Virtual System Using Hand Gestures

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Abstract- *In the digital information time, daily life is inseparable with human-computer interface (HCI). Human computer interaction has a long history to become more intuitive. For human being, hand gesture of different kind is one of the most intuitive and common communication. However, vision-based hand gesture recognition is still a challenging problem. In this paper, an embedded virtual mouse system by using hand gesture recognition is proposed. There are several techniques involved in the proposed system. Skin detection and motion detection method are used to capture the region-of-interest and distinguish the foreground/background area. Connected component labelling algorithm is used to identify the centroid of an object. The removal on arm and the convex hull algorithm are used to recognize hand area as well as the related gesture. The result shows that our system can operate well even in some harsh environment.*

Keywords- Matlab, arduinouno, voice recognition, color detection

I. INTRODUCTION

Problem Definition:The apparition on market of the low-cost webcams with, at least, satisfactory qualities open up new directions regarding the implementation of human computer interaction (HCI) interfaces. The evolution of the User Interface (UI) witnessed the development from text-based UI based on Keyboard to graphical UI based on mice. In current virtual environments applications, Keyboards, mice, and joysticks are still the most popular and dominant devices. However, they are inconvenient and unnatural. With the development of ubiquitous computing, current user interaction approaches with keyboard, mouse and pen are not sufficient. Due to the limitation of these devices the useable command set is also limited. Direct use of hands can be used as an input device for providing natural interaction. Research in Human Computer Interaction (HCI) primarily deals with the design, implementation, and assessment of new interfaces for improving the interaction between humans and machines so that it become natural without the use of any mechanical devices. The next few recently studies may be enough to encourage the research projects in the field of HCI. A natural user interface based on hand detection and tracking using a webcam was implemented. Because of the low-quality camera their purpose was quite complex, so that their algorithms become quite complex, combining a number of different techniques and algorithms such as: skin detector based on histograms, background subtraction and a clustering algorithm, an open hand detector and a modified particle algorithm. A method for two hands gesture detection using a Kinect sensor is also proposed. This similar concept was used in development of the X-boxes.

In this paper, HCI interface for mouse cursor control and keyboard control is to be developed. The purpose of the implemented solution is to control the mouse cursor or keyboard operations by user hand gestures captured through a webcam. For improving the gesture recognition based on the fluctuation of illuminance levels the finger strips color detection was used. The results reveal the good behaviour of the system in low and soft light condition.

Scope & Importance: The aim of the implemented system is to control the windows mouse cursor and specific keyboard operations using the human hand gestures. The system is composed by: (1) computer/ laptop; (2) webcam. The software application, which runs on the computer, takes an image (a captured frame/image) of the hand area through the webcam and process it regarding the tracking of the user hand and recognition of the hand gesture. The recognized hand gesture is converted in a movement event as: open and close window. A hand gesture is considered as recognized if the hand gesture is detected correctly based on certain corresponding colored strip/strips features. The practical tests reveal the robustness and the effectiveness of the method. This paper can be used and applied over many more devices such as televisions, LED monitors, etc. The device could be operated without any touch.

The purpose of the implemented solution is to develop a user interface which will read the gestures of a human hand through images/snapshots acquired from the video sequence by the webcam and control the windows operations of certain applications accordingly.

Finally, the aim of the paper was reached, and the movement control was achieved using an webcam, a software

that could interpret some hand gestures (based on different colors) and then turned the recognized gestures into operating system commands that controlled the keyboard actions on the computer display screen.

This application has an advantage in using color detection for gesture interpretation, because it can be used in low or high intensity light, and in the same time, it opens a window for further applications that intend to control any device using hand gestures or body movements. This system specifically proposed a real time vision system for hand gesture-based computer interaction to control an event like navigation of window opening and closing.

Overview: This particular section of this document gives an overview of the functionality of the product. It describes informal requirements and is used to establish a context for the technical requirements specification in the later chapter. It describes the overall design and development of the entire project in brief.

Hand Gesture Recognition Using a Camera is based on the concept of Image processing. This paper focuses on reducing cost and improving robustness of the proposed system using simple web camera. In this paper, we have a user interface designed using the GUIDE tool inbuilt in MATLAB. The web camera made use of is the internal web cam. The user interface has options to preview the video sequence so as to position the hand in a right way in front of the web camera. It also has an option to put off the preview. The video sequence is displayed in axes 1 of the user interface. It also has options for calibration and to add gestures to a database that is inbuilt in MATLAB. The images are stored in the database with mat extension. The system lets us add 10 similar gestures at a time. The gestures are obtained from the snapshots acquired from the video sequence. We have a start button to start testing the gestures acquired from snapshots of the real time video sequence. Similarly, we have a stop button to stop testing of the gestures and also the video sequence. The user interface has push button for preview, add gestures, hand gestures, start and stop buttons.

Meanwhile, the images/snapshots acquired from the video sequence before getting stored in the database undergo pre-processing where in, the hand gesture is extracted from the snapshot/image based on certain skin color criteria and light conditions. The extracted image of the hand gesture is further segmented where in, the hand gesture is separated from its background and the RGB image is further converted to HSV and YCBCR and its corresponding values are extracted. Later, the RGB image is then converted to greyscale. This greyscale image of the segmented hand is displayed in axes 2 of the user interface. Once segmentation is done, certain features are extracted from the human hand using certain appropriate feature extraction algorithms. The algorithms used for feature extraction are GLCM (Grey-Level Co-Occurrence Matrix) and Euclidean distance. The skin-tone based hand gesture segmented from its background is displayed in axes 3 of the user interface. Using a support vector classifier, we match the gestures acquired real time and the ones stored in the database. If the gestures are detected, recognised and matched properly, then, the class to which that particular gesture belongs to is displayed in a textbox given in the user interface. On finding a perfect match, the operation assigned to that particular gesture is performed. Otherwise, no operation is performed. The gestures used and the operations assigned to each of them are as follows.

(a) One finger open – stop window.
(b) Five fingers open – open window.
(c)Two fingers open-close window.

We have code for arduinouno which uses command-based input to open, close, on and off LED.

And we have developed android app for command-based inputs and an android app for voice-based command.

II. LITERATURE SURVEY

The evolution of the User Interface (UI) witnessed the development from text-based UI based on Keyboard to graphical UI based on mice. In current virtual environments applications, Keyboards, mice, and joysticks are still the most popular and dominant devices. However, they are inconvenient and unnatural. Research in Human Computer Interaction (HCI) primarily deals with the design, implementation, and assessment of new interfaces for improving the interaction between humans and machines so that it become natural without the use of any mechanical devices. The next few recently studies may be enough to encourage the research projects in the field of HCI. Further on an interactive hand gesture system for control steering and speed for movement in virtual reality (VR) was introduced. The system is based on the hand palm direction and distance from user using Oculus Rift and Leap Motion devices for VR. The authors proposed a human-3DTV interaction method via the use of a virtual 3D interface. Based on simple gestures (captured via the Kinect sensor), the user can manipulate 3DTV faster and more accurate than an existing product they used for performance comparison. A 3D hand tracking using two common webcams is to be used. For a better hand detection in the segmentation step the authors use an adaptive hue skin color filter combined with a template filter. The

authors are focused in finding some points on the hand contour which can be used in hand gesture control application. A natural user interface based on hand detection and tracking using a webcam was implemented. Because of the low-quality camera their purpose was quite complex, so that their algorithms become quite complex, combining a number of different techniques and algorithms such as: skin detector based on histograms, background subtraction and a clustering algorithm, an open hand detector and a modified particle algorithm. A method for two hands gesture detection using a Kinect sensor is also proposed. This similar concept was used in development of the X-boxes. The Graham algorithm was used so as to get this technique into to implementation. The practical tests reveal the robustness and the effectiveness of the method.

This paper can be used and applied over many more devices such as televisions, LED monitors, etc. The device could be operated without any touch.

The purpose of the implemented solution is to control the mouse curser by user hand gestures captured through a web cam.

The aim of the application was reached, and the mouse cursor control was achieved using an external webcam (Genius FaceCam 320), a software that could interpret some hand gestures (based on different colors) and then turned the recognized gestures into operating system commands that controlled the mouse actions on the computer display screen. This application has an advantage in using color detection for gesture interpretation, because it can be used in low or high intensity light, and in the same time, it opens a window for further applications that intend to control any device using hand gestures or body movements.

III. DESIGN

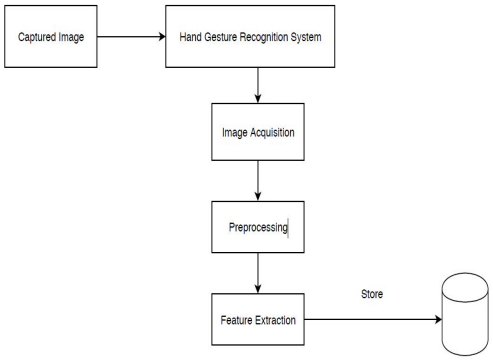

Fig 1. Architectural design

As soon as the palm is detected by the camera, it starts capturing the images and snapshots 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 such as color and shape. The gestures are stored in the database. [1]

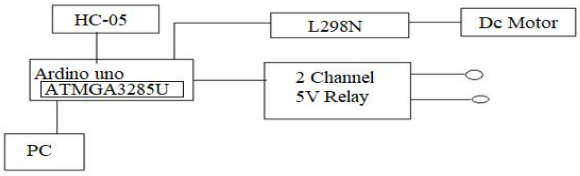

Fig 2. Block Diagram of virtual system using hand gestures

Here, these all extracted features are used for the further processing such as detecting hand gestures and working according to it. The user has access to the tools for image acquisition, pre-processing and feature extraction. After the feature extraction, the images are stored in the database. [2]

During both the training and test phase, the snapshot of the hand gesture is acquired and then passed on for pre-processing. Here, the RGB image is converted to HSV and YCBCR and each of these components are extracted separately. Then, the threshold value for the skin is calculated and unwanted pixels are removed. The color, shape and linear angle features are extracted.

For the train phase, after feature extraction, the images are stored into the database while for the test phase, the image is matched with those in the database and the appropriate task is performed. [5]

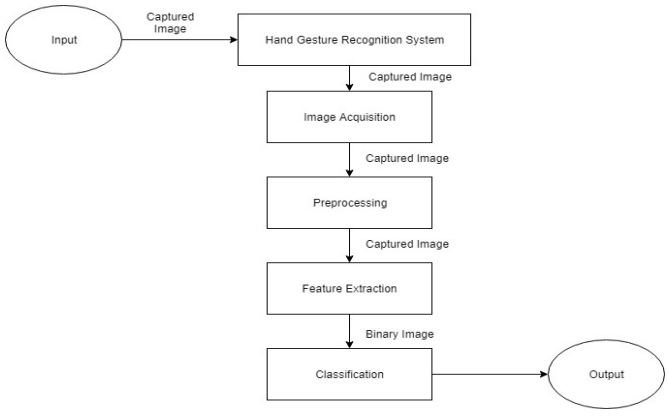

Fig 3: Level 0 DFD for training and testing phase

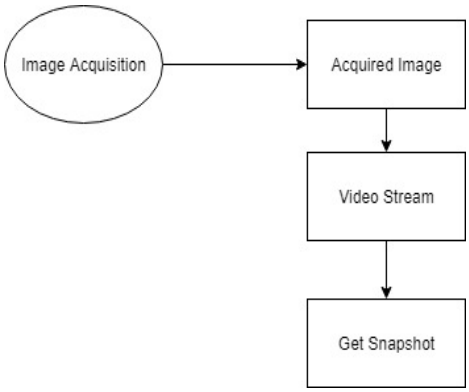

Fig 4: Level 1 DFD – acquiring image for training and testing phase

The captured image is passed on to the hand recognition system and pre-processed. The necessary features are extracted and the image is converted to binary. This binary image is then passed on for classification. The output is the performance of the appropriate task on recognizing the image.For image acquisition, the hand is pointed to the video camera in a real time environment and a snapshot is captured. For the train phase, after feature extraction, the images are stored into the database while for the test phase, the image is matched with those in the database and the appropriate task is performed

IV. IMPLEMENTATION

Software Requirements

MATLAB and its Toolkits

MATLAB (matrix laboratory) is a multi-paradigm numerical computing environment and proprietary programming language developed by MathWorks. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, C#, Java, Fortran and Python.

Toolkits & Packages:

Image Acquisition Toolkit.
Image Processing Toolkit.
OS Generic Package.

V. CONCLUSION AND FUTURE ENHANCEMENT

A common problem faced by professors, students etc. while giving/referring presentations is that they must physically perform PowerPoint operations. The doctors/surgeons in the operation theatre must physically operate the devices for referring images of bone fractures, organ cancer etc. This can be tiring, time-consuming and unhygienic at the OT.

The proposed solution to overcome this problem is the use of a Hand Gesture Recognition system that can perform window operations, particularly for PowerPoint.Hand gesture recognition system is considered as a way for more intuitive and proficient human computer interaction tool. The range of applications includes virtual prototyping, sign language analysis and machine learning. Sign language is one of the tools of communication for physically impaired, deaf and dumb people.

The mainscope of the hand gesture recognition is to use these gestures interact with devices without physically touching them. This is time saving since operations are performed faster, accurately and makes input devices like mouse, keyboards and touch screens redundant.

However, a few constraints imposed by this system is no other hand gesture except the ones matching the training sample will be accepted. The lighting conditions must be maintained, i.e., if there is to much brightness, the features of the hand may not be accurately extracted.

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