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A Real-Time Hand Gesture Recognition for Dynamic Applications

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Abstract—As a means for more visceral and efficient human computer interaction by a diversified range of application, virtual environment have always been considered. Analysis of complex scientific data, medical training, military simulation, phobia therapy and virtual prototyping included the spectrum of applications. Current user interaction approaches with keyboard, mouse and pen are not sufficient for the still widening spectrum of Human computer interaction, evolution of ubiquitous computing. Constraining and uncomfortable to use, Gloves and sensor based trackers are unwieldy. Due to the limitation of these devices the useable command set based diligences is also limited. For providing natural Human Computer Interaction which has its inheritance from text based interfaces through 2D graphical-based interfaces, multimedia-supported interfaces, to full- edged multi-participant Virtual Environment (VE) systems, direct use of hands as an input device is an innovative method. All without help of any input device, conceiving a future era of human-computer interaction with the implementations of 3D application where the user may be able to move and rotate objects simply by moving and rotating his hand. A low cost interface device for interacting with objects in virtual environment using hand gestures, the research effort centralizes on the efforts of implementing an application that employs computer vision algorithms and gesture recognition techniques which in turn results in developing.

Keywords— Gesture recognition, virtual, hand gesture, vision, image processing.

I. INTRODUCTION

Gesture recognition has gained a lot of importance since few years. Various applications can be controlled using gestures. Hand gestures are used in various applications like gaming, mouse control etc. In an application like robot control using hand gestures, the robot responds to hand gestures given by the human. This hand sign of humans is visually observed by robot through a camera. The algorithm that enables the robot to identify the hand gesture from the image is of interest. Each gesture corresponds to a particular command. The command that is identified will be used to control the robot to perform certain action or to execute a certain task. Different gestures will have different meaning associated with them. For example, count one could mean stop, two for move forward, three, four and five for turn right, turn left and reverse respectively. The hand gesture recognition system makes use of gloves, markers etc. Though the use of gestures increases the interactivity between man and machine, use of such gloves or markers increases the cost of the system. Some applications require the use of two cameras to obtain a 3D view of hand and from this hand gesture is recognized. Two types of hand gestures are used, static and dynamic. Static gestures make gestures by keeping the hand stable. For example, by using the finger without moving the hand, the system would perform the specified function.

Dynamic gestures are those that involve the movement of the hand. Like in media player that is controlled by hand gestures, moving the hand to the right side may indicate increasing the volume. For some application hand gesture recognition system may require to store images in the database. Execution of these applications may require the use of complex algorithm to compare images already stored in the database with that of images taken from the camera and then perform necessary tasks.

For such applications gestures should be known prior the use as they are already stored in the database.

Here in this approach of Hand Gesture Recognition System, control the devices using Distance Transform method which does not require storage of images in the database. The system uses both static and dynamic gestures for appliance control. In this system the images are captured through the webcam. It is segmented to recognize the hand region. A skin color detection algorithm is used for hand region detection. The binary image that is generated is given to the distance transform method that calculates the centroid of the hand and using this it calculates the number of active fingers or the motion of the hand. Accordingly the physical device is controlled.

II. SYSTEM ANALYSIS

System architecture consists of image acquisition, image processing, action mapping, motion recognition and finally controlling of various physical devices.

i. Image Pre-processing

Image Acquisition:

The user makes gestures by positioning hand parallel to webcam. Images are continuously captured and then given as input for further processing of gesture recognition.

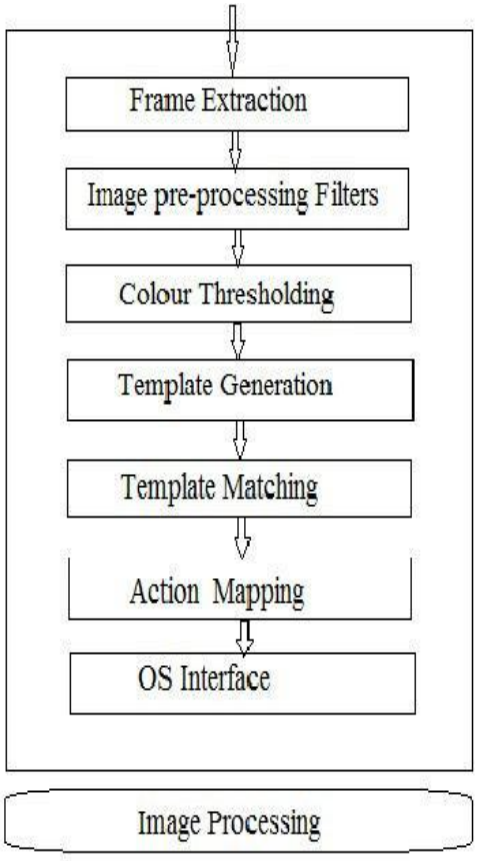

Figure1. System Architecture

Image Processing:

Image processing consists of mainly six steps and that are frame extraction, filtering, color thresholding, template generation, template matching and action mapping.

Frame Extraction:

The main motivation for extracting the content of information is the accessibility problem. It compare and calculate similarity of each video frame to consider whether there is a change in

scenery of not. The basic idea of color indexing in frame extraction is to compare similarity of two frames that is mainly RGB image to HSV image change. The change will be in terms of their shade and brightness. Therefore, frame extraction is a process which underlines two difficult tasks that is deciding what is relevant and extracting it.

Image pre-processing filters:

The primary goal of the pre-processing stage is to ensure the uniform input to classification network. Image pre-processing has been used for detection of hand which is applied in different fields. The first step involves the reading of gesture color image and conversion of input RGB image to HSV color space. This step is done because HSV model is more sensitive to changes in lighting condition. The resulting image is then filtered, smoothed and finally we obtain a gray scale image.

Color Thresholding:

Color thresholding is the simplest method of image segmentation. From a gray scale image, thresholding can be used to create binary images. The purpose of thresholding is to extract those pixels from some images which represent an object. The key value of this method is a threshold value. Using this threshold value gray scale image is converted into a binary image. The important step of this method is the selection of the threshold value. Several methods are used, including Otsu's method (maximum variance), k-means clustering and maximum entropy method.

Template generation:

After performing the above steps of image processing a template of image is to be generated. Then this template will be further used for template matching and ac-accordingly the required action will be taken for hand gesture recognition.

Template Matching:

Template Matching is a technique in image processing for finding small parts of an image which match a template image. It can be used as a way to detect edges in images. At region boundaries there is a sharp adjustment in intensity because of these edges and region boundaries are closely related. Edge detection techniques are used as the base of another segmentation technique. The edges that are identified by the edge detection method are often disconnected. Closed region boundaries are needed to segment an object from an image. Edges that are obtained from edge detector to which segmentation method can also be applied. After application of the edge filter to the image, pixels are then classified as edge or non-edge.

Action Mapping:

After pre-processing, a code will be generated which will be further sent to the IC (max 232 convertor). The input code to IC will be converted to binary code. IC would connect to CPU through serial port having 9600bps. The binary code will be input to the micro-controller. The binary code will be compared and the corresponding action will be executed.

Motion Recognition:

After image pre-processing the image is then given to the distance transform method which detects the motion of the hand. Therefore the pixel that is far from every boundary is chosen as centroid. Using this centroid active fingers are counted and if there is motion of hand, this is detected by motion of centroid from original position from a set of continuously captured images and the appliance is controlled that is either the device is on or off after recognizing gestures.

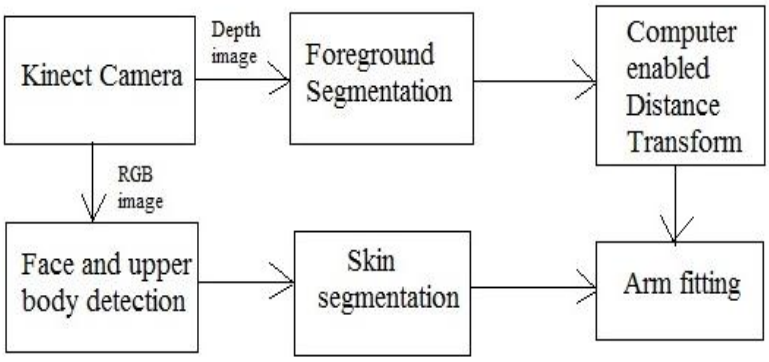

Figure2. Kinect Camera

ii. Kinect Camera

Haar Cascade Detection:
We use the Viola-Jones face and upper body detector to z the face and upper body positions of the subject. The detector is based on haar cascade classifiers. Each classifier uses rectangular haar features to classify the region of the image as a positive or negative match.

The Stick Skeleton Model:
We represent the human skeleton model by 7 body parts involving 8 points we use anthropometric data from the NASA Anthropometric Data Source Book to estimate the size of the body parts. We fix the head and neck points as the centroid and midpoint of the base line of the face detection rectangle.

Skin Segmentation:
We do skin color segmentation on the foreground segmented RGB image obtained from the Kinect to aid our arm fitting process. For skin segmentation, we project the input RGB image into HSV color space and the pixels values between two thresholds hsvmax and hsvmin are set to 255 while the rest are set to 0.

Arm Fitting:
In order to t the arms we make use of the Extended Distance Transform and the skin segmentation mask computed in the previous two steps. We initiate an angular search around the pivot point (shoulder point for elbow point estimation and elbow point for wrist point estimation) at a fixed sampling frequency and compute the summed EDT values along those lines

iii. Hardware connection

After pre-processing, a code will be generated which will be further sent to the IC (max 232 convertor).The input code to IC will be converted to binary code. IC would be connected to CPU through serial port having 9600bps.

The binary code will be input to the micro-controller. The binary code will be compared and the corresponding action will be executed as in table 1.

Direction	Code	RELAY (Device) ON/OFF
A	000	Device 1 ON
B	001	Device 2 ON
C	010	Device 3 ON
D	011	Device 4 ON
E	100	Device 1 OFF
F	101	Device 2 OFF
G	110	Device 3 OFF
H	111	Device 4 OFF

Table 1: Action Mapping

III. CONCLUSION

The proposed System uses Kinect to capture images effectively. Image pre-processing makes the system platform independent. Thus, the proposed system recognizes hand gesture in an effective manner.

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