Human Computer Interaction Using Gesture Recognition System

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Abstract – Hand gesture communication is a non verbal interaction which is widely used to interaction of the physical world with the digital world. Hand gesture communication uses our hands or figures to move objects around for more complex expressions for the feelings and also used for communicating with others. Gestures are thus a natural and intuitive form of both interaction and communication. Vision based Gesture recognition has the potential to be a natural and powerful tool supporting efficient and intuitive interaction between the human and the computer. Visual interpretation of hand gestures can help in achieving the ease and naturalness desired for Human Computer Interaction (HCI). This has motivated many researchers in computer vision-based analysis and interpretation of hand gestures as a very active research area. The purpose of this review is to introduce the field of gesture recognition as a mechanism for interaction with computers without any physical contact.

Keywords: Hand-gesture recognition, computer vision, human computer interaction.

I. INTRODUCTION

Sign language is the most natural and expressive way for the hearing impaired. Automatic sign language recognition offers enhancement of communication capabilities for the speech and hearing impaired. It promises improved social opportunities and integration in the society to these people. The idea of our project is to design a gesture recognition system that will automatically capture, recognize and translate the alphabets of Indian Sign Language into corresponding text and voice in a vision based setup. In our project we propose to recognize single handed as well as double handed gestures accurately with a single normal webcam using bare human hands. The aim of our project is to recognize the gestures with highest accuracy and in least possible time. To recognize the gestures, our system consists of 4 modules: Hand Tracking and Segmentation, Feature Extraction, Gesture Recognition, Application Interface.

II. RELATED WORK

To improve the interaction in qualitative terms in dynamic environment it is desired that the means of interaction should be as ordinary and natural as possible. Gestures, especially expressed by hands have become a popular means of human computer interface now days. Human hand gestures may be defined as a set of permutation generated by actions of the hand and arm. These movements may include the simple action of pointing by finger to more complex ones that are used for communication among people. Thus the adoption of hand, particularly the palm and fingers as the means of input devices sufficiently lowers the technological barrier in the interaction between the disinterested users and computer in the course of human computer interaction. This presents a very natural way of removing technological barriers while we are adopting the hands themselves as input devices. This needs the capability to understand human patterns without the requirement of contact sensors. The problem is that, the applications need to rely on external devices that are able to capture the gestures and convert them into input. For this the usage of a video camera can be done that grabs user’s gesture, along with that we require processing system that capture the useful features and partitions the behaviour into appropriate classes.

Various applications designed for gesture recognition require restricted background, set of gesture command and a camera for capturing images. Gesture input can be categorized into different categories depending on various characteristic [6]. The current technologies for gesture recognition are not in a state of providing acceptable solutions to the problems stated above. One of the major challenges is evolution in the due course of time of the complexity and robustness associated with the analysis and evaluation for gestures recognition. Different researchers have proposed and implemented different pragmatic techniques for gesture as the input for human computer interfaces. Dias et al. [7] presents a free-hand gesture user interface which is based on finding the flight of fiduciary color markers connected to the user’s fingers. The proposed technique is implemented without any use of sophisticated image processing algorithms and hardware. Atia et al. [9] designs a tilting interface for remote and quick interactions for controlling the directions in an application in ubiquitous environment. It uses coin sized 3D accelerometer sensor for manipulating the application. Controlling VLC media player using hand gesture recognition is done in real time environment.
using vision based techniques designs an interactive virtual blackboard by using video processing and gesture recognition engine for giving commands, writing and manipulating objects on a projected visual interface. The major drawbacks of such techniques are they are very complex and highly sophisticated for developing an actionable procedure to make the necessary jigs and tools for any typical application scenarios. This problem can be overcome by pattern recognition methods having lower hardware and computational overhead. These aspects have been considered in subsequent sections, by making the dynamic user interface for the validation of those concepts, where a user performs actions that generates an executable commands in an intelligent system to implement the user requirements in a natural way.

III. SYSTEM IMPLEMENTATION

A. Image pre-processing

1) Skin detection: To recognize the hand gesture, we need to detect the skin part in the image first. Some human-computer interaction systems detect the skin of people by checking the color of each pixel [6]. These systems have difficulty in dealing with different races of people. Some human-computer interaction systems detect people by infrared camera [7]. These systems are good at dealing with complex backgrounds and different skin colors, but they are sensitive to the temperatures and are more costly. Our system uses the HSV channel to detect the skin-like regions in an image. The variations in skin colors across ethnic groups are mainly dissimilarities in the concentration of pigments which primarily affect the saturation of the skin. The hue of the skin, on the other hand, is roughly invariant across ethnic groups. Based on these characters, a fast and effective approach can be formulated to detect skin-like regions in an image. We transform the image from RGB to HSV space. After that, segmentation is performed in the hue and saturation channel using predefined domains. Some non-skin pixels may be very similar to the skin-part in the HSV channel. This induces noises in the output threshold image.

2) Noise deletion: Certain objects that have similar hue and saturation characteristics with skin caused some salt and pepper noises in the produced image of skin detection. We use median filtering and morphological methods to reduce this noise. The basic idea of median filtering is to replace the value of a pixel by the median of the value in the neighbourhood of that pixel. This technique provides excellent noise-reduction capabilities. In our system, we use a 5 by 5 neighbourhood. After using the median filter, we use closing morphological operator after opening morphological operator to reduce other types of noise. The “opening” operator smooths the contour of an object, breaks narrow isthmuses, and eliminates thin protrusions. The “closing” operator tends to smooth sections of contours but, as opposed to “opening”, it generally fuses narrow breaks and long thin gulfs, eliminates small holes, and fills gaps in the contour. By using these methods, salt and pepper noise are reduced from the image, small regions containing skin-like pixels are corrected and holes are filled.

![Fig. 1. Noise Deletion result](image)

3) Contour extraction and smoothing:

After extracting the hand part from the image, we need extract the contour of hand to calculate the feature vector. The aperture between fingers may cause extra edges. We regard the connected edge with the most pixels as the hand contour we need. Fig.2 shows the result of contour extraction.

![Fig. 2. Contour extraction result](image)

Due to the complex backgrounds and lighting conditions, the contours extracted may be not very smooth. These zigzags can affect the recognition accuracy greatly.

![Fig. 3. Contour smoothing result](image)

Figure 3 shows the result of contour smoothing. Some of the zigzag parts, especially the fingertip part, cannot be smoothed by this method and cause the error in the feature vector.

B. Classification and Recognition:-
An efficient classifier and recognition method plays very important role in any gesture recognition system. This step goes forward with the pattern recognition and machine learning field. The Vision-based hand gesture recognition system also needs to meet the requirements including real-time performances, accuracy and robustness, so use of correct classifier is the need of the any machine learning system. Training and testing the system is the very important aspect of any research work. There are many error estimation methods available such as redistribution methods, Holdout method, Leave-one Out method, Rotation method, n-fold cross validation and bootstrap method. Depending on the availability of sample data and required performance one can choose the error estimation method for analysis of results. Some researcher worked on hybrid classifier or cascaded classifier to get best performance.

In this paper we proposed computer vision based interfaces for interactive art and entertainment installations. This work purpose is to provide the reader with information on some of the tools available for computer vision based body tracking, how they can be selected and applied to achieve the desired artistic goal and their limitations. What these computer vision interfaces have in common is low cost and ease of implementation, as it require means which are commonly available to most individuals/institutions, such as computers and small cameras. Hand gestures are an important modality for human computer interaction (HCI) that compared to many existing interfaces, hand gestures have the advantages of being easy to use, natural, and intuitive. Successful applications of hand gesture recognition include computer games control, human-robot interaction and sign language recognition, to name a few. Vision based recognition systems can give computers the capability of understanding and responding to hand gestures.

IV. EXPERIMENTAL ANALYSIS

We proposed vision based gesture recognition system which provides a real-time assistive communication system to help alleviate the difficulties faced by hearing and speech impaired people in communicating with others and among themselves. The most important advantage of the usage of hand gesture based input modes is that using this method the user can interact with the application from a distance without using the keyboard or mouse. The system makes use of bare hands for interacting with the computer and is inexpensive, therefore facilitating the deaf-dumb people to use it. The usage of a natural device free interface is the primary goal of this proposed system that recognizes the hand gestures as commands.

![Fig.4. Accessing The New Microsoft Office Word Document by hand gesture](image)

For the interaction of user with the computing device, this system uses a low cost webcam which is used for image acquisition. This interaction performs different applications like browsing image in the image browser, controlling power point presentation writing words on the notepad, etc. by some predefined hand gestures that acts as an interaction instructions or commands.

![Fig.5. Writing a word on Notepad by hand gesture](image)

By using hand gestures we can perform some mouse events like left click, right click or left double click and also keyboard events like right arrow, left arrow etc.

V. CONCLUSION

This project represents a hand gesture recognition which is very effectively used in various applications like educational technology. In Human-Computer Interaction, hand gesture recognition is the most natural and easy way of communication i.e through hand gestures instead of complex command or keyboard. To control the different applications the gesture vocabulary can be designed to operate the various functions. The vocabulary designed also gives flexibility to define gestures based on the user interest for specific command which make the gesture recognition system more easier. The most important advantage of the usage of hand gesture based input modes is that using this method the user can interact with the application from a distance without using the keyboard or mouse. Also the gesture vocabulary designed can be further extended for controlling different applications like game control etc. The vocabulary designed also gives flexibility to define
gestures based on the user interest for specific command which make the gesture recognition system more user friendly. As the system provides the flexibility to the users and specifically physically challenged users to define the gesture according to their feasibility and ease of use.

REFERENCES


