

Comparative Survey and Analysis of Hand Gesture Recognition on Various Gesture Recognition Technologies and Techniques

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Abstract

Normal human beings can communicate with each other with the help of various different languages, however, the people who can't speak have different sign languages to communicate with others. But a major setback of sign language is that only people those who know sign language can communicate with them. They are not able to communicate with others. In our paper we proposed a system which will be able to convert the sign language into words or sentences or audio output.

Keywords

Database, Comparison, Image Processing, Convex Hull, Recognition Techniques.

I. Introduction

Our description about the system that we are designing an interface between computer and human with the help of a camera which is used for taking the input gestures from the user. To make it more efficient and user friendly, the gestures of each user can be customized. The system provides medium accuracy and is able to provide high accuracy if the user is able to provide the most similar hand gestures as stored in the database.

II. Literature Survey

Most of the present hand recognition tools[2] do not collect all the information or they are static, they produce a good view, but do not produce correct output at all situations. Therefore they work on some platforms very well but not on all the platforms. The various different tools available for recognition of gesture depends on the approaches ranging from statistical & dynamic modeling image processing, computer vision and pattern recognition, etc.

III. Gesture Recognition Techniques

[11] The gesture recognition involves several concepts such as motion detection and analysis, pattern recognition, and machine learning. Different tools and techniques are utilized in gesture recognition systems, such as image processing, pattern recognition, computer vision, statistical modeling.

A. Artificial Neural Networks (ANN)

Artificial Neural Networks (ANNs) are a family of models inspired by biological neural networks and are used to estimate or approximate functions that can depend on a large number of inputs and are generally unknown. A neural network for handwriting recognition is defined by a set of input neurons which may be activated by the pixels of an input image. After being weighted and transformed by a function (determined by the network's designer), the activations of these neurons are then passed on to other neurons. This process is repeated until finally, an output neuron is activated. This determines which character was read. A system for hand tracking and gesture recognition using NNs to recognize

Myanmar Alphabet Language (MAL). Adobe Photoshop filter is applied to find the edges of the input image and histogram of local orientation employed to extract image feature vector which would be the input to the supervised neural networks system.

B. Fuzzy Clustering Algorithm

Fuzzy clustering is a process of assigning membership levels, and then using them to assign data elements to one or more clusters. Elements can belong to more than one cluster, and associated with each element is a set of membership levels. This indicate the strength of the association between that data element and a particular cluster. All the methods that dividing the given set of sample data into clusters based on some condition between grouped elements is termed as clustering algorithms. The pattern that share the same properties are grouped together to form a cluster. In fuzzy clustering, the partitioning of sample data into groups in a fuzzy way are the main difference between fuzzy clustering and other clustering algorithm, where the single data pattern might belong to different data groups. Clustering Algorithms have been widely spread because of their ability of grouping complicated data collections into regularly clusters.

C. Histogram Based Feature

An image histogram is type of histogram which acts as a graphical representation of the tonal distribution in a digital image. It plots the number of pixels for each tonal value. By looking at the histogram for a specific image. A method for recognizing gestures based on pattern recognition using orientation histogram. On digitized input image, some usual transformations were made on the image to calculate the histogram of local orientation of image, then a filter is used to blur the histogram, and plot it in polar coordinates. There are two phases of the system:-

1. In the training phase - For different input gestures the training set is stored with their histograms.
2. In running phase - A n input image is presented to the computer and the feature vector for the new image is formed, Then comparison is made between the feature vector (oriented histogram) of all images of the training phase and the feature vector of the input image, using Euclidean distance metric and selecting the less error between the two compared histograms. The total process time was 100 msec per frame.

IV. Design

A. Design [8]

The proposed solution consists of following components:

1. Hand Detect

Hand detection module primarily identifies the probable area in which the user's hand is present in the image and the specific

rectangular area is then passed to the gesture detection system. The user enables hand detection by placing hand in front of camera at minimum of 25cm upto the perfect capture. Once the hand is detected, the user is notified with the same. The webcam access is required before we proceed towards hand detection.

2. Hand Tracking [9]

Once a hand is traced by the system, the hand tracking component is used to track the hand in the view of the webcam. This is required as it is necessary that the system should follow hand movement continuously and also accurately to recognize various gestures.

3. Stored Text File (Database)

A text file is used to store various classifiers needed to recognize various gestures. Text file consist of many strong classifiers which in turn consist of weak classifier. Each weak classifier is set of multiple classifiers and each classifier is one of the features. These classifiers are used to recognize various gestures by the system.

4. Hand Gesture Recognition

Hand gesture recognition component performs the actual work of recognizing the gestures performed by the user. It draws a convex hull and convexity defects around the detected object. The recognition system then matches the movement of hand with stored classifiers and tries to identify the gesture. If complete set of simple classifiers is successfully detected, then the system considers the respective gesture is performed by user.

5. Event Handling

Once the system recognizes the gestures, the system notifies the user system with the action to be performed with respect to the gesture. The actions on gestures are predefined by the system and stored in text file. So, particular event takes place when user performs the particular gesture.

The event handling is demonstrated with the help of displaying the meaning associated with particular gesture.

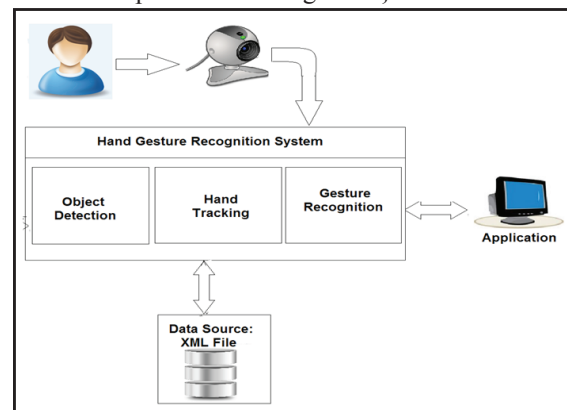
B. Set Representation of the System:

$S = \{I, O, P, Sc, F\}$

where,

- S -> System
- I -> Input,
- O -> Output,
- P -> Processes,
- Sc -> Success case,
- F -> Failure case

- I = {frames captured by camera}
- O = {actions performed according to hand gesture}
- P = {elimination of noise, edge detection, segmentation, feature measurement, scene analysis}
- Sc = {detection of the hand gesture, according to hand gesture performing the appropriate action}
- F = {hand detection is not done correctly, detection of wrong hand gesture, doing the wrong action for particular hand gesture}



Applications

- It can be used as an input device for computers
- It can be used for controlling robots
- This can be used as interface between mute people and other people
- It can be used as a controller in gaming.

V. Existing Tools

Table 1: Comparison of Existing Tools

| Name | Language/ Platform | Advantage | Disadvantage |
|---|--|---|---|
| 1. Gesture Recognition Toolkit[3] | Open-source, C++ Cross platform | Machine learning library | 1. Only C++ language 2. It does not work well when the data you want to classify is not linearly separable |
| 2. Kinect gesture recognition project, Kinect DTW Open source [4] | Many languages supported such as C, C++, python, java, etc. Windows, Linux | 1. Gesture recording 2. Save gestures 3. How the recognizer works 4. Works out of the box | Costly requires proprietary hardware. |
| 3. js-object detect is a JavaScript library for real-time object detection[5] | JavaScript, jQuery, Multiplatform, detection, browser based | Compatible to stump based classifiers used by OpenCV. Classifiers for face, hand and eye detection are already included | 1. Only two gestures available 2. No Documentation available |
| 4. OpenCV[6] | C, C++, python extensions, Multiplatform | 1. Various Filters and structure available 2. ConvexHull function built in data | 1. No built in hand gesture recognition 2. ConvexHull requires still background |

Table 2: Comparison of Depth Sensors

| Method | Technology | Efficiency | Library required | Disadvantages | Advantages |
|------------------------------------|---|---|----------------------------------|---|-----------------------------|
| 1. Microsoft Kinect[7] | VGA (640x480) video camera and QVGA (320x240) depth camera | Range is approximately 1.2 to 3.5 meters effectively. | Microsoft Kinect SDK, openNI SDK | 1. Does not perform well in bright sunlight 2. Price: Rs10,500/- | 30 frames per second (fps). |
| 2. Time of Flight (ToF) cameras[7] | RF-modulated light sources with phase detectors or shutters which open and close at the same rate of light pulses | Dependent on the light source | Custom | Relatively low Resolution (144x176). | 50 frames per second (fps). |
| 3. Stereoscopic cameras[7] | Pair of calibrated video cameras | Implementation dependent | Custom | Comparatively lower fidelity depth images than ToF cameras | Work well in bright light |

VII. Conclusion

From the proposed system we conclude that a new gesture recognition technique is required such as [10] OpenCV (Open Source Computer Vision Library). It is a library mainly aims at on real time Image Processing and Computer Vision. Its library is platform independent. It provides fast and efficient algorithms and data structures which can be used for complex real time Image Processing and Computer Vision applications. The requirement of this systems hardware and software are low that lead to cheap product cost. System needs white background for better output. Processing speed of the system depends upon the quality of processor.

The strength of this approach is that and it provides us with the higher recognition rate with minimum computation time & it does not require any significant amount of training or post processing. The assumption made in this method is, we define certain parameters and threshold values experimentally.

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