Analysis of Gesture Recognition to Evaluate Hand Signals

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Abstract. Human Computer Interaction is an effective tool of intersection between the human intellect and computers leading to improvisation in technology. Gestures help to communicate between two persons very effectively even without saying a word but it is really ideal to note that man’s immense potential and intelligence has motivated him to interact through gestures with his own invention called computer. This paper has been prepared on MATLAB using effectively a simple algorithm and basically deals with the recognition of finger gestures. It is executed by simple steps where initially the image is converted into binary which is followed by cutting the image from the point where the longest finger starts and also an amount from the bottom to get a subtle image and then simply counting the number of white objects (i.e. fingers) and this process is repeatedly done by rotating the image in all the four directions and the result is selected taking into account the outcome of the direction where maximum number of outcomes have occurred provided the background is in a solid colour which can reveal the image of the fingers displayed clearly. The application of this work includes choosing an option from any user interface by merely displaying numbers as per the number of fingers shown. This simple and innovative effort is user friendly and can be effectively used in imparting knowledge especially to differently abled.

1. Introduction

Gestures are used as communication channel for humans. The vital motive of developing a hand symbol recognition scheme is to produce a very accepted communication for humans and the computer the acknowledged signals can be exploited to monitor for conveying useful message to the user’s system [1]. The way a computer system interprets these hand gestures and produces the desired output in the gesture interaction [2] [3]. Gesture recognition can either be in a static form, or in the dynamic form. This paper represents an algorithms functioning for both stationary as well as dynamic gestures. The gestures are identified by the stationary gestures without any motion [4]. Gestures with live movement of hands can also be interpreted by the system. Some fresh appraisals clarified gesture recognition structure proposals and its rising location in our life particularly for HCI, Robotic pedals, games, and investigation, using diverse apparatuses and algorithms [11] [13]. This effort validates the progression of the gesture appreciation systems, with the dialogue of different phases vital to build a whole system with fewer flaws using different recognition algorithms. Gesture based human-machine
interfaces allow users to have control over a varied number of devices through hand signals. Most work, already done in this field attempts to resolve the problem by use of markers or marked gloves to produce better signal strength [5-7]. The proposed algorithm although does not work based on markers or marked gloves, but requires a clean background of operation. In methods of extracting information when the hand is in motion are presented by identifying the hand location, tracking the trajectory of the moving hand, and examining the hand-position variations [5]. In the study of methods for recognising hand signals and different methods for the breakdown of video processing is done [8]. An algorithm for sensing a set of hand gestures for remote robot control. A vision based system is established that uses a combined RGB and depth descriptor to classify hand gestures in [9-13]. Huang et al. process Three Dimensional neural network technique to advance a Taiwanese Sign Language (TSL) identified 15 different structure signals. David and Shah [17,18] offer a model-based methodology by means of a finite state machine to perfect four qualitatively various stages of an overall gesture. Hand figures are defined by a number of vectors and formerly matched with the deposited vector representations. Darrell and Pentland [19] recommend space-time sign recognition system. Signals are denoted by using collections of view models, and then are accorded to stored gesture arrangements using dynamic time distorting. Starner et al. [20] define an extensible scheme which makes use of colour camera to keep track of hands and recognises American Sign Language (ASL). They practice hidden Markov models (HMMs) to make out a complete sentence and establish the feasibility of analysing a series of complex signal series. Using instrumented glove, vision-based approach is used for taking the hand outline, position and route. The vision-based method picks the 3-D input data as feature vectors as an input for HMM. Other HMM-oriented [21] hand gesture identification methods have also been developed.

2. Proposed Algorithm
In the proposed work is a combination of some very simple notions based on Image Segmentation and processing the extracted data from an image. The program receives input in the form of images which is processed in order to achieve the number of fingers shown in Fig 1. Initially, the RGB image is converted into a binary image. If the background is lighter in colour than the hand, the conversion from RGB to binary will result in changing the colour of the hand and the background to black and white respectively and vice versa. In the first case where the background is lighter, the binary image is converted into its compliment. After this, the image is searched for the first white point (A) in the figure below, from the top of the image. This point is the tip of the longest finger. A standard threshold distance from this point (B) is marked and this part (PAQRBS) of the image is segmented out. Bwconncomp is the function, which gives the image size, number of object found in the object. Now the number of connected components with the specified connectivity is found out using ‘bwconncomp’. This gives the number of fingers shown by the user. This procedure is repetitively performed on rotating the binary image in all the four directions and the result is accepted where this value is maximum.

Figure 1. The algorithm above is described on the basis of the points in this image.
3. Proposed System Architecture

Image based investigation, is created on the method human beings detect data about their localities, it possibly the peak difficult to tool in an acceptable way. Numerous dissimilar means have been verified in existing work. One is to shape a three-dimensional classical of the human hand [14]. The perfect is matched to pictures of the hand by single or more cameras, and strictures conforming to orientation of the palm and combined viewpoints are assessed. These criticisms are then discarded to make gesture arrangement. Another one is to capture the image using an external camera and then, further extract some feature from the hand and those observed and extracted features are used as input to another classification procedure for further classification [15]. The system architecture of gesture recognition to assess the hand signal shown in Fig 2.

![System Architecture of Gesture Recognition](image)

**Figure 2.** System Architecture of Gesture Recognition to assess the Hand Signal.

The dataset was taken from prima database for modelling system of the hand gesture identification [16]. The necessary pre-processing algorithm has been applied for the images and the contour identified by obtaining the prime feature which is Local Contour Sequence (LCS).

4. Experimentation and Results

The experiments and testing of the Gesture Recognition system was done on 10 participants who voluntarily accepted to be a part of the test. The 10 participants were asked to execute tasks of showing fingers as numerical inputs to the live running camera, and the camera recognised their inputs in the numerical form. The results and output images of the experiment have been attached below the table of results. Gesture Input 1, 2, 3 and 4 shown in Figure 3, 4, 5 and 6.

| Gesture Input | Execution Time | Accuracy |
|---------------|----------------|----------|
| 1             | 1.586          | 83%      |
| 2             | 1.316          | 90%      |
| 3             | 2.145          | 85%      |
| 4             | 1.056          | 87%      |
Figure 3. ‘1’ is displayed when one finger is shown.

Figure 4. ‘2’ is displayed when two fingers are shown.

Figure 5. ‘3’ is displayed when three fingers are shown.
5. Conclusion
Hand Gesture Recognition is a concept of Image Processing that can be successfully used to interact with the computer in a simpler and more effective manner. The proposed work makes such interactions between the human and the computer easier and effective. Also, keeping in mind the comfort it provides to the users the proposed system is an operative one. By experimenting the subjects and taking reviews it is proved that the system is easy to use and does not require any prior knowledge about gesture recognition systems and image processing. Also, the dwell time and execution rates of the system are faster and not a lot of time is wasted in either training the subjects or getting the output. The effectiveness and self-effacing structure of the gesture recognition system makes it soother to use.

6. Future Work
Gestures are easy to exploit when a system is trained enough to understand them perfectly. Creating an effectual hand gesture identification is important part for effortlessly interaction for human and computer. This algorithm has the competency to simplify many tasks such as selecting an option from a list of given options. Further enhancement of this concept will make it possible for humans to perform many day-to-day activities which include controlling devices like lights, fans, air conditioners etc. and even switching channels without a TV remote by the help of gestures. Therefore, clear directions for future work include applying this idea to different frameworks in order to make lives easier.

7. References
[1] Murthy GR and Jadon RS 2009 A review of vision based hand gestures recognition International Journal of Information Technology and Knowledge Management 2 405-10
[2] Khan RZ and Ibraheem NA 2012 Hand gesture recognition a literature review International journal of artificial Intelligence & Applications 3 161
[3] Garg P, Aggarwal N and Sofat S 2009 Vision based hand gesture recognition World academy of science, engineering and technology 49 972-7
[4] Lockton R and Fitzgibbon AW 2002 Real-time gesture recognition using deterministic boosting InBMVC 2002 1-10
[5] Alsheakhali M, Skaik A, Aldahdouh M and Alhelou M 2011Hand gesture recognition system Information & Communication Systems 132
[6] Baudel T and Beaudouin-Lafon M Charade 1993 remote control of objects using free-hand gestures Communications of the ACM3 6 28-35
[7] Sturman DJ and Zeltzer D 1994 A survey of glove-based input IEEE Computer graphics and Applications 14 30-9
[8] Swapna C and Shaikh S 2014 Literature survey on hand gesture recognition for video processing International Journal of Advanced Research in Computer Science and Software Engineering 4
[9] Aghajari E and Gharpure D 2014 Real Time Vision-Based Hand Gesture Recognition for Robotic Application International Journal 4
[10] Ohn-Bar E and Trivedi MM 2014 Hand gesture recognition in real time for automotive interfaces A multimodal vision-based approach and evaluations IEEE transactions on intelligent transportation systems 15 2368-77
[11] LaViola J 1999 A survey of hand posture and gesture recognition techniques and technology. Brown university, providence 29
[12] Khan RZ and Ibraheem NA 2012 Survey on gesture recognition for hand image postures Computer and information science 5 110
[13] Moeslund TB and Granum E 2001 A survey of computer vision-based human motion capture Computer vision and image understanding 81 231-68
[14] Turk MA and Pentland AP 1991 Face recognition using eigenfaces In Proceedings 1991 IEEE computer society conference on computer vision and pattern recognition 586-587 IEEE Computer Society
[15] Jackson JE and Edward A 1991 User’s guide to principal components John Willey Sons. Inc. New York 40
[16] http://www-prima.inrialpes.fr/FGnet/data/12-MoeslundGesture/database.html
[17] Huang CL and Huang WY 1998 Sign language recognition using model-based tracking and a 3D Hopfield neural network Machine vision and applications 10 292-307
[18] Davis J and Shah M 1994 Visual gesture recognition IEE Proceedings-Vision, Image and Signal Processing 141 101-6
[19] Darrell T and Pentland A 1993 Recognition of space-time gestures using a distributed representation Vision and Modeling Group, Media Laboratory, Massachusetts Institute of Technology
[20] Starner TE 1995 Visual Recognition of American Sign Language Using Hidden Markov Models Massachusetts Inst Of Tech Cambridge Dept Of Brain And Cognitive Sciences
[21] Campbell LW, Becker DA, Azarbayejani A, Bobick AF and Pentland A 1996 Invariant features for 3-D gesture recognition In Proceedings of the second international conference on automatic face and gesture recognition 157-162 IEEE