Performance of Sign Language Recognition System

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Abstract

Sign Language is a primary form of communication between members of the Deaf community. Sign Language recognition system acts as an interpreter between common people and socially aided people. Firstly, this system consisted of the image acquisition by using digital camera, making pre-processing steps. In training phase, back-propagation algorithm was used to train the multilayer perceptron and the gradient descent momentum with LR (traingdx) method was used for training the input feature vectors of sign language. And also, to be reduced the error values in training Neural Network, Mean Square Error (MSE) function was also used for this system. The sign languages of 26 English alphabets were applied in this system. The 156 images of all alphabets were used for the training process by taking six images for each alphabet. And then, 260 alphabet images were tested in this system. The overall process of this system was performed by using MATLAB. The accuracy of the sign language recognition is also presented in this paper.

1. Introduction

Sign language is a widely used medium of communication for deaf and dumb people. The motivation factor is the possibility of reducing the communications barrier which exists between the deaf and hearing communities. In addition, very few hearing people have much knowledge of sign language, and so communication between sign-language users and hearing people [1]. For this reason, the deaf community tends to be insular and somewhat separate from the rest of society.

The sign language (SL) is described by the specifications of hand and facial idioms to express their views and thoughts of speech and hearing disabled persons with the normal (speech and hearing) people. Most of the normal persons may not clearly understand the sign language. Therefore, there is a massive communication gap between the deaf communities with the general public [2]. Therefore, the sign language recognition system is implemented in order to solve this problem.

The sign language can be used as the human-computer interaction (HCI) between the deaf people and hearing people. Moreover, SLR is an important application area of HCI that can be very useful to facilitate interaction between deaf person and technologies as well between deaf and hearing people [6]. SL is used by deaf and hearing-impaired communities, in order to establish a communication. It can be described as a visual language which characterized by the motion of certain parts of the body such as, the face, the mouth, eyes, truck and hands. At the present time, it can admit that several researchers are meant to put the stress on the automatic analysis and recognition of signs, particularly automatic SL interpretation [4] [5].

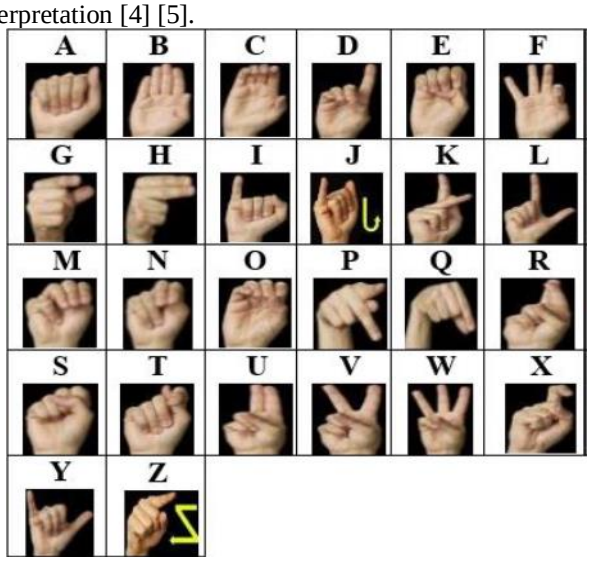

Figure 1. The Sign language (SL) of english alphabets

In this sign language recognition system, the English alphabets are used to apply as the inputs of the system. The sign language of English alphabets is illustrated in Figure 1. To perform this sign language recognition, the image acquisition is firstly required to implement the sign language database [3]. And then, the pre-processing and image extraction processes are needed for image analysis. Finally, the classification method is used for feature extraction from image and compared the test images with stored images from the database. In this system, MATLAB programming is used as a tool.

This paper is organized with five sections. The introduction of this system is presented in this introduction. The second section is inserted to present the database implementation of this system and the performance procedure of this system is described in section three. The testing and results are presented in section four and the performance of this system is concluded in section five.

2. Database Implementation

The first step of the sign language recognition system is to implement the sign language database. Therefore, the database of sign language images is firstly implemented for both the training process and the testing processing. In the implementation of the sign language classification system, firstly needs to create

the database of the signs which will be given as input to the Neural Network. The database is similar to digital image acquisition. Digital image acquisition is the creation of a digitally encoded representation of the visual characteristics of an object. There are many aspects of that: image capture (cameras, lighting, etc.), data storage, image analysis, feature vector comparison, what to do based on the results, etc.

This system utilizes 26 types of American sign language images. The dataset of sign language images has been created with two folders like train and untrained (test) sign images. The sign language images must be trained in order to remember that the features of the test image are similar to that of which alphabet. Therefore, the features of all trained sign language images are stored in the trained database. This can be applied to check that the test feature is match with which features from the trained database. So, this training step is essential for this sign language recognition system. This system especially uses American Sign Language. One alphabet has different 10 images (i.e. 6 images for the training process and 4 images for testing process). This system uses the sign languages of all English alphabets (from A to Z). Therefore, the total number of 260 sign languages is applied in the testing process. The number of 156 images is for the training process.

3. Methodology

In this sign language recognition system, the image database is firstly created for both the trained dataset and tested dataset. And then, it operates the other tasks such as image pre-processing parts, segmentation image, and image extraction. The image extraction process is started to extract the features of sign language images. The features of the trained images are saved as .mat file and it is taken to the training neural network by giving target data, then it is ready to recognize and make classification in neural network. Final result is shown in GUI by translating the image into text. The overall block diagram of the sign language recognition system is depicted in Figure 2.

The overall flowchart of this system is illustrated in Figure 3. The step-by-step procedures for TSign Language Recognition system are developed by using MATLAB. This system has two main phases: training phase and testing phase. In training phase, first to create image acquisition process from digital camera so that to be inputted for pre-processing steps. Pre-processing is complete by making resize image, gray-scale and binary image. And then, feature data is received as (.mat file) from the pixels of binary image by extracting features. This feature data is trained with back-propagation algorithm of artificial Neural Network.

The main reason of training data is for recognition of images in testing phase input the unknown images (trained or untrained images) and it's make pre-processing steps and extract feature from binary image. The extracted features of the test image are compared with that from the database and the result is display as alphabet name if the comparison rate is greater than the threshold value or cannot identify if the comparison rate is less than the threshold value.

In this recognition system, the artificial neural network is implemented with the following data.

- One fifty six inputs
- Thirty eight hidden neurons
- Twenty six output neurons
- Two biases

The following describe the target vector for training dataset;

```
load FEATdata.mat
A = ones (1,6); B = zeros (1,6);
T =[ABBBBBBBBBBBBBBBBBBBBBBB;
  BABBBBBBBBBBBBBBBBBBBBBB;
  BBABBBBBBBBBBBBBBBBBBBBB;
  BBBABBBBBBBBBBBBBBBBBBBB;
  BBBBABBBBBBBBBBBBBBBBBBB;
  BBBBBABBBBBBBBBBBBBBBBBB;
  BBBBBBABBBBBBBBBBBBBBBBB;
  BBBBBBBABBBBBBBBBBBBBBBB;
  BBBBBBBBABBBBBBBBBBBBBBB;
  BBBBBBBBBABBBBBBBBBBBBBB;
  BBBBBBBBBBABBBBBBBBBBBBB;
  BBBBBBBBBBBABBBBBBBBBBBB;
  BBBBBBBBBBBBABBBBBBBBBBB;
  BBBBBBBBBBBBBABBBBBBBBBB;
  BBBBBBBBBBBBBBABBBBBBBBB;
  BBBBBBBBBBBBBBBABBBBBBBB;
  BBBBBBBBBBBBBBBBABBBBBBB;
  BBBBBBBBBBBBBBBBBABBBBBB;
  BBBBBBBBBBBBBBBBBBABBBBB;
  BBBBBBBBBBBBBBBBBBBABBBB;
  BBBBBBBBBBBBBBBBBBBBABBB;
  BBBBBBBBBBBBBBBBBBBBBABB;
  BBBBBBBBBBBBBBBBBBBBBBAB;
  BBBBBBBBBBBBBBBBBBBBBBBA];
net =Trainbackpropagation_NN(FEAT,T);
save netdata.mat net;
```

The target vector 'T' is implemented with letter A and B. It is described in above where each letter must be separated with space, but it cannot be separated with space according to the paper limitation.

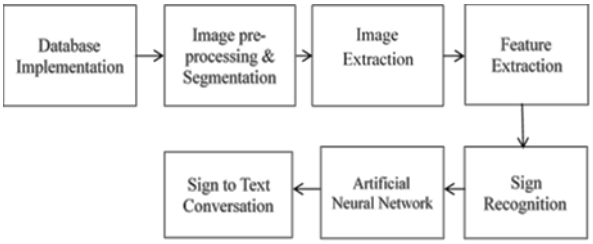

Figure 2. The overall block diagram of sign language recognition system

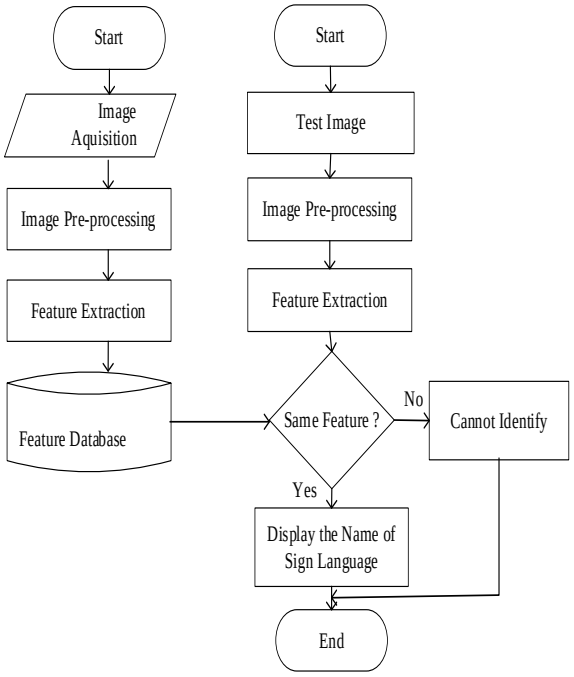

Figure 3. Overall flowchart for sign language recognition system

4. Test and Results

The sign language images can be tested after training the trained images. The image preprocessing must be performed before doing the feature extraction of the applied image. The image preprocessing step consists of RGB to gray conversion, black and white conversion, edge detection, cropping and resize the image. The step by step performances are described in Graphical User Interface (GUI). The testing result of alphabet 'A' is shown in Figure 4.

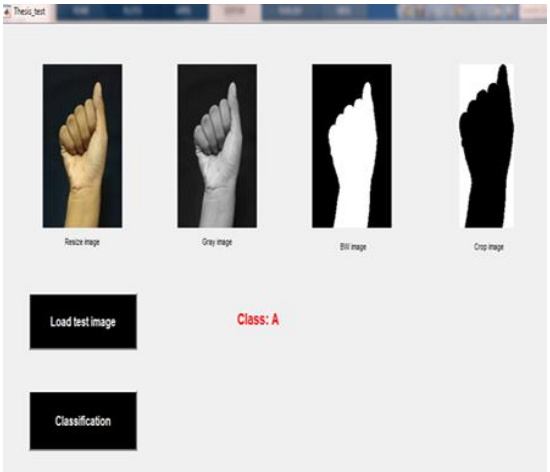

Figure 4. Result of sign language image for alphabet'A'

It is very important to take the photo of sign language carefully with the right position and right posture. If the sign language image is taken with wrong position or posture and test it, the tested image cannot be identified. The result of the wrong sign language image of 'A' is described in Figure 5.

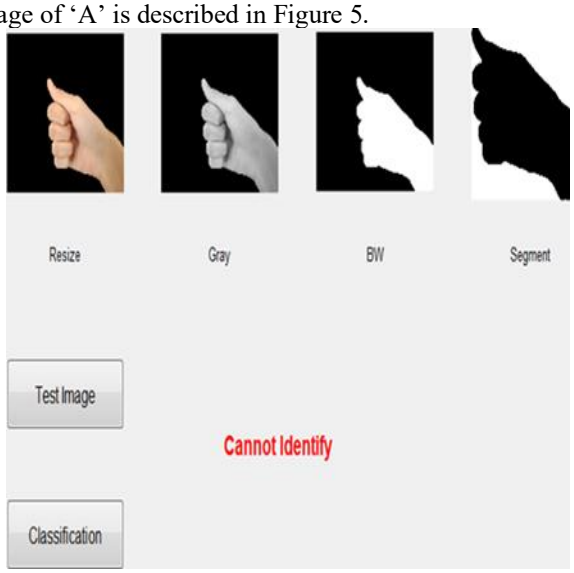

Figure 5. Classification result of wrong position image of 'A'

The results of sign language images of alphabet 'M' and 'N' are shown in Figure 6 and Figure 7.

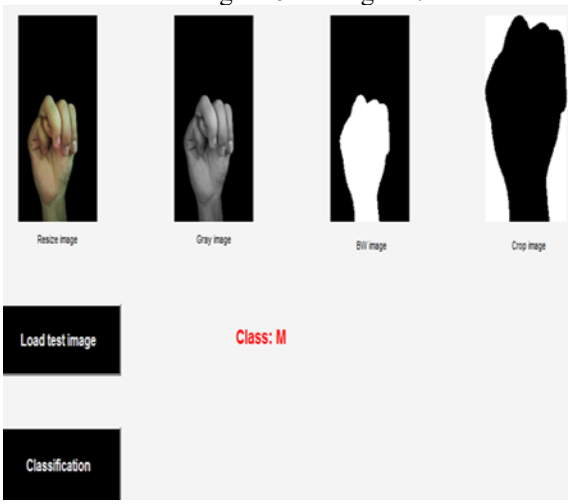

Figure 6. The classification result of 'M'

Figure 7. The classification result of 'N'

In this sign language recognition system, the image can be correctly classified that the test image is which alphabet type. However, it is necessary that the test image must be in right gesture position for the proposed alphabet. Nevertheless, this system can be effectively classified into the sign language images due to the test images with most right gesture position.

In this system, all English alphabets are tested by using MATLAB software. The ten times of each alphabet are tested by taking different images. Every image is different from another image with lighting condition, posture and so on. Therefore, the total testing time for this system is260. This system cannot recognize about 100% for all alphabets.

The accuracy of the system can be include like that the product of the number of true result and 100% by dividing with the total number of testing. It can be seen in equation (1).

$$Accuracy = \left(\frac{No.\ of\ True\ Result}{No.of\ Total\ Testing}\right) \times 100\% \quad (1)$$

The overall accuracy result is presented in Table 1.

Table 1. Accuracy of the Test and Result (%)

Alphabet	No. of Total Test	No. of True Result	No. of False Result	Accuracy (%)
Class : A	10	9	1	90%
Class : B	10	9	1	90%
Class : C	10	10	0	100%
Class : D	10	9	1	90%
Class : E	10	7	3	70%
Class : F	10	10	0	100%
Class : G	10	10	0	100%
Class : H	10	10	0	100%
Class : I	10	9	1	90%
Class : J	10	10	0	100%
Class : K	10	8	2	80%
Class : L	10	10	0	100%
Class : M	10	10	0	100%
Class : N	10	10	0	100%
Class : O	10	10	0	100%
Class : P	10	10	0	100%
Class : Q	10	10	0	100%
Class : R	10	10	0	100%
Class : S	10	9	1	90%
Class : T	10	9	1	90%
Class : U	10	9	1	90%
Class : V	10	10	0	100%
Class : W	10	10	0	100%
Class : X	10	10	0	100%
Class : Y	10	10	0	100%
Class : Z	10	10	0	100%

5. Conclusion

In this sign language recognition system, the sign languages of all English alphabets were tested by creating the training database and testing database. The different images of each sign language are applied by taking photos with digital camera. The total 260 images of sign language for all English alphabets were tested in this system. The 16 images per each alphabet were taken for both training and testing database. This system can classify very well. This system achieved the accuracy of 95 % of the testing. However, the input image must be carefully taken by digitally camera. When the posture and position were missed in taking photo, the sign language image cannot be classified well. Most of all, this system could not classify for that condition. Therefore, it is necessary to take the images with right posture and position. Moreover, it is also important to be the same light intensity for all images. The same light intensity is applied in this system for all images. This system can be applied in the deaf communities.

6. Acknowledgement

The author desires to express her special thanks to Prof. Dr. Khin Htike Htike Lwin, Rector, Technological University (Kyaukse), for her encouragement and kind permission to submit this system. The author particularly wishes to acknowledge all the teachers from the Department of Electronic Engineering, Technological University (Kyaukse), for their encouragement and invaluable suggestions in the preparation of this paper.

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