Conversion of Gesture to Text Message Using Neural Network

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Abstract: The use of gestures as means to convey information is an important part of human communication. The hand gesture recognition are important methods for nonverbal communication for human beings. The non-verbal communication is not only used for physically challenged person but also it can be efficiently used for various applications such as 3D gaming, aviation, surveying, etc. To solve the difficulties faced by hearing impairment, it is necessary to develop a system which translates the sign language into text which can easily be recognized by the impaired people.For recognizing the gestures, there are several algorithms are available. There are several approaches for gesture recognition using MATLAB. Artificial Neural networks are flexible in a changing environment. It also describes the process of gesture recognition using neural network. It's a highly efficient method that has been proven able to distinguish and classify with an amazing rate of performances. Then, it will be possible to train the network with a full set of examples and finally to use in real time conditions.

Keywords: Gesture Recognition, Artificial Neural Network, Feature Extraction, MATLAB

1 INTRODUCTION

Hand gestures are the movements of hands, arms or fingers. Gesture recognition is process of identifying gestures by the computer which is made by user. The idea of developing hand gesture recognition procedure is to develop, an interaction between human and computer and the recognized gestures are used to control the meaningful information. [1] Recently there has been surge in interest in recognizing human hand gestures. The sign language recognition is done in two ways Static gesture and dynamic gesture [2]. Static hand gesture is particular hand configuration and pose represented by single image. A dynamic hand gesture is a moving gesture, represented by sequence of images. Dynamic gesture is more practical as compared to static gesture, even though it has more difficulties. We focused on the recognition of static images. Vision based interfaces are feasible and popular at this moment because the computer is able to communicate with user using webcam [3] . This means, user able to give command to the computer by just showing some actions in front of the webcam without typing keyboard and clicking mouse button. Hence, users are able to perform human-machine interaction (HMI) with these user-friendlier features. Eventually, this will deploy new commands that are not possible with current computer input devices. Lately, there has been a surge in interest in recognizing human hand gestures. The most structured sets of gestures belong to sign language [4]. In sign language, each gesture has an assigned meaning (or meanings). This project used some numeric sign like American Sign Language (ASL). ASL is the language of choice for most deaf people. The main purpose of invented ASL is to allow deaf people communicate with normal people. ASL consists of approximately 6000 gestures of common words with finger spelling which are used to communicate proper nouns.

2 Objective of the work

The objective of this project is to develop a program implementing gesture recognition. At any time, a user can exhibit his hand doing a specific gesture in front of a camera linked to a computer.

The program has to collect pictures of his gestures, analyze it and to identify the sign. In order to lighten the project, it has been decided that the identification would consist in counting the number of fingers and recognition of American Sign Language that are used by user in input picture.

3. System Development

3.1 Experimental Set up

The experimental set up consist of
1. Digital Camera: To take the images. The camera is interfaced to computer.
2. Computer: Computer is used to create a database & analysis of the images. The computer consists of a program prepared in MATLAB for the various operations on the images. Using Neural Network tool box, analysis of the images is done.

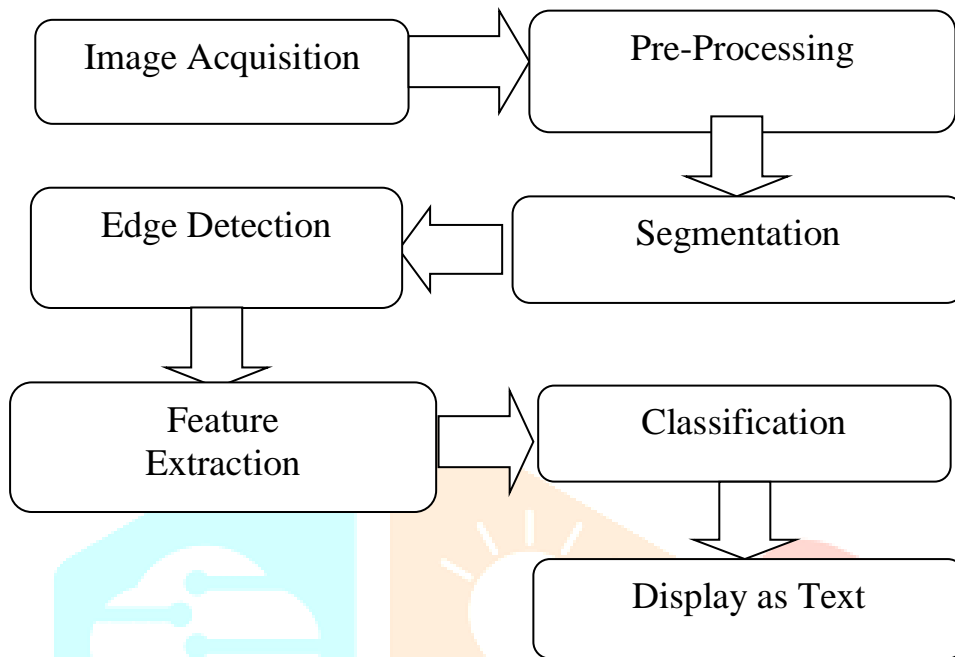3.2 The conceptual block diagram of the work is shown below.

Figure1 Block Diagram ofrecognition system

a) **Image creation:** The images are taken by camera. Camera is interfaced to the computer.
b) **Pre-processing**: A pre-processing step is performed to get the appropriate image, which is required for real time classification. So, it consists of some steps. The net effect of this processing is to extract the hand only from the given input because once the hand is detected from the given input it can be recognized easily. So preprocessing steps consists of following tasks.
       i) Skin Modelling
       ii) Removal of background
       iii) Conversion of RGB to binary
       iv) Hand Detection
   i)   **Skin Modelling:**
       There are numerous method used for skin detection such as RGB(Red, Green, Blue) ,YCbCr(Luminanc Chrominance) and HSV(Hue,Saturation,Value)
   ii)   **Removal of Background:**
       I have found that background greatly affects the result of hand detection that's why I have decided to remove it.
   iii)   **Conversion of RGB to binary:**
       All algorithms accept an input in RGB form and convert it into binary format in order to provide ease in recognizing any gesture and also retaining the luminance factor in an image.
   iv)   **Hand detection:**
       Image could have more than one skin area but we required only hand for further process.

c) **Feature Extraction**
       In this step the required features are extracted from the image The following steps are used.
       i)   **Subtraction: -**
       In background subtraction method the image of the background is
       Captured as reference image. The plain background image is subtracted from the image having hand with background that is Target image. The resulting image is only hand. This is the simple and easiest method of extraction.

ii)　**Segmentation: -**

Thresholding is used for clarity. Thresholding by Hysteresis method is used. The hysteresis will give the information which point is to selected as threshold. Also, it will convert into the binary form. So, it is easy for further processing.

iii)　**Edge Detection: -**

The images are first captured using webcam, and converted into grayscale format. After converting this image into grayscale image edge detection is applied. Here we find the points of the image where there are sharp edges or discontinuous or where sharp changes in brightness is encountered. Fig shows edge detected hand.
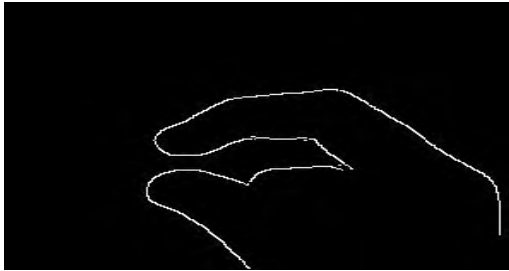

Figure 2 After Edge Detection

iv)　**Image filling and Boundary Detection**

From the hand counter obtained from the preprocessing steps, the feature of interest is the set of fingertips, which in turn is a subset of boundary of hand. We use bwboundaries a MATLAB function to store the boundary of the hand counter in a linear array, formed sequentially from the topmost band leftmost boundary pixel, which is on. bwboundaries detects boundaries of filled images or holes within filled objects. Thus, we filled the continuous edge of the hand counter with white pixel as shown in Figure 3

Figure 3 Filled Image

v)　**Vectorization**

In order to reduce computing complexity, we define the angle $C(i)$ between two vectors $[P(i-k), p(i)]$ and $[P(i), p(i+k)]$ as curvature, where k is a constant. The points along the edge where the curvature reached a local extreme, that is the local features, are then identified. Some of these local features are labeled as "peak" or "valley".

Weusethisalgorithmtocomputecurvaturesateverypoint, and thus detect positions of the fingertip in the boundary detected hand contour as shown in Figure 4 It shows yellow vectors denote curvatures belonging to a fingertip; green vectorsdenotecurvatures,whichdonotbelongtoafingertip.
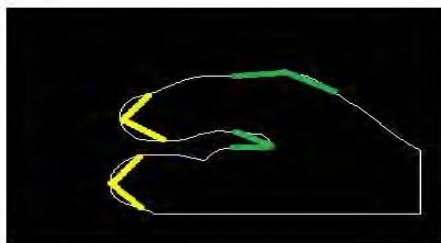

Figure 4 Vectorization

vi)　**Fingertip tracking and gesture identification**

In fingertip tracking and Gesture Identification; we used ANN algorithm, to train the system and accordingly give us the necessary output.

d)　Artificial Neural Network

i) Creating Training Sets: The pattern recognition block consists of creating a training set from the images. Here the input and expected output is known & according to that neural network is trained, which calculates the weight & bias? This creates the training sets.

ii) Testing: For testing unknown image is given input to the network which is then compared with training set Depending upon the match it gives output.
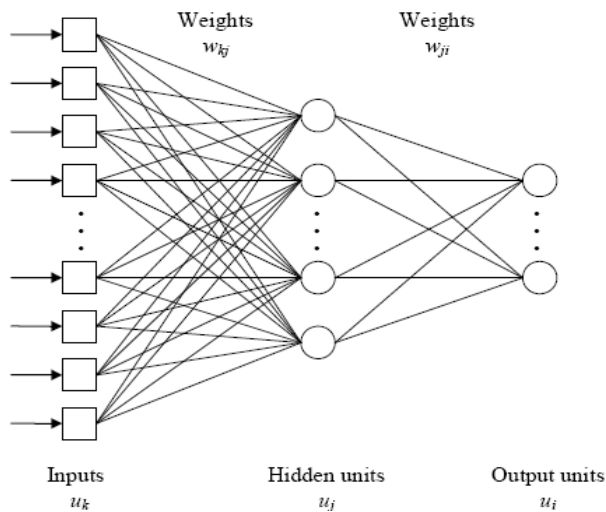
iii) Feedforward Neural Network

Figure 5 Feedforward Neural Network

Inputs are used to create the Training sets are given at the input layer. In the feed forward network, the output of the input node is connected to each of the input of hidden layer node. Each input is having weight which is updated according to the error generated by nodes associated with mismatch between the actual output and the desired output.

When there is perfect match, the error is zero and the wights are fixed. In this way, the network is trained for a particular input and output combination.

The images to be tested are given as input to the trained network. Depending on the comparison we are getting output for a given image. The output is depending on training system i.e., how we train the system.

4. Implementation and Result

The easiest way to create a neural network is to use one of the network creation functions (see New Networks Functions in the Neural Network Toolbox Reference for a full list of these functions).To investigate how this is done, you can create a simple, Artificial Neural Network ,using the command newfit.

    Net = newfit
    This command will display the following:

net =Neural Network

name: 'Artificial Neural Network'

The output of the hand detection is binary image in which white pixels are the members of hand region, while the black pixels belong to the background. An example of the hand detection is shown in Figure 6 Then the following procedure is implemented on the binary hand image to segment the fingers and palm.

Figure 6 The detected hand region

i) Palm Point: - The palm point is defined as center point of the palm. It is found by the method of distance transform. Distance transform also called distance map is a representation of an image, In the distance transform image, each pixel records the distance of it and the nearest boundary pixel. An example of distance transform is demonstrated in figure 7. Figure 7(a) is binary image and Figure 7(b) is distance transform image. The block city distance is used to measure the distances between pixels and the nearest boundary pixels. As is shown in figure, the center point of the binary image is with largest distance 4. Figure 8 is the distance transform image of binary hand image. The pixel is largest distance chosen is palm point. The found palm point is shown in figure 9

0	0	0	0	0	0	0	0	0
0	1	1	1	1	1	1	1	0
0	1	1	1	1	1	1	1	0
0	1	1	1	1	1	1	1	0
0	1	1	1	1	1	1	1	0
0	1	1	1	1	1	1	1	0
0	1	1	1	1	1	1	1	0
0	1	1	1	1	1	1	1	0
0	0	0	0	0	0	0	0	0

(a)

0	0	0	0	0	0	0	0	0	0
0	1	1	1	1	1	1	1	0	
0	1	2	2	2	2	2	1	0	
0	1	2	3	3	3	2	1	0	
0	1	2	3	4	3	2	1	0	
0	1	2	3	3	3	2	1	0	
0	1	2	2	2	2	2	1	0	
0	1	1	1	1	1	1	1	0	
0	0	0	0	0	0	0	0	0	

(b)

FIGURE 7 : An example of distance transform: (a) is a binary image ; (b) is the distance transform
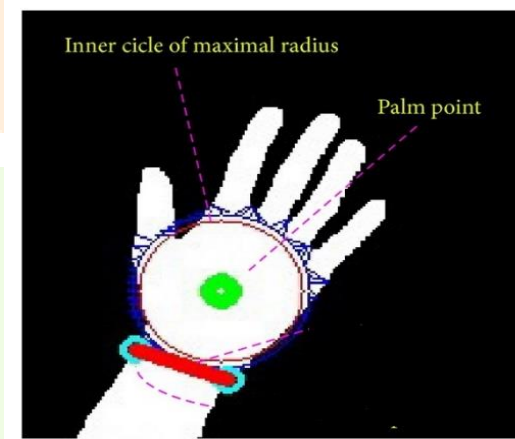

Figure 8

Figure 9 The palm point and inner circle of maximal Radius

 ii) Inner Circle of the maximal Radius: When the palm point is found it can draw a circle with the palm point as the center point inside the palm, The circle is called inner circle because it is included inside a palm. The radius of the circle gradually increases until it reaches the edges of the palm. That is radius of circle stops to increase when a black pixel are included in the circle.
The circle is inner circle of maximal radius which is drawn as the circle with red colour.

In Figure 9.Recognition of hand gesture by using Neural Network is executable. After running executable file such as database. After executing the Executable file if web camera is attached to system, then classification of hand gesture first calculates the finger points. After that finger count value displayed in text form.
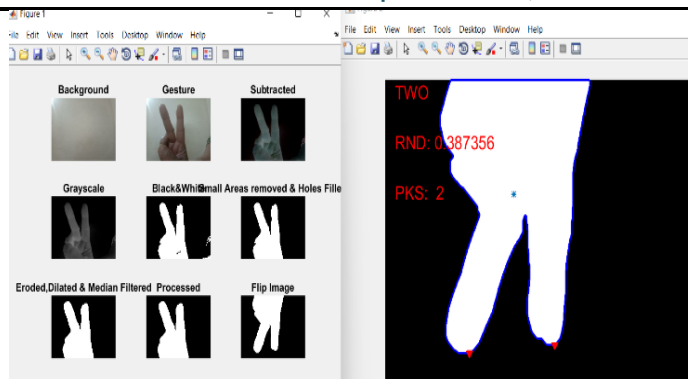
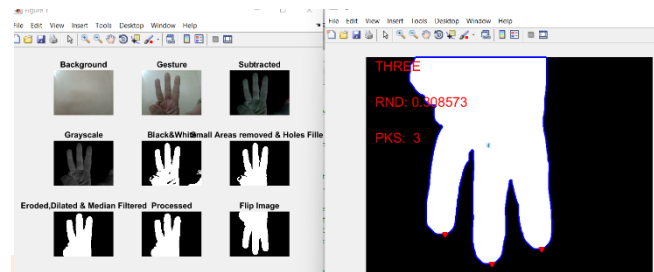Figure 6 a) Two finger calculates b) Output of hand gesture

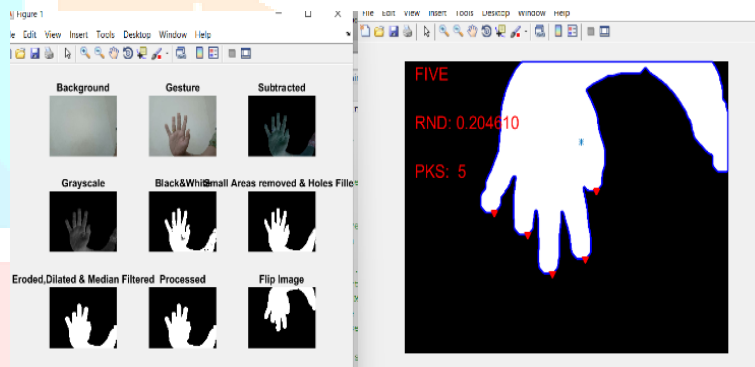Figure 7 a) Three finger calculates　　b) Output of hand gesture

Figure 8 a) Five finger calculates b) Output of hand gesture

5. Conclusion

Human hand gestures provide the most important means for non-verbal interaction among people. At present, artificial neural networks are emerging as the technology of choice for many applications, such as pattern recognition, gesture recognition, prediction, system identification, and control. ANN provides good and powerful solution for gesture recognition in MATLAB. Artificial Neural networks are applicable to multivariate non-linear problems. It has a fast computational ability. The ability of neural nets to generalize makes them a natural for gesture recognition. The major goal of this project is that to developed a system which translates the sign language into text which can easily be recognized by the impaired people.

REFRENCES :-

[1] Khan, Rafiqul Zaman, and Noor Adnan Ibraheem. "Hand gesture recognition: a literature review." International journal of artificial Intelligence & Applications 3, no. 4 (2012): 161.

[2]Priyanka C Pankajakshan, Thilagavathi B, Sign Language Recognition System, IEEE Sponsored 2nd International Conference on Innovations in Information Embedded and Communication Systems ICIIECS15.

[3] [Bowden &Sarhadi, 2000] Building temporal models for gesture recognition. In proceedings British Machine Vision Conference, 2000, pages 32-41.

[4] Noor SalizaMohdSalleh, JamilinJais, LucyantieMazalan, Roslan Ismail, Salman Yussof, Azhana Ahmad, AdzlyAnuar, and Dzulkifli Mohamad, "Sign Language to Voice Recognition: Hand Detection Techniques for Vision-Based Approach," Current Developments in Technology-Assisted Education, FORMATEX 2006, vol. 2, pp.967-972.

[5] S. Mitra and T. Acharya, " Gesture recognition: A survey," *IEEETransactions on Systems, Man, and Cybernetics,* vol. 37, no. 3, pp. 311 -324, 2007. J. Clerk Maxwell, A Treatise on Electricity and Magnetism,3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.

[6] T. Baudel and M. Beaudouin-Lafon, "Charade: remote control of objects using free-hand gestures," *Communications of the ACM,* vol. 36, no. 7,pp. 28-35, 1993.

[7] K.-Y. Lian, C.-C. Chiu, Y.-J. Hong and W.-T. Sung, "Wearable armband for real time hand gesture recognition," in *IEEE International Conference on Systems, Man, and Cybernetics*, Canada, 2017.

[8] Y. Ma, Y. Liu, R. Jin, X. Yuan, R. Sekha, S. Wilson and R.Vaidyanathan, "Hand gesture recognition with convolutional neural networks for the multimodal UAV control," in *Workshop*

[9] G. Joshi, J. Sivaswamy, "A simple scheme for contour detection", 2004 pages 236-242

[10]G. Awcock, and R. Thomas, "Applied Image Processing", 1995, pp-1281 - 1284 Acmillan press LTD, London.Vladimir I. Pavlovic, Rajeev Sharma, Thomas S Huang, "Visual Interpretation of Hand Gestures for Human-Computer Interaction: A review" *IEEE Transactions of pattern analysis and machine intelligence, Vole 19, NO 7, July 1997,*677 - 695

[11] Visual gesture recognition. In proceedings IEEE Visual Image Signal Process ,by Davis & Shah, 1994 vol.141,Issue:2,101 – 106.

[12]"Hand gesture Recognition of Radial Basis Functions (RBF) Networks and Decision Trees *"International Journal of Pattern Recognition and Artificial Intelligence.*Volume: 11, Issue: 6(1997) pp. 845-850.

[13] Sanaa KhudayerJadwaa, Feature Extraction for Hand Gesture Recognition: A Review, International Journal of Scientific Engineering Research, Volume 6, Issue 7, July-2015

[14] George Karidakisetal , Feature Extraction-Shodhganga

[15]L. Fausett, "Fundamentals of Neural Networks, Architectures, Algorithms, and Applications", Prentice-Hall, Inc. 1994, pp-304-315

[16] K.Murakami, H.Taguchi: Gesture Recognition using Recurrent Neural Networks.
In CHI '91 Conference Proceedings (pp. 237-242). ACM. 1991