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# Computer Control through Touchless System Using Vision Based Hand Gesture Recognition

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**Abstract:** ***Hand gesture recognition is a simplest and innovative way to connect with computer ,since interactions with the computer can be increased through multi dimensional use of hand gestures .hand gesture recognition is one of the active region of research in computer vision. When user doesn't have technical knowledge about the system then human computer interaction enable the user to use system without any problem. They still will be able to use the system with their normal hands. Gestures communicate the meaning of statement said by the human being. Hand gesture has been one of the most common and natural communication media among human being. Hand gesture recognition research has gained a lot of attentions because of its applications for interactive human-machine interface and virtual environments.***

**Keywords**: gesture recognition, vision based hand gesture recognition, human computer interaction.

## 1. Introduction

Natural Human Computer Interaction (HCI) is the demand of today's world the hand gesture is the most easy and natural way of communication. Real-time vision-based hand gesture recognition is considered to be more and more feasible for Human-Computer Interaction with the help of latest advances in the field of computer vision and pattern recognition the most easy and natural way of communication. Real-time vision-based hand gesture recognition is considered to be more and more feasible for Human-Computer Interaction with the help of latest advances in the field of computer vision and pattern recognition. Vision-based automatic hand gesture recognition has been a very active research topic in recent years with motivating applications such as human computer interaction (HCI), robot control, and sign language interpretation Recently, Computer is used by many people either for their work or in their spare-time. Since the computer technology continues to grow up, the importance of human computer interaction is enormously increasing. Special input and output devices have been designed over the years with the purpose of easing the communication between computers and humans, the two most known are the keyboard and mouse. Every new device can be seen as an attempt to make the computer more intelligent and making humans able to perform more complicated communication with the computer. Nowadays most of the mobile devices are using a touch screen technology. However, this technology is still not cheap enough to be used in desktop systems. Creating a virtual human computer interaction device such as mouse or keyboard using a webcam and the computer vision techniques can be an alternative way for the touch screen.

## 2. Problem Statement

- Earlier developing a advance human interaction system uses computer vision.
- Where,
  a) System will look for human behavior
  b) Process the action and convert to input
  c) Last perform a user defined action

In this, we are developing human interaction with machine so that we are giving input to the processor then it process the action and we are waiting for output and then last perfom a user defined action .It require time to process the action.

## 3. Related Work

Gestures are the non-verbally exchanged information where visible bodily actions communicate particular messages. A person can perform innumerable gestures at a time. Gestures allow individuals to communicate a variety of feelings and thoughts, from contempt and hostility to approval and affection, often together with body language in addition to words when they speak i.e. gesture acts a medium of communication for non-vocal communication in conjunction with or without verbal communication is intended to express meaningful commands. Psychological aspects of gestures based on hand are also an important aspect of hand gesture recognition systems. Since human gestures being major constituent of human communication and are perceived through vision, it is a subject of great interest for computer vision researchers which serves as an important means for human computer interaction. It is hard to settle on a specific useful definition of gestures due to its wide variety of applications and a statement can only specify a particular domain of gestures. 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 . Many researchers had tried to define gestures but their actual meaning is still arbitrary. Bobick and Wilson have defined gestures as the motion of the body that is intended to communicate with other agents. For a successful communication, a sender and a receiver must have the same set of information for a particular gesture. A gesture is scientifically are categorized into two different categories: static and dynamic. Moreover, as specified earlier gestures are often language and culture specific. They can broadly be of the following types

1) Hand and arm gestures: Recognition of hand poses, sign languages, and entertainment applications (allowing children to play and interact in virtual environments);
2) Head and face gestures: Some examples are: a) nodding or shaking of head; b) direction of eye gaze; c) raising the eyebrows; d) opening the mouth to speak; e) winking, f) flaring the nostrils; and g) looks of surprise, happiness, disgust, fear, anger, sadness, contempt, etc.;
3) Body gestures: Involvement of full body motion, as in: a) tracking movements of two people interacting outdoors b) analyzing movements of a dancer for generating matching music and graphics and c) recognizing human gaits for medical rehabilitation and athletic training.

## 4. Proposed Approach

In vision based hand gesture recognition system, a video camera used to record hand movements, and the input video is partitioned into frames, for each frame, a set of features are extracted. After some preprocessing operations, the hand object is localized and segmented and the necessary features are extracted and stored in the computer as a trained set. Then each input image pass through the previous steps to extract its features, and classification algorithms are applied by comparing the extracted features from input image with the training set, to interpret the gesture meaning according to a specific application . Figure shows a block diagram of hand gesture recognition system.

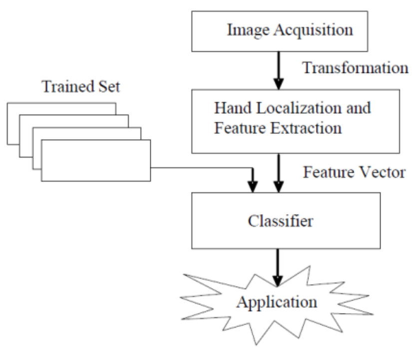


**Figure:** Block diagram of gesture recognition process

## 5. Vision Based Hand Gesture Recognition Techniques

Vision based analysis, is based on the way human beings perceive information about their surroundings. The complete hand interactive mechanisms that act as a building block for vision based hand gesture recognition system are comprised of three fundamental phases:

**1) 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 crucial because it isolates the task-relevant data from the image background, before passing them to the subsequent tracking and recognition stages. A large number of methods have been proposed that utilize a several types of visual features and, in many cases, their combination. Such features are skin color, shape, motion and anatomical models of hands.

**2) 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 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)

**3) Recognition**

The overall goal of hand gesture recognition is the interpretation of the semantics that the hand(s) location, posture, or gesture conveys. The recognition of gesture involves several concepts such as pattern recognition, motion detection and analysis and machine learning. Some of the different tools and techniques are utilized in gesture recognition systems, such as computer vision, image processing, pattern recognition, statistical modelling.

## 6. System Architecture

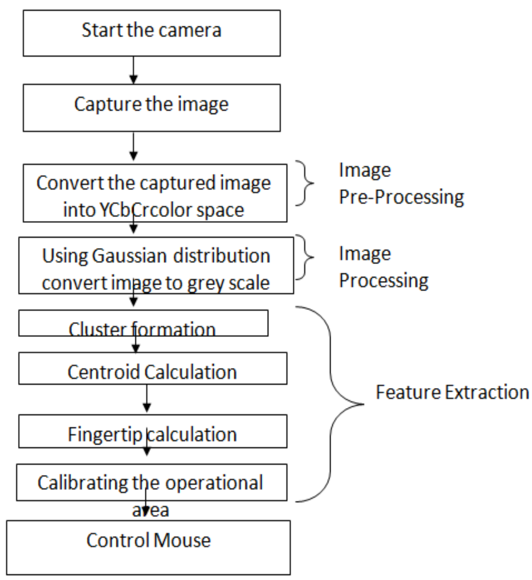


**Figure:** System Architecture

The USB web camera used is INTeX IT-305WC which is mounted on the system facing towards the user in order to capture the hand movements which are made by the user. The web camera can be connected to any of the USB port which is available free. The video captures the frames up to 30 fps and supports up to 16 mega pixels

**Image Capture:**
To access any of the cameras we need camera driver to be installed as it handle the camera working. After installing the camera drivers the camera is now ready to work. The image is being captured using the web camera as the web camera is pointing towards the user‘s action.

In this stage the processing on the image is carried out where the input to this stage is a pre-processed image which is converted to YCbCrcolor space from the RGB color space. After the image is converted to YCbCr the obtained image is transformed to gray scale image using Gaussian distribution. It is done as follows.
Mean calculation m=E { x}
Value of x=(cb,cr)^T
Calculating the covariance matrix=E{(x-m)(x-m)^T}
P(cb,cr)=exp{ -0.5(x-m)^TC^-1(x-m)}
Where m is the mean of x, C is the covariance of matrix.

## 7. Feature Extraction

In this phase the different features such as skin pixel clustering, centroid formation tip detection are extracted. To extract the features it is necessary to locate the hand. For localization of hand we find boundary contours of the hand in the image. The scanning of the obtained image is started from left to right. The first white pixel which is encounter is treated as the left side of the hand. Then we start the scanning of image from right to left. The first white pixel from this side again which is encounter is set as the right side of the hand. Now we perform scanning in horizontal direction within the vertical boundaries which are defined earlier from left to right and top to bottom. The first encounter white pixel is set as top of the hand. As the hand extends from the bottommost part of the image, there is no cropping required for locating the end of the hand.

Centroid is calculated via image moment, which is the weighted average of pixel‘s intensities of the image. The centroid can be calculated by first calculating the image moment using this formula. Mij=ΣΣ xiyjI(x,y)
whereMij is image moment, I(x, y) is the intensity at coordinate (x, y).
{ x̄, ȳ }= {M10/M00,M01/M00 }
Wherex,y are the coordinate of centroid and M00is the area for binary image

After the centroid calculation the peaks which are used to represent the tip of the fingers are to be detected. We trace the entire boundary matrices of hand object segmented in previous step. We process vertical hand image and horizontal hand image differently for finger region detection. In vertical image, we only consider the y coordinates of the boundary matrices. When we get the values of y-boundaries starts increasing after the decrement in the y-boundaries values. We fix it as a peak value or a peak. In horizontal image, we consider the x coordinate of the boundary matrices. This time only the x coordinates of the boundary matrices is considered. When we get the x-boundaries starts decreasing after the increment we mark this point as a peak value. After marking the detected peaks we must find out the highest peak in the hand image. Euclidean distance is used to calculate the distance between all the tip of the fingers (peaks detected) and centroid. The formula for calculating Euclidean distance is
E,D(a,b)=sqrt(xa-xb)^2+(ya-yb)^2

where‘a‘ represents all the boundary points and ‘b‘ is the reference point which is centroid itself. Euclidean distance is calculated in order to map the circle. Thus all the required features are extracted as shown in fig:

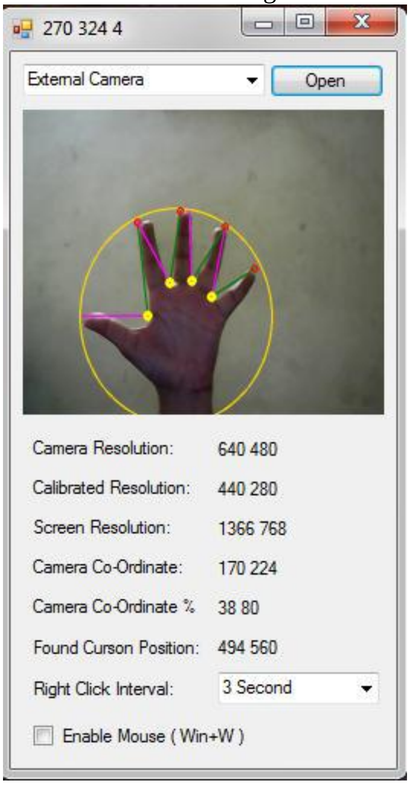


**Figure:** Extracted Features

**PROCESS:**

Step1: Assuming a Web Camera Resolution
Step 2: Give the margin to get more prominent workable capture area.
Step 3: Calculate Cab x & Cab y for the calibrated area as follows:
Cab x=Cab x-Left Margin;
Cab y= Cab y-Top Margin;
[Subtracting the margin the calibration captured resolution is obtain which will be the calibration area of the camera]
Step 4: Finding the percentage of Calibrated co- ordinates in calibrated area as follows
Step 5: To find display screen co-ordinates % Cab x and % Cab y are used as follows
Step 6: The X & Y co-ordinate of Display screen is achieved in term of Mx and My. These co-ordinates are the actual position of cursor on the projected screen.
Step 7: Utilized these Mx&My as per the application.

Where,
Captured X =X co-ordinates of web camera resolution.
Captured Y= Y co-ordinates of web camera resolution.
Cab x =X co-ordinates of Calibrated operational area.
Cab y = Y co-ordinates of Calibrated operational area

## 8. Results

In this, we have discussed in detail the experimental results of the proposed approach. This section shows the comparative analysis of proposed approach with the already existing approach. For experimental results we have taken reading for detecting skin pixel values under different illumination conditions and from the result it was observed that luminance has great impact in skin detection technique

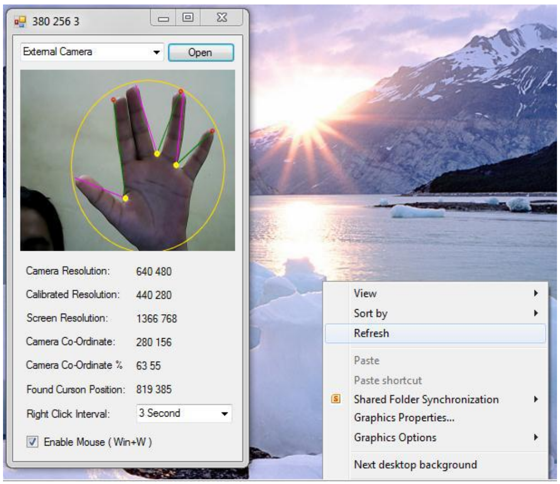


**Figure:** showing right click event

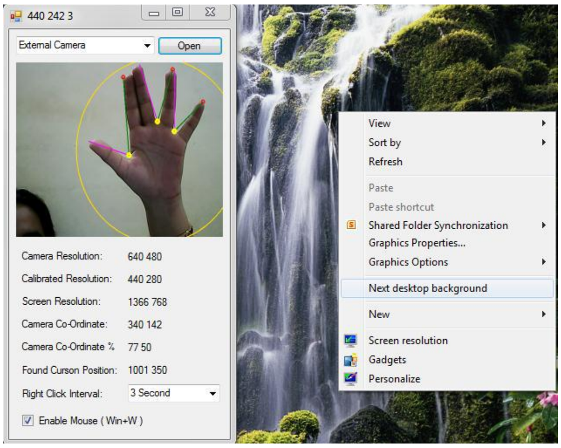


**Figure:** Showing left click event

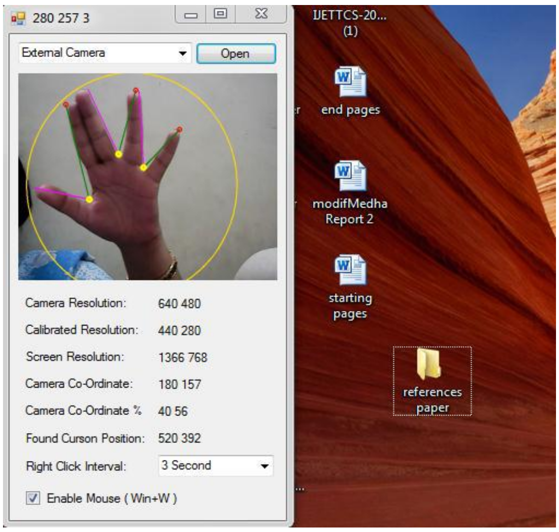


**Figure:** Folder named "reference paper" moved at other place

## 9. Conclusion and Future Work

A new technique has been proposed to control the mouse cursor and implement its function using a real time camera. The goal of this project is to create a system that will recognize the hand gestures and control the computer/laptop according to those gestures. This system is based on computer vision algorithms and can do all mouse tasks such as left and right clicking, double clicking and starting the applications using the gestures like notepad, paint, word etc. A new HCI vision-based interface is designed, which is sufficiently robust to replace a computer mouse and extend the interaction capabilities. This system realizes the function of the mouse gestures very well and controls the mouse cursor movement and click events of the mouse using hand gestures effectively. A virtual human computer interaction device is developed in a cost effective manner. More features such as the zoom-in and zoom out can also be implemented to make the system more efficient and reliable. This system can also be further implemented in the mobile where using pointing devices like mouse is difficult

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