

Web Camera Color Detection for Interactive Real-Time System Control

Nour Alhassan^{*1}, Fatima Zahra² & Yasmine Belkacem³

^{*1}Assistant Professor, Department of Computer Science, King Saud University, Riyadh, Saudi Arabia

²Ph.D. Scholar, Department of Computer Science, King Saud University, Riyadh, Saudi Arabia

³Associate Professor, Department of Computer Science, King Saud University, Riyadh, Saudi Arabia

ABSTRACT

Many modules have been developed to help the physical world interact with the digital world. Here we present a novel approach for Human Computer Interaction (HCI) where, we control cursor movement using a real-time camera and color pointers. Our method is to use a camera and computer vision technology, such as image segmentation, background subtraction and color tracking, to control mouse tasks (left clicking, right clicking, double-clicking and scrolling actions) and we show how it can perform everything as current mouse devices can. A color pointer has been used for the object recognition and tracking, so as to implement the module without any physical contact with the system. Click events of the mouse have been achieved by detecting the number of pointers on the images. The application has been created on MATLAB environment with operating system as windows 7. This method mainly focuses on the use of a Web Camera to develop a virtual human computer interaction device in a cost effective manner.

KEYWORDS: Human Computer Interaction, Background Subtraction, Color Detection, Web Camera, Computer Vision.

I. INTRODUCTION

Overview

The importance of computers has increased to a great extent these days. Then it can be used for general purpose or at work places. Even there is a demand of more and more application based devices, where the latest example can be of smart phones. Traditionally, we use hardware devices i.e. the mouse and keyboard to interact with the system. But due to the growth of technology and demand of virtualization, this technique has been proposed. An alternative way for touch screen can be creation of a virtual human computer interactive device.

The various HCI Interfaces that are being used since earlier times having some demerits. They block the improvement of computer dependent devices or systems. It is now a general tendency to lessen human efforts and overcome the usual, traditionally being used computer dependent devices. Considering an example of a keyboard, it is not possible to reduce the entire keyboard in a very small size so that it can accommodate the fingers. Thus it becomes somewhat difficulty while working where accuracy is needed.

Gesture is defined as an expressive, meaningful body motion that expresses an idea, opinion, emotion, etc. Human interaction with a computer in which human gestures, usually hand motions, are recognized by the computer. Gesture recognition is used to interact with computers, such as interpreting sign language. The hand gesture recognition technique can be classified into two types: 3D-hand model approach and the appearance based approach. A static gesture is observed at the sudden burst of time whereas a dynamic gesture is intended to change over a period of time. A waving hand means goodbye is an example of dynamic gesture and the stop sign is an example of static gesture. To understand a full message, it is necessary to interpret all the static and dynamic gestures over a period of time. This complex process is called gesture recognition.

In this review, a shading pointer has been utilized for the question acknowledgment and following. Left and the correct snap occasions of the mouse have been accomplished by recognizing the quantity of pointers on the picture

Objective

The great challenge lies in developing an economically feasible and hardware independent system so that humans can interact without having any physical connection with the computer.

The main objective is to develop an object tracking application to interact with the computer, and a virtual human computer interaction device, where in no physical contact with the device is required and also to provide an easier human-machine interaction routine.

Purpose

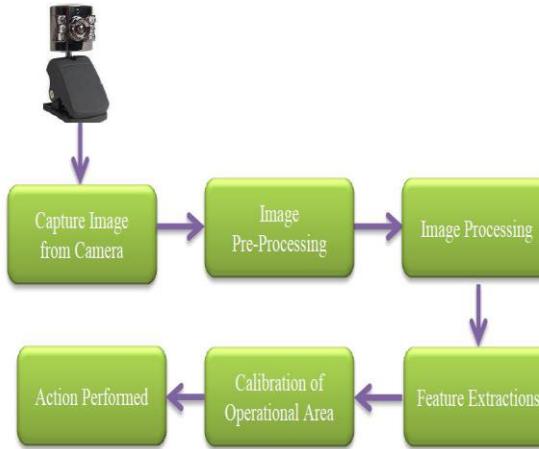
The purpose of the project is to create a virtual mouse that works with the help of a web camera. In this project a camera continuously takes images of hand movements of a user, which is then mapped into mouse inputs. This means that we can give inputs to computer without having any physical connection with the computer and without having any hardware movements.

Problem Definition

To develop a software solution to a problem, the first step is to understand the problem. The problem here is to develop a way so that humans can interact with a computer without having any physical connection with the computer. Many ideas were put forward but they all required physical movement of hardware. Another idea put forward was to use the principle of photoelectric effect. But for that a special hardware is needed and it is not economically feasible. So the final decision is to develop a virtual mouse which uses simple and cheap image processing techniques.

II. PROPOSED WORK

The proposed system is a real time video processing that is based on a real time application system. This can replace one of the traditionally used input device i.e. mouse so that simply by using the hand gestures the user will be able to interact naturally with their computer. The basic block diagram of the overall proposed system is as shown below in the figure.



Basic block diagram As soon as the palm is detected by the camera, it starts capturing the images and takes out the current images and starts processing. The processed image is given as input to the next phase of processing where it starts detecting the palm following the centers and edges. These all extracted features are used for the further processing such as detecting hand gestures and working according to it. The flowchart of the proposed system above is shown for the single frame which is captured. The system is a real time system so the flowchart is a continuous process for each and every frame that is captured by the web camera.

In the protest following application one of the principle issues is question identification. Rather than fingertips, a shading pointer has been utilized to make the question recognition simple and quick. A circle blue sticker is utilized as a shading pointer in this review. To mimic the snap occasions of the mouse three fingers with three shading pointers has been utilized.

The basic block diagram of the system

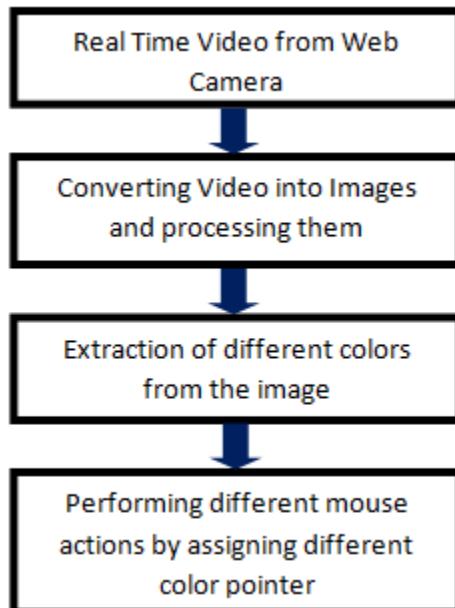


Figure- 1 The Basic Block Diagram

System Approach

- Capturing real time video using Web-Camera.
- Processing the individual image frame.
- Flipping of each image frame.
- Conversion of each frame to a grey scale image.
- Color detection and extraction of the different colors (RGB) from flipped gray scale image.
- Conversion of the detected image into a binary image.
- Finding the region of the image and calculating its centroid.
- Tracking the mouse pointer using the coordinates obtained from the centroid.
- Simulating the left click and the right click events of the mouse by assigning different color pointers.

III. RESEARCH METHODOLOGY

Capturing the real time video

For the framework to work we require a sensor to distinguish the hand developments of the client. The webcam of the PC is utilized as a sensor. The webcam catches the constant video at a settled casing rate and determination which is controlled by the equipment of the camera. The casing rate and determination can be changed in the framework if required. Computer Webcam is utilized to catch the Real Time Video

Video is partitioned into Image outlines in light of the FPS (Frames every second) of the camera

Processing of individual Frames



Figure-2 Capturing the video

Flipping of Images

At the point when the camera catches a picture, it is upset. This implies on the off chance that we move the shading pointer towards the left, the picture of the pointer moves towards the privilege and the other way around. It's like a picture acquired when we remain before a mirror (Left is distinguished as right and right is recognized as cleared out). To maintain a strategic distance from this issue we have to vertically flip the picture. The picture caught is a RGB picture and flipping activities can't be straightforwardly performed on it. So the individual shading channels of the picture are isolated and afterward they are flipped independently. In the wake of flipping the red, blue and green hued channels separately, they are connected and a flipped RGB picture is gotten.

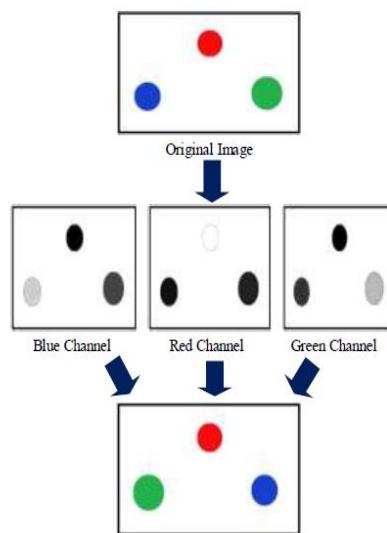


Figure-3 Flipping of an Image

The following images show the entire flipping process in real time.

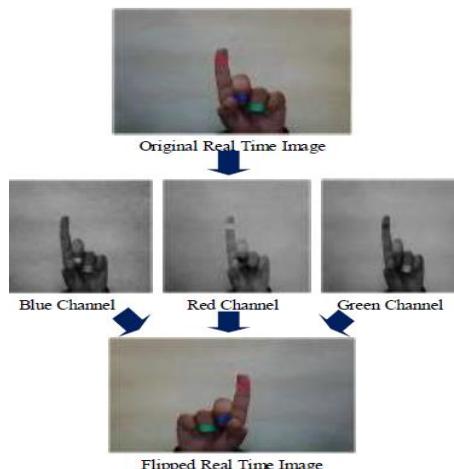


Figure-4 Flipping of a Real time Image

Conversion of Flipped Image into Gray scale Image

When contrasted with a shaded picture, computational many-sided quality is diminished in a dim scale picture. In this way the flipped picture is changed over into a dim scale picture. All the fundamental operations were performed in the wake of changing over the picture into dark scale.

Colour Detection

This is the most critical stride in the entire procedure. The red, green and blue shading article is recognized by subtracting the flipped shading smothered channel from the flipped Gray-Scale Image. This makes a picture which contains the recognized protest as a fix of dim encompassed by dark space.

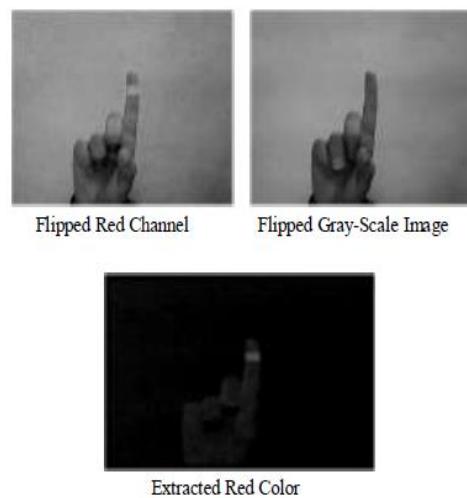


Figure-5 Detection of Red Color

Performing Clicking Actions

The control activities of the mouse are performed by controlling the banners related with the mouse catches. JAVA is utilized to get to these banners. The client needs to perform hand motions keeping in mind the end goal to make the control activities. Because of the utilization of shading pointers, the calculation time required is lessened. Besides the framework ends up noticeably impervious to foundation clamor and low light conditions. The discovery of green and blue hues takes after a similar strategy examined previously. Clicking activity depends on concurrent recognition of two hues.

If Red alongside Green shading is recognized, Left clicking activity is performed

If Red alongside Blue shading is identified, Right clicking activity is performed

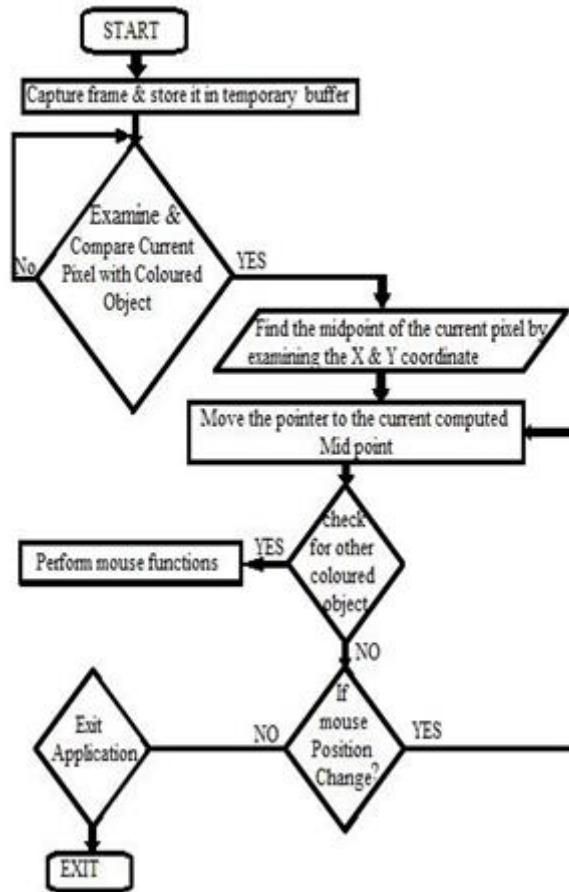


Figure-6 flowchart

Color Detection

To recognize the blue shade of the pointer, MATLAB's implicit "imsubtract" work has been utilized. Imsubtract capacity can be utilized as;

$Z = \text{imsubtract}(X, Y)$

Where; it subtracts every component in cluster Y from the relating component in exhibit X and returns the distinction in the comparing component of the yield cluster Z. X and Y are genuine, non-inadequate numeric varieties of a similar size and class, or Y is a twofold scalar. The cluster returned, Z, has an indistinguishable size and class from X unless X is coherent, in which case Z is twofold. Be that as it may, this approach is for all intents and purposes hard to apply particularly in Live video because of the surrounding light. There is one more arrangement where one can recognize a specific shading say red, blue or green. In spite of the fact that this is not adaptable for all hues, but rather it effortlessly wipes out the issue of surrounding light. Here, we will utilize a similar approach so as to recognize red shading.



Fig :7 Color Detection

IV. EXPERIMENTAL RESULTS

The necessary steps to be followed are as follows:

- Firstly, we need to interface the camera using MATLAB.
- Start the camera to capture the images continuously.
- Capturing the real time video using the started up camera.
- Processing the individual image frame obtained from the video.
- Flipping of each image frame.
- Conversion of each frame to a GRAY-SCALE image.
- Color detection and extraction of different colors.
- Conversion of each frame into BINARY-SCALE image.
- Find the center and draw the bounding box.
- Track mouse pointer using coordinates of centroid.

Different mouse actions are performed based on the steps below.

- First, we need to detect red color in the image.
- If Red color pointer is detected, we need to track the mouse pointer.
- If a single Blue color pointer is detected, we need to perform Left click.
- If two Blue pointers are detected, we need to perform Right clicking action.
- If three Blue pointers are detected, we need to perform Double clicking action.
- If none of the color has been detected again we need to try tracking different colors from the image.

V. CONCLUSION

The proposed system is used to control the mouse cursor and implement its function using a real-time camera. We implemented mouse movement, selection of the icons and its functions like right, left, double click and scrolling. This system is based on image comparison and motion detection technology to do mouse pointer movements and selection of icon. From the results, we can expect that if the algorithms can work in all environments then our system will work more efficiently. This system could be useful in presentations and to reduce work space. In the future, we plan to add more features such as enlarging and shrinking windows, closing window, etc. by using the palm and multiple fingers.

VI. FUTURE WORK

There are as yet numerous changes that can be made to our framework like enhancing the execution of the present framework and including components, for example, broadening and contracting windows, shutting window, and so forth by utilizing the palm and different fingers. The present framework is variation to reflection and scale changes and requires legitimate hand signals, great enlightenment innovation and intense camera for the execution of mouse capacities. Accuracy can simply be expanded at the cost of review by including more stages, however each progressive stage sets aside twice as much opportunity to discover harder negative examples and the applications which advantage from this innovation. We introduce a picture seeing application for instance of where this innovation could prompt a more characteristic UI. The same could be said for exploring something like Google Maps or perusing envelopes on a screen. In any case, the applications reach a long ways past that. They are especially convincing in circumstances where touch screens are not relevant or not as much as perfect. For instance, with projection frameworks, there is no screen to touch. Here vision-based innovation would give a perfect substitution to touch screen innovation. Likewise out in the open terminals, consistent utilize brings about the spread of soil and germs. Vision-based frameworks would evacuate the need to touch such setups, and would bring about enhanced connection.

VII. REFERENCES

- [1] **A. Erdem, E. Yardimci, Y. Atalay, V. Cetin, A. E.** “Computer vision based mouse”, Acoustics, Speech, and Signal Processing, Proceedings. (ICASS). *IEEE International Conference*, 2012
- [2] **Hojoon Park**, “A Method for Controlling the Mouse Movement using a Real Time Camera”, *Brown University*, Providence, RI, USA, Department of computer science, 2013
- [3] **Chu-Feng Lien**, “Portable Vision-Based HCI – A Realtime Hand Mouse System on Handheld Devices”, *National Taiwan University*, Computer Science and Information Engineering Department
- [4] **Kamran Niyazi, Vikram Kumar, Swapnil Mahe, Swapnil Vyawahare**, “Mouse Simulation Using Two Coloured Tapes”, Department of Computer Science, University of Pune, India, *International Journal of Information Sciences and Techniques (IJIST) Vol.2, No.2*, March 2012
- [5] **K N. Shah, K R. Rathod and S. J. Agrawat**, “A survey on Human Computer Interaction Mechanism Using Finger Tracking” *International Journal of Computer Trends and Technology*, 7(3), 2014, 174-177
- [6] **Rafael C. Gonzalez and Richard E. Woods**, *Digital Image Processing*, 2nd edition, Prentice Hall, Upper Saddle River, New Jersey, 07458
- [7] **Shahzad Malik**, “Real-time Hand Tracking and Finger Tracking for Interaction”, CSC2503F Project Report, December 18, 2013
- [8] **A. Erdem, E. Yardimci, Y. Atalay, V. Cetin, A. E.** “Computer vision based mouse”, Acoustics, Speech, and Signal Processing, 2012. Proceedings. (ICASS). IEEE International Conference
- [9] **Hojoon Park**. A Method for Controlling Mouse Movement using a Real-Time Camera. www.cs.brown.edu/research/pubs/theses/masters/2010/park.pdf2010.
- [10] Computer vision based mouse, **A. Erdem, E. Yardimci, Y. Atalay, V. Cetin, A. E.** *Acoustics, Speech, and Signal Processing*, 2002. Proceedings. (ICASS). IEEE International Conference.
- [11] Chu-Feng Lien, “Portable Vision-Based HCI – A Real-time Hand Mouse System on Handheld Devices”, National Taiwan University, Computer Science and Information Engineering Department
- [12] **Chu-Feng Lien, Portable Vision-Based HCI** - A Real-time Hand Mouse System on Handheld Devices.
- [13] **Hojoon Park**, “A Method For Controlling The MouseMovement using a Real Time Camera”, 2008, Brown University, Providence ,RI ,USA, Department of computer science
- [14] **Chris Solomon and Toby Breckon**, “Fundamentals Of Digital Image Processing”, Third edition, John Wiley & Sons, Ltd,2011.