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Hand Gesture Recognition System Using Histogram and Neural Network

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Abstract — In this paper, consider the problem facing by distance between hand and the web cam and corresponding image noise in a Hand gesture recognition for human computer interaction (HCI) using a web cam.In this paper a survey of various recent hand gesture recognition systems background information is presented, along with key issues and major challenges of hand gesture recognition system are presented. In this paper consider histogram and neural network approaches for hand detection. At the end of this paper focus on different hand gesture approaches, algorithm, prototype model, technologies and its applications. The present approaches can be mainly divided into Data-Glove Based, Computer Vision Based approach and Drawing gesture.

Hand gesture is a method of non-verbal communication for human beings. Using gesture applications human can interact with computer efficiently without any input devices.

Keywords — *Hand gesture, Human computer interaction, Web-cam, Image noise, Computer vision, Data-clove, Histogram, Neural network.*

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I. INTRODUCTION

The essential aim of building hand gesture recognition system is to create an interaction between human and computer where the recognized gestures can be used for conveying meaningful information [1].How to form the resulted hand gestures to be understood and well interpreted by the computer considered as the problem of gesture interaction [1]. Vision based interfaces are feasible and popular at this moment because the computer is able to communicate with user using webcam. 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-Computer Interaction (HCI) with these user-friendlier features [2]. Today gesture can totally replace the mechanical devices like keyboard, Mouse, track ball and other input devices. There are two main characteristics should be deemed when designing a HCI system as mentioned in [3]: functionality and usability. System functionality referred to the set of functions or services that the system equips to the users [3], while system usability referred to the level and scope that the system can operate and perform specific user purposes efficiently [3]. In this paper, we focus our attention to vision-based recognition of hand gestures [2]. Gestures can be static or dynamic [4]. Some gestures also have both static and dynamic elements, as in sign languages. A dynamic gesture is intended to change over a period of time but which are more complex but suitable for real time environments whereas a static gesture which require less computational complexity [4].
Different methods have been proposed for acquiring information necessary for recognition gestures system. Some methods used additional hardware devices such as data glove devices and color markers to easily extract comprehensive description of gesture feature. Other methods based on the appearance of the hand using the skin color to segment the hand and extract necessary features [5], these methods considered easy, natural and less cost comparing with methods mentioned before. For digitizing hand and finger motions into multi-parametric data, Data-Glove based methods use sensors. The extra sensors make it easy to collect hand configuration and movement [6]. However, the extra devices are quite cost expensive. In contrast, the Vision Based methods require only a camera, thus realizing a natural interaction between humans and computers without the use of any extra devices [7].
For handling different hand gesture recognition many tools have been applied including mathematical models like Finite State Machine (FSM) , software computing methods such as fuzzy clustering , Artificial Neural Network (ANN) [8].

This paper organization is as follows: Section 2 demonstrates hand gesture recognition approaches. Section 3 explains vision based hand gesture recognition methodology. Applications of hand gesture recognition are presented in Section4. Section 5 explains the challenges in gesture recognition, and finally conclusion in section 6.

II. HAND GESTURE RECOGNITION APPROACHES

For any system the first step is to collect the data necessary to accomplish a specific task. For hand gesture recognition system different technologies are used for acquiring input data

Present hand gesture recognition approaches can be classified into various categories.

2.1. Data glove based approaches:

Data Glove, based approach uses a glove-type device which could detect hand position, movement and finger bending. In this approach user require to wear a glove like device, which uses sensors that can sense the movements of hand(s) and fingers, and pass the information to the computer, and perform the required gesture operation. These approaches can easily provide exact coordinates of palm and finger's location and orientation, and hand configurations [6] [9].The main advantage of these approach are high accuracy and fast reaction speed but the limitation of this approach is to be quite expensive, due to extra requirement of hardware(Sensor).
Another disadvantages of glove based approach is user comfort and the hand size. Also it is inefficient for working in virtual reality. Fig 2.1 illustrate the glove based approach.

Fig. 2.1 Data Glove

2.2. Vision based approaches:

In this approach user not require to wear anything. Instead the system requires only camera, which are used to capture the images of hands for interaction between human and computers. Vision based approach is simple, natural and convenience [10]. A vision-based solution to collecting data for hand gesture recognition requires four equally important components:
The first is the placement and number of cameras used.
The second component in a vision-based solution for hand gesture recognition is to make the hands more visible to the camera for simpler extraction of hand data.
The third component of a vision-based solution for hand gesture recognition is the extraction of features from the stream or streams of raw image data, and the fourth component is to apply recognition algorithms to these extracted features.
However, there are still several challenges to be addressed, for instance, illumination change, background noise, accuracy, partial or full obstacle etc. Fig 2.2 illustrate the vision based approach.

Fig.2.2 Vision Based

2.3. Color glove based approaches:

Color glove based approaches represent a compromise between data glove based approaches and vision based approaches. Marked gloves or color markers are gloves that worn by the human hand [8] with some colors to direct the process of tracking the hand and locating the palm and fingers, which provide the ability to extract geometric features necessary to form hand shape [8]. The disadvantages are similar to data glove based approaches: they are unnatural and not suitable for applications with multiple users due to hygiene issues. Fig 2.3 illustrate the color glove based approach.

Fig.2.3 Color Markers

III. HAND GESTURE RECOGNITION METHODOLOGY

The gesture recognition method essentially consists of four parts:

a) Taking input from the webcam and converting it into a form that can be processed easily.

b) Intercepting the gesture from the input of the webcam.
c) Recognizing the gesture from a database of gestures.
d) According to the intercepted gesture, give corresponding commands for the operations.

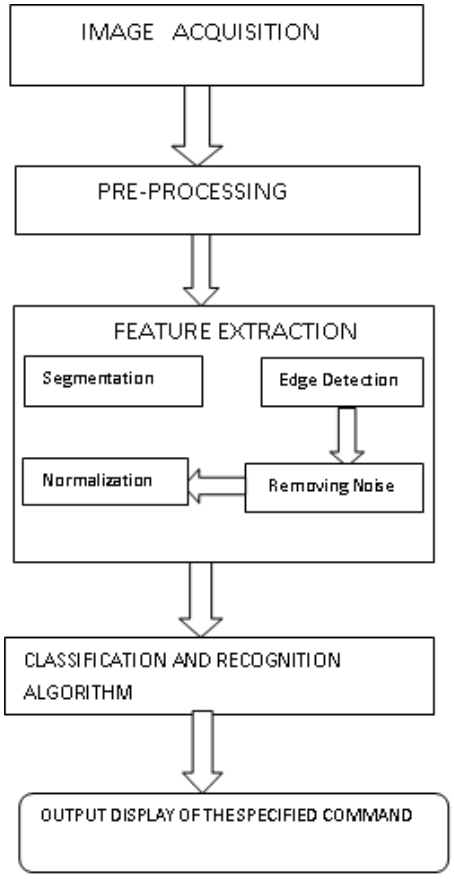


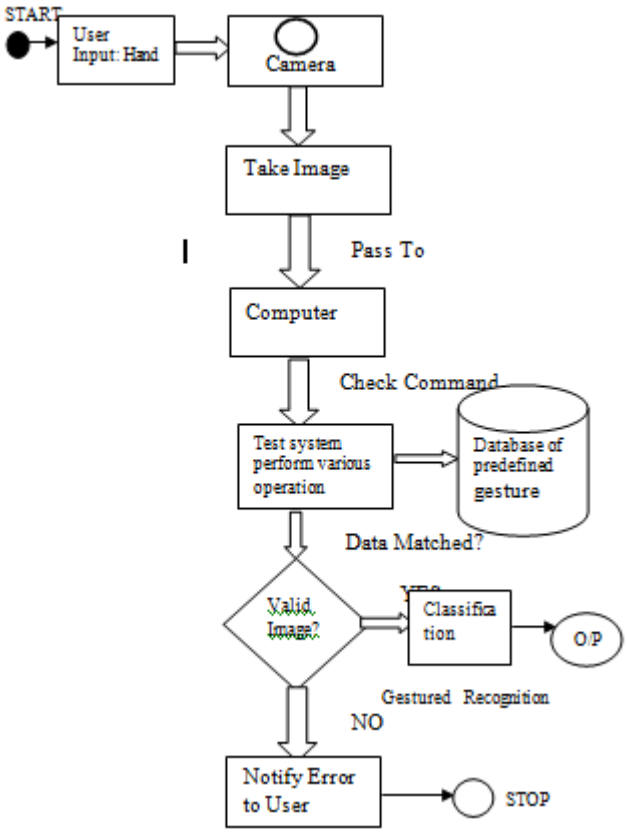
Fig. 3.1 Flow of gesture recognition system

In the Fig.3.1 shows the system overview of hand gesture recognition. The first stage of any vision system is the image acquisition stage. Get the image from the web cam to be processed for detection of hand. The images database can be any image file format such as '.jpg', '.bmp' and many more. After the image has been obtained, various methods of processing can be applied to the image to perform the many different vision tasks required. However, if the image has not been acquired satisfactorily then the intended tasks may not be achievable. After the image acquisition stage the next stage is image pre-processing the role of image pre-processing is responsible for extracting the hand region from the image captured and converted to binary format. In this stage Pre-processing is a common name for operations with images at the lowest level of abstraction -both input and output are intensity images. The aim of pre-processing is an improvement of the image data that suppresses unwanted distortions or enhances some image features important for further processing.

The third stage of system is Feature extraction .In pattern recognition and in image processing, feature extraction is a special form of dimensionality reduction. In this stage remove the noise, distortion and any other undesired background activity to achieve the desire feature.

The final stage of system is Classification, for gesture application we can apply various classification algorithms to achieve the desire task. Classification algorithms typically employ two phases of processing: training and testing.

3.1. Vision Based Real Time Hand Gesture Recognition System Working diagram



[Put your hand back down and try again after a while]

Fig. 3.2 Overall System Design

In the Fig. 3.2 shows the overall working principle of hand gesture recognition system:

First, the user places his hand in front of the webcam. The webcam then detects the user's hand by creating a rectangle/circle around it.

Once the hand has been detected the application further tracks different gestures of the user performed by his hand and generates contour/shape around it.

Gestures for manipulating objects in virtual environment, several commands are move left, move right, move up, move down, Rotate clockwise, Rotate counterclockwise...etc.

The gesture functions enable you to perform various operations on applications with a hand gesture recognized by the built-in camera on your computer.

If the built-in camera does not recognize your hand gesture correctly, put your hand back down and try again after a

while.

3.2. Algorithmic Techniques for Recognizing Hand Gestures

Once the raw data has been collected from a vision- or glove-based data collection system, it must be analysed to determine if any gestures have been recognized.

In this section, various algorithmic techniques for recognizing hand gestures are discussed.

This section presents a brief introduction into the concepts involved in neural networks [15] [16]. A neural network is an information processing system loosely based on the operation

of neurons in the brain. While the neuron acts as the fundamental functional unit of the brain, the neural network uses the node as its fundamental unit; the nodes are connected by links, and the links have an associated weight that can act as a storage mechanism. The objective of system is using Artificial Neural Network (ANN).

Implementation of pattern recognition using Neural Network into MATLAB. The implemented system should able to perform classification correctly. The implemented application should be user friendly enough for anyone to use. System should be able to get static image through the webcam and perform the classification.

Neural networks are a useful method for recognizing hand gestures, yield increased accuracy conditioned upon network training, and work for both glove based and vision-based solutions. If the gesture set is known beforehand this is not an issue, but if postures and gestures are likely to change dynamically as the system develops, a neural network is probably not appropriate [17] [18].In Fig 3.3 shows the flow chart of neural network.

1st Step: Select test set image / Get Image from Webcam

Once the Network is completed trained, the network is ready for testing. First, we select test set of image which already converted into feature vector form or get image through webcam then process it into feature vector form [18].

2nd Step: Process by Neural Network

Now the image in feature vector form is feed into the network. These feature vector values will go through all the adjusted

weights (neurons) inside the Perceptron network and the will come out an output.

3rd Step: Display Matched Output

The system will display the matched output which presented in vector format. Improvement is made so the output will display both vector format and the meaning of gesture sign in graphical form [16]. After performed those steps at previous pages, now is time to get the results

Strengths of neural network

I. Can be used in either a vision- or glove-based solution

II. Can recognize large posture or gesture sets

III. With adequate training, high accuracy can be achieved

Weaknesses of neural network

I. Network training can be very time consuming and does not guarantee good results

II. Requires retraining of the entire network if hand gestures are added or removed.

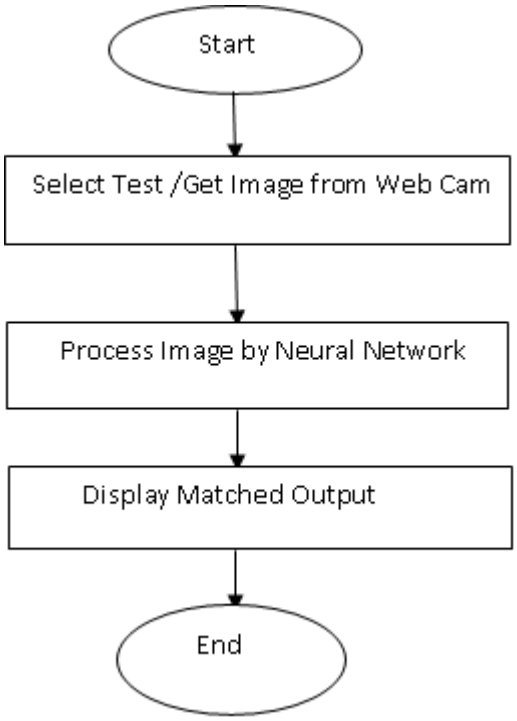


Fig 3.3 Network Testing Flow Chart

IV. APPLICATION AREAS OF HAND GESTURES SYSTEM

Hand gestures recognition system has been applied for different applications on different domains. Overview of some hand gesture application areas are listed below:

A.Sign Language Recognition:

Sign language is the natural way of communication of hearing and/or speech impaired people. Various vision based gesture recognition methods have been embedded into sign language interpreters [11]. Usually, a capture device is used to find and track hands and record the shapes and trajectories of hands, which are represented by feature vectors. After being matched to corresponding signs, the feature vectors are compared against a grammar library to determine whether the signs make sense in a grammar context. For example recognized American Sign Language (ASL) includes 26 symbol for static hand gestures related to A-Z alphabets.

B.Robot Control:

Controlling the robot using gestures considered as one of the interesting applications in this field. [12] Proposed a system that uses the numbering to count the five fingers for

controlling a robot using hand pose signs. The orders are given to the robot to perform a particular task [12], where each sign has a specific meaning and represents different function for example, "one" means "move forward", "five" means "stop", and so on.

C.Surgical System:

In a surgical environment, hand gesture recognition systems can help doctors manipulate digital images during medical procedures using hand gestures instead of touch screens or computer keyboards.

D.Television Control:

Hand gestures are used for controlling the Television device [9]. In a set of hand gesture are used to control the TV activities, such as turning the TV on and off, increasing and decreasing the volume, muting the sound, and changing the channel using open and close hand.

E. Gesture-to-Speech

Gesture-to-speech applications translate the user's hand gestures into speech. Such systems could give hearing-impaired people the ability to communicate through a computer. A gesture-to-speech interface could be especially valuable to hearing-impaired people who wish to communicate with people who do not know sign language. Fels [13] and Kramer [14] have developed systems for converting hand gestures to speech that use gloves to collect the hand gestures and speech synthesizers for speech output.

V. CHALLENGES

There are many challenges associated with the accuracy and robustness of gesture recognition system. For image based gesture recognition there are limitations on the equipment used, distance between hand and camera and image noise. Images or video may not be under consistent lighting, or in the same location. The camera gesture functions may not work correctly working in the following cases: Someone or something is moving behind you while you are making a hand gesture. Your computer is placed in an unstable position. You are using your computer in a dark room. You are making a hand gesture out of range of the built-in camera. You move your hand too fast. Items in the background or distinct features of the users may make recognition more difficult. The number of cameras used for recognition. For example, an algorithm calibrated for one camera may not work for a different camera.

The algorithm also changes for user left and right hand .The amount of background noise also causes tracking and recognition difficulties. The end product must support wide spatial detection and the ability to function in all lighting conditions.

VI. CONCLUSION

In this paper, we compared different major approaches for recognizing static, dynamic hand gestures and high-lighted the significant advantages and disadvantages of each approach.

A new hand gesture recognition system which works under most lightning conditions with different skin colored users and with different camera parameters is aim. The implemented system is very fast and robustness. It should not need any training or not make the user wear a special glove etc. Also the system will aim to work in or nearly real time to be applicable in human computer applications. Finally it should work in a typical PC with a cheap USB webcam.

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REFERENCES

[1] **S**. Mitra, and T. Acharya, 2007. Gesture Recognition: A Survey. IEEE Transactions on systems, Man and Cybernetics, Part C: Applications and reviews, vol. 37 (3), pp. 311-324, doi: 10.1109/TSMCC.2007.893280.

[2] J. P. Wachs, M. Kolsch, H. Stern, and Y. Edan, "Vision-based hand gesture applications," Communications of the ACM, vol. 54, pp. 60–71, 2011.

[3] Sanjay Meena, 2011. A Study on Hand Gesture Recognition Technique, Master thesis, Department of Electronics and Communication Engineering, National Institute of Technology, India.

[4] Xingyan Li. (2003). "Gesture Recognition Based on Fuzzy C-Means Clustering Algorithm", Department of Computer Science. The University of Tennessee Knoxville.

[5] Simei G. Wysoski, Marcus V. Lamar, Susumu Kuroyanagi, Akira Iwata, (2002). "A Rotation Invariant Approach on Static-Gesture Recognition Using Boundary Histograms And Neural Networks," IEEE Proceedings of the 9th International Conference on Neural Information Processing, Singapore.

[6] J. Weissmann and R. Salomon, "Gesture Recognition for Virtual Reality Applications Using Data Gloves and Neural Networks," In Proceedings of the International Joint Conference on Neural Networks, vol.3, pp. 2043-2046, 1999.

[7] Y. Wu and T. S. Huang, "Vision-Based Gesture Recognition: A Review," In Proceedings of the International Gesture Workshop on Gesture-Based

Communication in Human-Computer Interaction, pp.103-115, 1999.

[8] Rama B. Dan et al, (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 5 (2) , 2014, 2050-2052.

[9] Harshith.C, Karthik.R.Shastry, Manoj Ravindran, M.V.V.N.S Srikanth, Navee Lakshmikhanth "Survey on various Gesture Recognition Techniques for Interfacing Machines based on Ambient Intelligence" (IJCSES) Vol.1, No.2, November 2010.

[10] Pragati Garg, Naveen Aggarwal and SanjeevSofat, 2009. Vision Based Hand Gesture Recognition, World Academy of Science, Engineering and Technology 49, pp. 972-977.

[11] H. Birk and T. B. Moeslund, "Recognizing Gestures From the HandAlphabet Using Principal Component Analysis," Master Thesis, Laboratory of Image Analysis, Aalborg University, Denmark, 1996.

[12] Malima,A.,Ozgur, E.,Cetin, M. (2006). A Fast Algorithm for Vision-Based Hand Gesture Recognition, IEEE 14th conference on Signal Processing and Communications Applications, pp. 1-4. doi:10.1109/SIU.2006.1659822

[13] Fels, Sidney. Glove-TalkII: Mapping Hand Gestures to Speech Using Neural Networks – An Approach to Building Adaptive Interfaces. Ph.D. dissertation, University of Toronto, 1994.

[14] Kramer, James, and Larry Leifer. The Talking Glove: An Expressive and Re-ceptive 'Verbal' Communication Aid for the Deaf, Deaf-blind, and Non-vocal. Technical Report, Department of Electrical Engineering, Stanford University, 1989.

[15] Russell, Stuart, and Peter Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall, Englewood Cliffs, NJ, 1995.

[16] Krose, Ben J. A., and P. Patrick van der Smagt. An Introduction to Neural Networks. University of Amsterdam, 1995.

[17] Anderson, James A. An Introduction to Neural Networks. Bradford Books, Boston, 1995.

[18] Allianna J. Maren, Craig T. Harston. Robert M. Pap (1990). Handbook of Neural Computing Applications. Michigan: Academic Press.