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A Comprehensive Study On Hand Gesture Recognition Approaches

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ABSTRACT

In today's world of computer virtualization, traditional human-computer interaction devices like keyboard and mouse are ineffective. There is need of more natural and efficient way of human computer interaction. Gesture recognition is an approach in this direction. It is the process through which the gestures made by the user are recognized by the receiver. Gestures are expressive, meaningful body motions involving physical movements of the fingers, hands, arms, head, face, or body for conveying meaningful information or interacting with the environment. Survey and Sign language study shows that the hand gesture is the most easy and natural way of communication. The hand is the most effective general purpose tool for interaction, due to its dexterity. Hand gestures are a collection of motions of the hands and arms that vary from the static posture of pointing at something to the dynamic ones used to communicate with others. Many different algorithms and techniques are developed in this area addressing different aspects of the problem. Hand gesture recognition has great importance in designing an efficient human computer interaction. This paper highlights on the different hand gesture recognition approaches and applications. These approaches are primarily divided into Data-Glove Based and Vision Based approaches.

***Keywords*— Gesture recognition, hand gesture recognition, human computer interaction, computer vision.**

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I. INTRODUCTION

In the present day of computer virtualization and intelligent computing, an efficient human–computer interaction is very importance in our day today life. Gesture recognition[1] is an approach in this direction. It is the process by which the gestures made by the user are recognized by the receiver. Gestures are expressive, meaningful body movements involving physical movements of the fingers, hands, arms, head, face, or body with the intention of: 1) conveying meaningful information or 2) interacting with the environment. Gestures can be either static (the user consider it as a certain pose)or dynamic (gesture changing over time). Some gestures can have both static and dynamic elements, as in the sign languages. Recently hand gesture recognition has gained great importance due to its huge applications in contactless human computer interaction. It enables people to communicate with computer more easily and naturally. There is major development in this area and number of algorithms and techniques addressing different problems have been proposed. Some of them uses electronic glove or optical markers to detect hands but the devices are expensive, requires complex configuration and not easy to use for domestic applications. Methods based on hand shape and skin color have also been proposed but are not robust in the dynamic environment.

Different tools for handling hand gesture recognition are used including mathematical models like Hidden Markow Model (HMM)[2] and Finite State Machine (FSM),software computing methods such as fuzzy clustering, Artificial Neural Network (ANN). Numerous approaches have been proposed for enabling hand gesture recognition. A common taxonomy is based on whether extra devices are required for raw data collection. In this way, the hand gesture recognition systems are basically divided into two techniques, namely the glove-based and the vision-based methods. The Data-Glove based approach uses sensor devices for digitizing hand and finger movements into multi-parametric data. The other sensors facilitate detection

of hand configuration and movement. However, the sensor devices are expensive and wearing such gloves increases the setup time. On the other hand, the Vision Based [3] method require only a camera for natural interaction between humans and computers without the use any other devices. These systems tend to complement biological vision by describing artificial vision systems that are implemented in software and/or hardware. Vision-based methods are easy, natural and useful for real-time applications. Vision based systems requires application specific image processing algorithms, programming, and machine learning.

This paper is organized as follows : Part II demonstrates the different hand gesture recognition approaches. Part III presents applications of hand gesture recognition. Part IV explains the challenges in gesture recognition. This paper is concluded in part V..

II. HAND GESTURE RECOGNITION APPROACHES

Their is huge number of developments in hand gesture recognition. Many researchers have proposed various techniques for hand gesture recognition. Recently hand gesture recognition systems based on superpixel and distance metric are proposed which shows promising performance. The different methods in hand gesture recognition are:

1. Vision Based Hand Gesture Recognition [3]

In a vision based hand gesture recognition system the motions or actions of the hand are captured in the form of frames by a camera. From these frames a set of features are extracted. A classifier uses the extracted features to recognize different postures for every frame. There are mainly two categories of vision based hand gesture recognition, namely the three dimensional (3D) hand model-based methods and the appearance-based methods. Vision-based methods are easy, natural and useful for real-time applications. Vision based systems requires application specific image processing algorithms, programming, and machine learning.

2. 3D Hand Shape Model [4]

Many approaches use the 3D hand shape model. It rely on the 3D kinematic hand model with significant degrees of freedom and try to estimate the hand parameters by comparison between the input images and the possible 2D appearance projected by the 3D hand model. This approach is ideal for realistic interactions in virtual environments . In contrast, 3D model based approaches can exploit the depth information and are much more computationally expensive but can identify hand gestures more effectively. 3D Model can be classified into volumetric and skeletal models.

3. Bag-of-Features [5]

A Bag of Features technique is one that represents images as orderless groups of local features. Keypoint features extracted from SIFT algorithm can be used in their raw format for direct image matching ,or vector-quantized keypoint features into a representation like the bag-of-words representation of text documents. Bag-of-features representations have shown outstanding performance for action recognition. They permit the recognition of a rich set of actions. However, “bag-of-features” approaches exclusively rely on the dense local motion features.

4. Hidden Markov Model [2]

The Hidden Markov Model (HMM) is possibly the most well known machine learning tool used in gesture recognition literature. An HMM used in dynamic gesture recognition provides many advantages compared with other classifiers while on the contrary to static posture recognition. This is due to temporal gesture segmentation and recognition that happen simultaneously, and HMMs can be trained by a number of training samples like Neural Networks.

5. Histogram of 3D Facets (H3DF) [6]

Histogram of 3D Facets explicitly encode the 3D shape information from depth maps. The 3D facet are defined as 3D local support surface associated with each 3D cloud point. By robust coding and pooling 3D facets from a depth map, H3DF descriptor can effectively represent the 3D shapes and structures of various hand gestures.

6. Superpixel Based Hand Gesture Recognition [7]

Superpixel based hand gesture recognition uses Kinect depth camera and superpixel earth mover’s distance metric for gesture recognition. The depth and skeleton information from kinect is used to extract the hands. The hand shapes, textures and depths are represented in the form of superpixels which effectively retains the overall shapes and the color of the gestures. Based on superpixels, the superpixel earth mover’s distance metric is used to measure the dissimilarity between the hand gestures. This measurement is robust to distortion and articulation and also invariant to scaling, translation and rotation with proper preprocessing. The system has moderate complexity and can be implemented in real-time. It is able to achieve fast recognition speed and high mean accuracy.

III. APPLICATION

Hand gesture recognition has wide range of applications such as the following:

_ developing aids for the deaf people,
_ enabling easy way for young children to interact with Computers,
_ designing techniques for forensic identification,
_ recognizing sign language,
_ medically monitoring patients’ emotional states or stress levels,
_ navigating and/or manipulating in virtual environments,
_ communicating in video conferencing;
_ distance learning/tele-teaching assistance;
_ interactive gaming:
_ monitoring automobile drivers’ alertness/drowsiness levels, etc.

IV. CHALLENGES

There are many issues related with the accuracy and recognition speed of gesture recognition systems. For image-based gesture recognition there are limitations on the

devices used. It may be affected by the lighting conditions, image noise and large variations in hand gesture and textures. Items may not be at the same location. Background items may make the recognition more difficult, especially when occlusions occur. The various implementations for image-based hand gesture recognition may cause issue for viability of the technology to general usage. Also, the distance from the camera, its resolution and quality also cause variations in recognition accuracy. In order to capture human gestures by visual sensors, robust computer vision methods are required

V. CONCLUSION

There are many different approaches for hand gesture recognition and each approach has some strengths and weaknesses. This survey paper has explained a comprehensive overview of various hand gesture recognition techniques. In this paper, we reviewed several existing methods for supporting vision-based human-computer interaction. Vision based hand gesture recognition method shows the promising performance. Now a days many real time hand gesture recognition applications are available.

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