of calculating the value of features, Integral Image method is used. Integral image at location x, y contains the number of pixels above and next to the left of x, y. As in Figure 2, and the calculation of the equation 1-3.

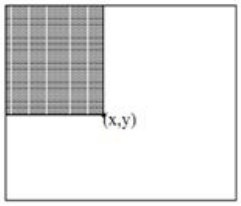


Fig. 2. Feature Extraction with Integral Image[1]

Integral image equations[1]:

$$ii(x,y) = \sum_{x' \le x, y' \le y} i(x',y') \qquad (1)$$

$$s(x,y) = s(x,y-1) + i(x,y) \qquad (2)$$

$$ii(x,y) = ii(x-1,y) + s(x,y) \qquad (3)$$

Description:
ii(x,y) : integral image
i(x,y) : original image source
s (x,y) : The cumulative value of the number of rows

B. K Nearest Neighbors Classifier

K-nearest neighbor (k-NN or KNN) Algorithm is a method to perform the classification of objects based on data that is distance learning closest to the object. Learning data is projected onto the many-dimensional space, where each dimension represents the features of the data. The space is divided into sections based on the learning data classification. A point in this space marked class c if class C is the most common classification of the k nearest neighbors that point. Near or far neighbors are usually calculated based on Euclidean distance. If p = (p1, p2) and p = (q1, q2) then the distance Euclidiean the two points are:

$$d\,(p,q) = \sqrt{(p1-q1)^2 + (p2-q2)^2} \qquad (4)$$

Description :
p1: position of actual data on x-axis
q1: position of actual data on y-axis
p2: position of reference data on x-axis
q2: position of reference data on y-axis
d : distance between actual data and reference data

Equation 4 is the Euclidean distance formula between two points. In the learning phase, the algorithm is simply to store the vectors of features and classification of learning data. In the classification phase, the same features are calculated for the test data (which classification is not known). The distance of this new vector of all learning data vector is calculated, and the number of the closest k taken. New point classification included in the classification predicted most of these points.

C. Android

Android is a Linux-based operating system for mobile phones such as smart phones and tablet computers. Android provides an open platform for developers to create their own applications for use by a variety of mobile devices. Initially, Google Inc. bought Android Inc., newcomers who make software for mobile phones. In this world there are two types of distributors operating system Android. The first fully supported by Google or Google Mail Services (GMS) and the second is completely free distribution without direct support Google otherwise known as the Open Handset Distribution (OHD). Object detection and gesture recognition is likely to occur on this device. OpenCV is a computer vision library that supports android that can be used for the development of sign language translation studied in this research[5].

D. Finger Alphabet

Finger alphabet is a gesture that is formed with the fingers of the hand (right hand or left hand) to spell out the letters or numbers. Shape cues for letters and numbers in a similar SIBI with the International Manual Alphabet. Finger alphabet is used for:
a. Cues proper name
b. Cue abbreviations or acronyms; and
c. Cue word that there is no hint.

Figure 3 is Standard Indonesian Sign Language is often called SIBI [6].

Fig. 3. Indonesia Sign Language Systems[6]

The diagram in Figure 4 is the design process, Image capture by the camera android smartphone.

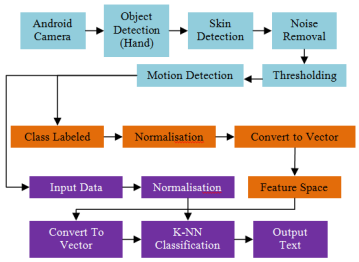


Fig. 4. Translator Design

The system will perform object detection feature to get a hand on the images obtained, then build a region of interest (ROI) / area desired. This process can be recognised in one frame process on one captured. The time needed by the system to recognise single sign is between 6 (Frame per Second or FPS) until 20 FPS. After capture the image, it will run the detection of skin color, noise removal, thresholding. Motion detection is used as an indication of where if there is no movement of the image will be classified. Results of this phase is the hand shape image as input data and training data.

IV. EXPERIMENT

The initial view of the application, an image will appear in the duration of 3 seconds. Applications such as in Figure 5. Then the application is equipped with a tutorial

(a) Home (b) App Menu

(c)Hand Code/Sign

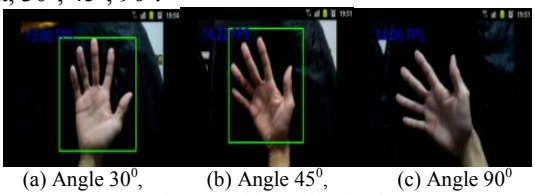
Fig. 5. Application Program

This application is made by the research team of faculty and students. Explanation of the application menu:

- Translator: is the main menu in this application, its main function is to capture images in the form of hand gestures to be classified and interpreted written language online.
- Dictionary Gestures: is an application menu that contains sign language tutorial in the form of a static image of interest. Tutorial only contains sign language alphabet.
- About me: is the application menu that contains the history of app makers
- Application Info: is the application menu that contains the usefulness of making an application. In this case is about graduation requirements.
- Advisor: is the application menu that contains the names and photos advisor from faculty who conducts in the completion of this application.

A. Testing with Angle Position

Three stages of testing in this study is testing based on the position of the hand with the same intensity of incoming light and the same distance anyway. As used in the test position is upright, 30^0, 45^0, 90^0.



(a) Angle 30^0, (b) Angle 45^0, (c) Angle 90^0

Fig. 6. Position of the hand

TABLE I. Test results with corner upright position 0^0, 30^0, 45^0, 90^0

Subject	0^0	30^0	45^0	90^0
1	√	√	X	X
2	√	X	X	X
3	√	√	√	X
4	√	√	√	√
5	√	X	X	X
6	√	X	X	X
7	√	√	X	X
8	√	√	X	X
Mean	100 %	63 %	25%	13%

Description:

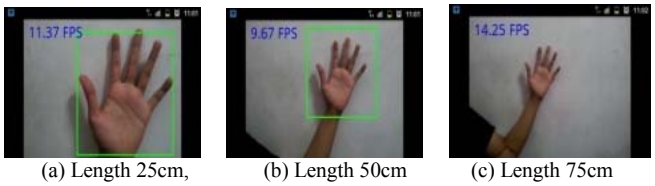
√ Objects can be detected system

X Objects can not be detected

Data from table 1 show that the detection system made hand can only be used to detect the hand in an upright position, the results are not optimal for conditions other than upright.

B. Testing with Distance Object

Testing with parameters different distances with the same amount of light, and the position of the palm of the same hand as well (upright position). The distance used in the testing times are 30 cm, 50 cm, 70 cm, 90 cm and 110 cm.



(a) Length 25cm, (b) Length 50cm (c) Length 75cm

Fig. 7. Distance of the hand

TABLE II. Test results with different distance parameters.

Subject	25 cm	50 cm	75 cm	100 cm
1	√	√	√	X
2	√	√	X	X
3	√	√	X	X
4	√	√	X	X
5	√	√	X	X
6	√	√	X	X
7	√	√	√	X
8	√	√	X	X
Mean	100 %	100 %	25 %	0 %

Description:

√ Objects can be detected system

X Objects can not be detected

Detection of palms would be optimal if done at a distance of between 30 cm to 70 cm, more than the distance of the hand detection system has become no longer optimal for detecting objects palms.

It may be caused by the method used Haar classifier system will detect the object in accordance with the pixel size is determined during the process of training occurs. If we set the pixel size of 20x20, then automatically the pixel size will be the smallest pixel size that is able to be detected by this system.

V. CONCLUSION

The conclusion based on the test results are within the palm of the hand with the camera should be less than 50 cm so that the hand can be detected by the object detection system and hand it would be optimal if the hands are in the upright position on 0^0.

The time needed by the system to recognise single sign is between 6 (Frame per Second or FPS) until 20 FPS.

VI. NEXT RESEARCH

Future research is to identify cues that not only the shape of the hand but also combined with facial expressions and posture.

References

[1] Viola, Paul, & Micheal Jones. Robust Real-Time Object Detection. Canada. 2001.

[2] Asriani, Farida, & Hesti Susilawati. Introduction of Static Hand Gesture In Indonesian Sign System Based on Artificial Neural Networks. Universitas Jendral Soedirman. Purwokerto. 2010.

[3] Sigit, Riyanto. Dasar Pengolahan Citra (3). Politeknik Elektronika Negeri Surabaya. Surabaya. 2012.

[4] Gary Bradski, Adrian Kaehler. "Learning OpenCV". Oreilly team's Intel. 2005.

[5] Wikipedia. Android (Sistem Operasi). (diakses tanggal 26 Juni 2012)

[6] PSBRW Melati Jakarta. SIBI (Sistem Bahasa Isyarat Indonesia). http://melati.depsos.go.id.

[7] Indika Pradana, Edi Satriyanto, Eru Puspita, Budi Nur Iman, Hand Gesture identification for Safe Security System using Fuzzy C-Means, Politeknik Elektronika Negeri Surabaya PENS.

[8] Susilawati, Hesti dan Farida Asriani. Introduction of Static Hand Gesture In Indonesian Broadcasting System Based Back Propagation Neural Network. Fakultas Sains dan Teknik. Purwokerto. 2010.

[9] https://play.google.com/store/apps/details?id=org. rifluxyss.anddev.videobook.

[10] JanFizza Bukhari, Maryam Rehman, Saman Ishtiaq Malik, Awais M. Kamboh and Ahmad Salman ,American Sign Language Translation through Sensory Glove; SignSpeak, International Journal of u- and e-Service, Science and Technology, Vol.8, No.1 (2015), pp.131-142.