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Control of Electronic Appliances by Hand Gesture Recognition System

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Abstract: -
Hand gesture recognition recalls the concepts of human computer interaction (HCI). The modern day methodologies of HCI is being limited by number of peripheral devices like mouse, keyboard and other hardwares etc. Hand segmentation is the most important step of every hand gesture recognition system. Every step of the system depends upon the accuracy and the proper use of the hand segmentations. This paper deals with the concept of controlling the electronic appliances by the help of image processing and hand gesture recognition system. It also approaches with the development of the existing system with simplifying hardware concepts, increasing level of accuracy, with cheap budget. The proposed system here is far more advance to the existing system and it uses the HCI concepts, hand gesture recognition to control over the electronic appliances.

Keywords- hand gesture recognition; image processing; segmentation; human computer interaction

INTRODUCTION

With the impact of computers in society,
HCI (Human Computer Interaction) has grown as a important part of our daily lives. In recent years there has been a big growth of research towards human computer interaction. This is leading the advancement of technology and the HCI concepts. By simplifying the human effort by launching new kind if devices and their techniques. One great attempt in HCI has been to convert the natural means that humans employ to communicate with each other into HCI. With this motivation controlling of devices by image processing has been a topic of research for decades. Tremendous progress has been made in image processing, and several commercially successful image processing interfaces have been deployed. However, it has only been in last few years that there has been an increased interest in trying to introduce other human-to-human communication modalities into HCI. This includes a class of techniques based on the movement of the human arm and hand, or hand gestures. 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. To exploit the use of gestures in HCI it is necessary to provide the means by which they can be interpreted by computers. The HCI interpretation of gestures requires that dynamic and/or static configurations of the human hand, arm, and even other parts of the human body, be measurable by the machine. First attempts to solve this problem resulted in mechanical devices that directly measure hand and/or arm joint angles and spatial position. This can be best used to control the electronic appliances or other devices by the gestural interfaces. By connecting the so called controllable device to a computer and a webcam. Potentially, any awkwardness in using computer or any other devices can be overcome by using video-based *noncontact* interaction techniques. This approach suggests using a set of video

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cameras and computer vision techniques to interpret gestures. Many of those approaches have been chosen and implemented so that they focus on one particular aspect of gestures, such as, hand tracking, hand posture estimation, or hand pose classification. Until recently, most of the work on vision-based gestural HCI has been focused on the recognition of static hand gestures or postures. The hand gesture recognition utilizing image processing relies upon recognition through markers or hand extraction by colors, therefore it is heavily restricted by the colors of clothes or skin. Therefore we propose a new method to recognized hand gestures used to control electronic appliances and devices.

GESTURES

Gesture acts a medium of communication for non vocal communication in conjunction with or without verbal communication is intended to express meaningful commands. These gestures may be articulated with any of the body parts or with combination of one or many of them. Gestures being major constituent of human communication may serve as an important means for human computer interaction too. Though the significance and meaning associated with different gestures differ very much with cultures having less or invariable or universal meaning for single gesture. For instance different gestures are used for greeting at different geographical separations of the world. For example pointing an extended finger is a common gesture in USA & Europe but it is taken to be as a rude and offensive gesture in Asia. Hence the semantic interpretation of gestures depends strictly on given culture.

DIFFERENT TYPE OF GESTURES

Type	Meaning	Examples
Symbolic gesture	Gestures with single meaning	Sign language
Deictic gesture	Gestures direct the listeners attention in specific environment	Pointing gestures
Iconic gesture	Gestures represents meaningful objects or actions	Predefined gestures
Pantomimic gesture	Gestures that depict actions with or without speech.	Mimic gestures

HAND GESTURE RECOGNITION

Hand gesture plays an important part of human communication. Hand gesture has been the most common and natural way for human to interact and communicate with each other. Hand gesture provides expressive means of interactions among people that
involves hand postures and dynamic hand movements. A hand posture represents static finger configuration without hand movement, whereas dynamic hand movement consists of a hand gesture with or without finger motion. The ability to detect and recognize the human hand gesture posed many challenges to researchers throughout the decades. Hand gesture recognition studies have gained a lot of attentions for Human-Computer Interaction (HCI). Hand gestures are classified into two type‘s static and dynamic gestures. Static hand gestures are defined as orientation and position of hand in the space during an amount of time without any movement and if a movement is there in the aforementioned time duration it is called dynamic gesture. Dynamic hand gestures include gestures involving body parts like waving of hand while static hand gestures include single formation without movement like jamming the thumb and forefinger to form the ―ok symbol is a static pose which represents static gesture. Dynamic hand gestures done intentionally for communication are called conscious dynamic

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gestures, whereas unintentionally (unawareness) done gesture carried out during causal physical activity is known as unconscious dynamic gesture. 35% of human communication consists of verbal communication and 65 % is non verbal gesture based communication.

From above Figure, gestures can be divided into manipulative and communicative. Manipulative gestures are the ones used to act on objects in an environment (object movement, rotation, etc.). Communicative gestures, on the other hand, have an inherent communicational purpose.

GESTURE RECOGNITION

Selecting features is crucial to gesture recognition, since hand gestures are very rich in shape variation, motion and textures. For static hand posture recognition, although it is possible to recognize hand posture by extracting some geometric features such as fingertips, finger directions and hand contours, such features are not always available and reliable due to self-occlusion and lighting conditions. There are also many other non-geometric features such as color, Silhouette and textures, however, they are inadequate in recognition. Since it is not easy to specify features explicitly, the whole image or transformed image is taken as the input and features are selected implicitly and automatically by the recognizer.

CLASSIFICATION

Hand movements are thus a mean of non-verbal communication, ranging from simple actions (pointing at objects for example) to more complex ones (such as expressing feelings or communicating with others). In this sense, gestures are not only an ornament of spoken language, but are essential components of the language generation process itself. A gesture can be defined as a physical movement of the hands, arms, face and body with the intent to convey information or meaning. In particular, recognizing hand gestures for interaction can help in achieving the ease and naturalness desired for human computer interaction. Users generally use hand gestures for expression of their feelings and notifications of their thoughts.

Most of the complete hand interactive mechanisms that act as a building block for hand gesture recognition system are comprised of three fundamental phases: detection, tracking and recognition.

GESTURE RECOGNITION

DETECTION TRACKING RECOGNOITION

STATIC DYNAMIC

DETECTION

The primary step in hand gesture recognition systems is the detection of hands and the segmentation of the corresponding image regions. This segmentation is important because it isolates the task-relevant data from the image background, before passing them
to the subsequent tracking and recognition stages. Initially we set a database of number of images of our hand gestures, which is then coded with unique instructions that is being used to control the appliances and devices.

The above images are being coded with specific algorithms for running a specific task.

TRACKING

If the detection method is fast enough to operate at image acquisition frame rate, it can be used for tracking as well. However, tracking hands is notoriously difficult since they can move very fast and their appearance can change vastly within a few frames. Tracking can be defined as the frame-to-frame correspondence of the segmented hand regions or features towards understanding the observed hand movements. The importance of robust tracking is twofold. First, it provides the inter-frame linking of hand/finger. Appearances, giving rise to

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trajectories of features in time. These trajectories convey essential information regarding the gesture and might be used either in a raw form (e.g. in certain control applications like virtual drawing the tracked hand trajectory directly guides
the drawing operation) or after further analysis (e.g. recognition of a certain type of hand gesture). Second, in model-based methods.
Tracking also provides a way to maintain estimates of model parameters variables and features that are not directly observable at a certain moment in time.

RECOGNITION

The overall goal of hand gesture recognition is the interpretation of the semantics that the hand(s) location, posture, or gesture conveys. Hand gesture recognition techniques can be further classified under static and dynamic gestures. To detect static Gestures (i.e. postures), a general classifier or a template-matcher can be used. A dynamic hand gesture is then considered as a path between an initial state and a final state. The main limitation of the approaches based on automata is that the gesture model must be modified when a new gesture needs to be recognized. Moreover, the computational complexity of such approaches is generally huge Vision based hand gesture recognition for human computer interaction since it is proportional to the number of gestures to be recognized which is not the case for methods based on other techniques.

FLOW CHART TO CONTROL THE APPLIANCES:

CAPTURING IMAGES OF GESTURES
PROCESSING THE GESTURE INPUT
COMMAND SIGNAL GENERATION
PASSING SIGNAL TO THE APPLIANCES
OUTPUT FROM THE APPLIANCES

BLOCK DIAGRAM OF SYSTEM ARCHITECTURE

HAND GESTURE
WEB CAM CAPTURING IMAGE
CAPTURED IMAGE
PROCESSED IMAGE
HAND TRACKING
GENERARATING COMMANDS
APPLIANCE 1 APPLIANCE 2

The configured system follows the above block diagram. Initially the image is captured by a web cam and then the image is processed. After the processing of the image, the processed image is encoded with specific command for its application to run. The image signal is hand tracked and then commands are been generated by the help of the software architecture of the configured system and then the generated signals are been sent to the appliances for its operation.

SOFTWARE ARCHITECTURE

INPUT IMAGE

PRE- PROCESSING

FEATURE EXTRACTION

CLASSFIER

POSTURES HAND TRACKING
SYNTACTIC ANALYSIS

HAND MOTION FINGER
RECOGNITION RECOGNINITION

GESTURE RECOGNIZED

The above block diagram is been followed by the software part of the system configured. The software may be MATLAB, Xilinx or any other software but it has to follow the above steps. We take the input image and then it is been pre-processed in the matlab editor to get the required BW format of the image. And then the necessary

feature is been extracted and the commands are encoded to control the appliances. The classifier identifies the hand postures, segmentation and shadows etc , and classifies accordingly and finally the syntactic analysis is been followed for recognition of the hand motion or the finger tip motion and then finally after total recognition is been achieved the generated signal is been sent to the embedded part of the configured system . and then the rest work is been controlled by the embedded part.

CONCLUSION

HCI has lots of applications in day to day life and hand gesture recognition system is the important part of it. As from HCI,we got some ideas which we implemented on our project using
bothmatlab and embedded system.
With the help of properly analyzed system and software architecture,
This project gave a useful result to hand gesture in modern technical fields (example-defence,banksecurity,controlling household appliances and it can also be important support to challenging people). This paper has a lot more uses in real time applications and also hand gesture recognition techniques has a bright future and a lot more future aspects are yet to be achieved.

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