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Vision-Based Hand Gestures to Control Music in Human Machine Interaction

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Abstract: ***Hand gestures are useful for providing interfacing various devices for human computer interaction. It is a study of the communication and transmission of required information, emotion between human and machines. Normally human-computer interaction with hand gestures can help in gain the naturalness of required human-computer interaction. This method provides smart solutions naturally built method, so coming future so many corporate are working and find its use on different applications. Hand gestures provide a simple way to link with cumbersome interface devices for human-computer interaction (HCI). In particular, visual analysis of hand gestures can help in accomplishing the ease and naturalness desired for HCI. This has motivated a very active research area concerned with computer vision-based analysis and interpretation of hand gestures. This abstract is organized on the basis of the modeling, analyzing, and recognizing gestures. Important differences in the gesture interpretation approaches arise depending on modeling scheme. There are two basic ways - 1. Using glove based method and 2. Using vision based method. The vision based method is further classified as mentioned below (a) 3D model (b) Appearance-based model. Here we also describe implemented gestural systems as well as other potential applications of vision-based gesture recognition. Although the current progress is encouraging, further theoretical as well as computational advances are needed before gestures can be widely used for HCI. Human machine interaction is a study looking at the transmission and communication of information and emotion between human and machines, and, in order for human to sense the realistic and comfortable relation when interacting with machines, an interface for natural and intuitive interactions will be important for the bridging of relation between human and machines. Hand gesture, apart from language, is a kind of body language that allows the expression of human emotion and intention.***

Keywords: Gestures, Control, vision based, human, machine

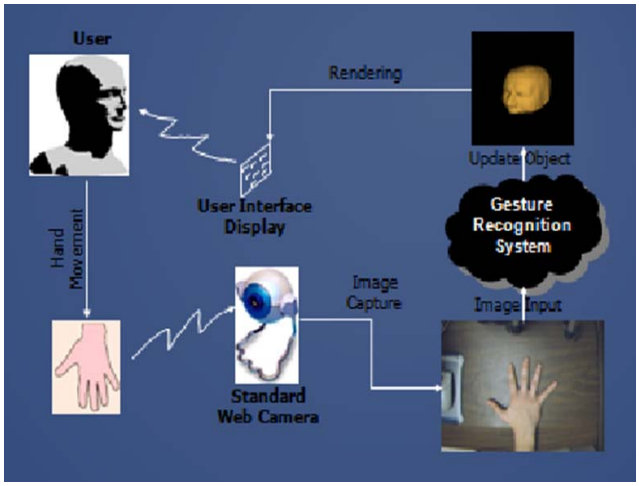
1. Introduction

Gestures are a powerful means of communication among humans. In fact, gesturing is so deeply rooted in our communication that people often continue gesturing while speaking on the telephone. Hand gestures provide a separate complementary modality to speech for expressing ones ideas. Information associated with hand gestures in a conversation is degree, discourse structure, spatial and temporal structure. So, a natural interaction between humans and computing devices can be achieved by using hand gestures for communication between them. The key problem in gesture interaction is how to make hand gestures understood by computers. The approaches present can be mainly divided into "Data-Glove based" and "Vision Based" approaches. The Data-Glove based methods use sensor devices for digitizing hand and finger motions into multi-parametric data. The extra sensors make it easy to collect hand configuration and movement.

However, the devices are quite expensive and bring much cumbersome experience to the users. 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. These systems tend to complement biological vision by describing artificial vision systems that are implemented in software and/or hardware. This poses a challenging problem as these systems need to be background invariant, lighting insensitive, person and camera independent to achieve real time performance. Moreover, such systems must be optimized to meet the requirements, including accuracy and robustness. The purpose of this is to review of Vision based Hand Gesture Recognition techniques for Human Computer Interaction (HCI), consolidating the various available approaches, pointing out their general advantages and disadvantages.

2. Overview and Proposed System

It is widely believed that as the computing, communication, and display technologies progress even further, the existing HCI techniques may become a bottleneck in the effective utilization of the available information flow. Human hand gestures are a means of non-verbal interaction among people. They range from simple actions of using our hand to point at and move objects around to the more complex ones that express our feelings and allow us to communicate with others. Vision-based recognition technology can be further divided into two types: Contour-Based Methods and Model-Based Methods. Contour-based recognition method requires the building of the hand portion image, then generating the outline of the contour, based on the shape of the hand portion image, and, finally, performing the recognition of the hand gesture, based on the contour. Model-based recognition method starts with defining a 3-D hand model and the motion latitude. With considerations given to human anatomy, and the position and orientation of the palm. there can be 27 possible latitudes; therefore, the application of this method for hand gesture recognition usually requires the designing of Hand-Model-Fitting Algorithm, comparing the internal model with the input image, and calculating the curving of each of the joints and the corresponding positions of the finger tips.

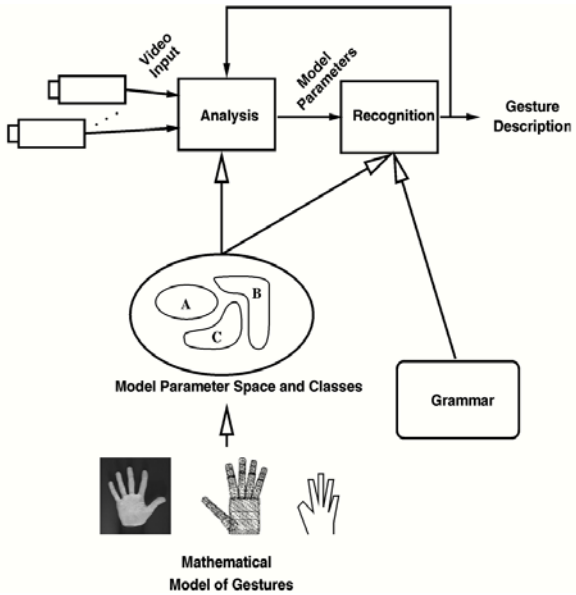


General Vision Based System

3. General View of a Gesture Recognition System

There has been rapid growth of various studies related to vision-based gesture analysis fueled by a need to develop more natural and efficient human-computer interfaces. These studies are reported in disparate literature and are sometimes confusing in their claims and their scope. Visual images of gesturers are acquired by one or more video cameras. They are processed in the analysis stage where the gesture model parameters are estimated. Discomfort in using gloves and other different devices can be overcome by using video-based noncontact communication techniques which have many advantages. Many studies have been undertaken within the context of a particular application, such as using a finger as a pointer to control a TV, or interpretation of American Sign LanguageThere has been rapid growth of various studies related to vision-based gesture analysis fueled by a need to develop more natural and efficient human-computer interfaces.

This discussion based on following main components shown in the diagram below,



Vision-based gesture interpretation system

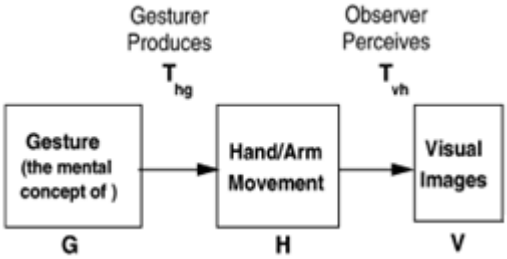
- Gesture Modeling
- Gesture Recognition
- Gesture Analysis
- Gesture-Based Systems and Applications

The first phase of a recognition task is choosing a model of the gesture. The approach used for modeling plays a pivotal role in the nature and performance of gesture interpretation. Once the model is decided upon, an analysis stage is used compute the model parameters from the image features that are extracted from single or multiple video input streams. Evaluation of a particular gesture recognition approach encompasses accuracy, robustness, and speed as well as the variability in the number of different classes of hand/arm movements it covers.

Gesture recognition is the possible to use hand gestures in various applications aiming at a natural interaction between the human and various computer-controlled displays. Gesture recognition is the phase in which the data analyzed from the visual images of gestures is recognized as a specific gesture. the HCI structure, hand gestures cannot be simply defined. The definitions, if they exist, are mainly linked to the communicational feature of the human hand and body actions.

Gesture recognition is the stage of which the information analyzed from the visual images of gestures is predictable as a particular gesture. The path in model parameter space is classify as a portion of some significant compartment of that parameter space Two tasks are commonly associated with the recognition Process:

Optimal partitioning of the parameter space and Implementation of the recognition procedure.



Production and perception of gestures

In a computer controlled environment one wants to use the human hand to perform tasks that mimic both the natural use of the hand as a manipulator, and its use in human-machine communication. Classical definitions of gestures, on the other hand, are rarely, if ever, concerned with the former mentioned use of the human hand.

Hand gestures originate as a mental concept G, are expressed (Thg) through arm and hand motion H, and are perceived (Tvh) as visual images V. Hand gestures are a means of communication, similar to spoken language. The production and perception model of gestures can also be summarized in the following form:

H = Thg G
V = Tvh H
V = Tvh (ThgG) = Tvg G

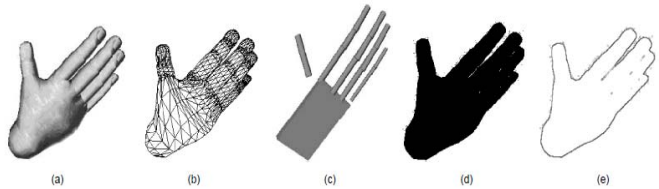
Transformations T can be viewed as different models: Thg is a model of hand or arm motion given gesture G, Tvh is a model of visual images given hand or arm motion H, and Tvg describes how visual images V are formed given some gesture G.
In modeling of gestures. we examine the two approaches more close in the following subsections.

3D – Hand Model

3D hand model-based models of gestures use expressed models of the human hand and arm to approximation the hand and arm movement parameters. Such movements are later recognized as gestures the idea behind the analysis-by-synthesis approach is to analyze the body's posture by synthesizing the 3D model of the human body in question and then varying its parameters until the model and the real human body appears as the same visual images. The 3D models of more complex body parts, like hands, arms, or legs, are then obtained by connecting together the models of the simpler parts.

In addition to the parameters of the simple models, these structures contain the information on connections between the basic parts. The information may also include constraints which describe the interaction between the basic parts in the structure. The human hand skeleton consists of 27 bones , divided in three groups:

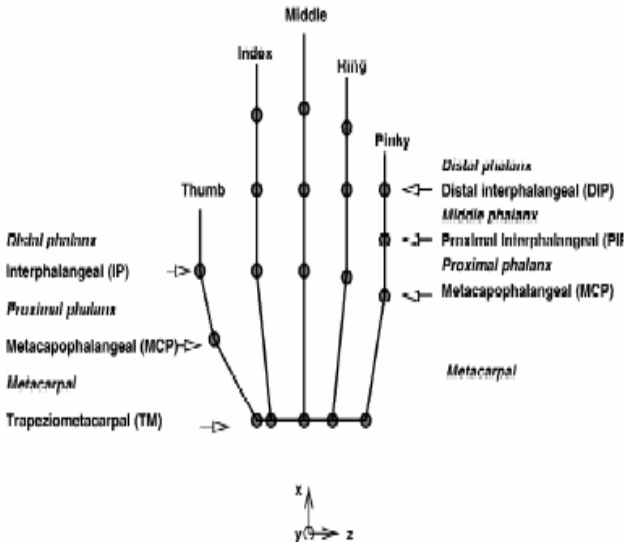
Carpals (wrist bones—eight), Metacarpals (palm bones—five), and Phalanges (finger bones—14)



Hand Models

Different hand models shown in above figure which are used to represent the same hand posture. 3D Textured volumetric model, 3D wireframe volumetric model, 3D skeletal model, Binary silhouette and Contour.

Appearance-Based Model



Model of the human hand

The hand models of 27 bones which approximates the anatomical structure using five serial link chains with 19 links as shown in above figure. The gestures are modeled by relating the appearance of any gesture to the appearance of the set of predefined, pattern gestures. Models are based on appearance of hands/arms in the visual images. This means that the model parameters are not directly resulting from the 3D spatial explanation of the hand. A large variety of models belong to this group. Some are based on deformable 2D templates of the human hands, arms, or even body.

4. Hand Motion GESTURE recognition

Hand gesture recognition mainly consists of three parts: skin color detection, signing motion detection, and hand gesture recognition. All above parts are explain in short here, & Out of that my project related with Hand gesture recognition.

4.1 Skin Color Detection

Skin color is a unique feature of human. The analysis on color distribution of skin color in color imaging allows the hand to be separated from the complicated background information; color space depends on the RGB models retrieved by CCD for the conversion, which can be illustrated by the formula stated below

$$H = \begin{cases} \theta, & if\ B \le G \\ 360 - \theta, & if\ B > G \end{cases}$$

$$S = 1 - \frac{3}{(R+G+B)}[\min(R,G,B)]$$

$$I = \frac{1}{3}(R+G+B)$$

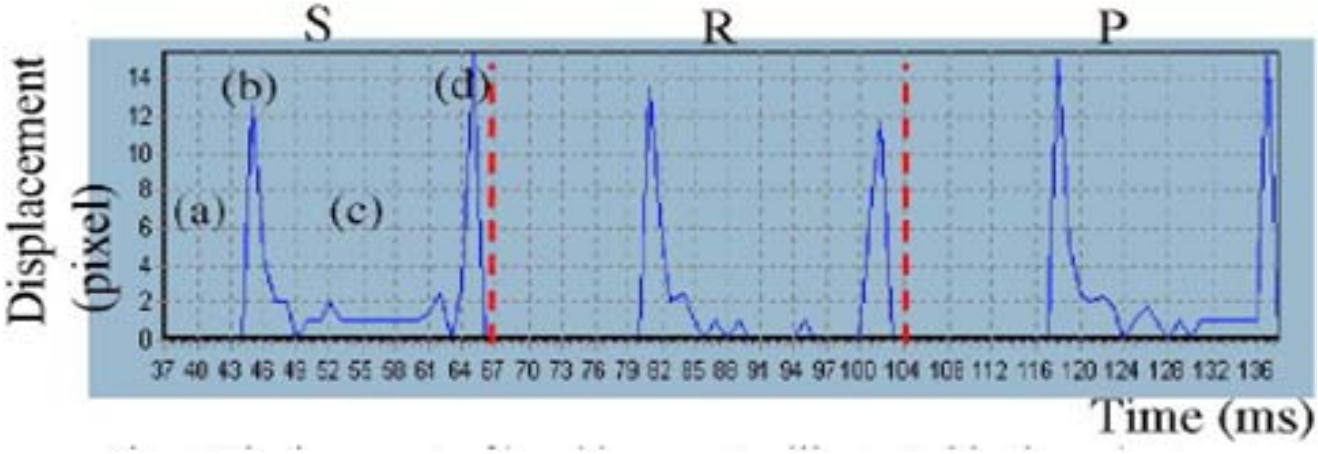
$$\text{where, } \theta = \cos^{-1}\left\{\frac{2R-G-B}{2\sqrt{(R-G)^2+(R-B)(G-B)}}\right\}.$$

4.2 Signing Motion Detection

The movements of finger guessing game start with a static fist clenching posture, with natural arm movement in the course of signing, while changing the hand posture for the

signing; when the posture performing is completed, the body movements pause temporally to allow both parties to observe and determine the meaning of each other's hand gesture and to determine the game result. The order of the signing can be obtained from the displacement of the barycenters, and then the correct timing for hand gesture recognition can be determined.

$$\Delta dist = \sqrt{\Delta x^2 + \Delta y^2} = \sqrt{(x_{t-1} - x_t)^2 + (y_{t-1} - y_t)^2}$$



Displacement of hand barycenter in time chart

4.3 Hand Gesture recognition

Hand gesture recognition uses the counting of n the number of fingers in the hand images to judge the type of hand gesture. For this the fingers have to be separated from the palm: first, the image is eroded in multiple times by the size of the hand. The palm mask is then deducted from the original palm image. The fingers, being the portions thin and lengthy in form, are the portions that get eroded, leaving the portion of the palm. The representation of the palm is then dilated & compensated, working as the masks for the division of palm as of the fingers.

(a) hand image after pre-treatment (b) palm-shaped mask (c) finger Images after separation

Finger counting uses component category, normally used in image division techniques, to identify fingers of various clusters.

5. Future Scope

Vision based hand gestures system can be used in many area where security is a concern, by combining with CCTV monitoring system generating alarms, sound alerts in cinema halls or multiplexes when any mishaps and urgency by using specific gestures and signals. This system can also be used in places where just body signals can work and producing sounds, alarms based on signals towards target audiences at remote distance.

6. Conclusion

Human-computer interaction is still in its infancy. Visual interpretation of hand gestures can allow the development of natural interfaces to computer controlled environments. In result to this potential, the number of different approaches to video-based hand gesture recognition has improve rapidly in now a days .so we need improvement for systematization and analysis of many things of gestural interaction. This result surveys the various approaches to modeling, analysis, and recognition of hand gestures for visual interpretation. The above research recognizes two classes of models employed in the visual interpretation of hand gestures. The first model relies on 3D models of the human hand, and second model make use of appearance of the human hand in the image.

So, current systems assigns hand gestures for the modification of objects, the complexity of the interpretation of gestures dictates the doable result. For example, the gestures used to take scheming actions today are usually of the forthcoming type. Further, hand gestures for HCI are mostly limited for single-handed and gives result only by a single user in the system. This consequently reduces the effectiveness of the interaction.

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