



Gesture Controlled Computer

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Abstract— *As the world is modernized, the computers have become smart, but they still use the same keyboard and mouse. The power to sense what we want to say to a computer using optical devices is the purpose of this paper. The paper uses simple Web Cam as a sensing element to detect the gestures and hand movements. The camera senses the color bands and gestures which are then converted into digital form by using algorithms. These algorithms are implemented using MATLAB programming.*

This paper describes the method for humans to interact with digital world and use the computer with just our hand movements. The paper is based on image processing. The camera detects gestures, and converts those gestures into equivalent digital algorithms as programmed. The complete computer can be controlled through hand gestures. This will make our over all work easier and efficient. This paper deals with the controlling all operations of mouse such as right click, left click and movement of cursor over the desktop, drag and drop, snapshot, Air writing and painting through hand gestures.

Keywords--- *hand gestures, mouse control, drag and drop icons, snapshot, Air writing, Air painting*

I. INTRODUCTION

The new generation computer technology in user-interfaces has changed to gesture interface, capturing the motion of our hands and controlling the devices is more natural and realistic. Hand gesture may include multi-touch screen interface, MS Surface computing, or camera based gesture recognition, adding new interactions in shopping applications and even in gaming industries There are many inventions in controlling computer applications with gestures by various technologies such as data glove, vision based and touch screen. Different types of data gloves were proposed by MITglove, ZTMglove, Cyber glove for gesture recognition, and then coloured gloves came into picture. In this paper we are recognising gestures using colour bands.

The main objective of paper is to have an intelligent computer, which can understand human gestures, and to introduce new technology, by which humans can interact with computer. This paper deals with the controlling all operations of mouse such as right click, left click and movement of cursor over the desktop, drag and drop, snapshot, Air writing and painting through hand gesture. MATLAB is a numerical computing environment, developed by Math Works. MATLAB allows the generation, manipulation and processing of signals and images in the form of arrays and Matrices. It contains hundreds of built-in libraries (i.e. toolboxes) for Signal Processing, image processing, bio-matrix, data acquisition, etc.

The paper uses simple Web Cam as a sensing element to detect the gestures and hand movements. The camera senses the colour bands and gestures which are then converted into digital form by using algorithms. These algorithms are implemented using MATLAB programming. In this paper, we mainly focus on Air writing (character recognition), mouse operations like its movement, left click and right click, drag and drop, snapshot.

II. REVIEW OF LITERATURE



Fig.1 (a) Data-Glove based (b) Vision based (c) Coloured marker based

(a) Data-Glove based approaches:

Data glove based interface are designed and researched for replacing static and fixed keyboard and mouse to have more natural way of communication as human being does by making gestures while communication. But have this, the gesture must be recognized first and thus data glove is used. It provides data based on the angular measure of the bones in hand. Gestures are the first most interactive module for game control, Wilmot. Komura and Lam have proposed a method to control a small robot walking motion using the data glove. They actually proposed a mapping system between finger motion and 3D characters location.

In this proposed paper, we are mapping the finger motion with the 3D mouse pointer to sketch something useful on the computer screen. Basically the mapping is between the real world and the digital world, connecting each other. The data glove used for the experiment is an electronic device with motion capture sensors, i.e., flex sensors, capturing the movements of each individual finger from physical world and converts them to digital signal using analog-to-digital convertor. This digital signal is then passed to the computer to further process and paints the digital or virtual world, as it is the mimic of physical or real world.

(b) Vision based approaches:

In vision based approach, Using cameras to recognize hand gestures started very early along with the development of the first wearable data gloves. There were many hurdles at that time in interpreting camera based gestures. Coupled with very low computing power available only on main frame computers, cameras offered very poor resolution along with colour inconsistency. The theoretical developments that lead to identifying skin segmentation were in its infancy and were not widely recognized for its good performance that we see today. Despite these hurdles, the first computer vision gesture recognition system was reported in 1980s.

(c) Coloured markers approach:

In this approach, the human hand used to wear marked gloves or coloured markers with some colours to direct the process of tracking the hand and locating the palm and fingers. It provides the ability to extract geometric features necessary to form hand shape .There might be different colours of colour glove, where three different colours are used to represent the fingers and palms, where a wool glove was used.

The MIT-LED glove was developed at the MIT Media Laboratory in the early 1980s as part of a camera-based LED system to track body and limb position for real-time computer graphics animation. A camera sitting in front of the user could capture number of LEDs as they were studded on the glove. The different illumination patterns for different gestures that could be interpreted by a computer. However, the performance was poor due to occlusions and the variations of any gesture performed by different users. One of the first instances of gesture recognition using a glove with finger tip markers was reported by Davies et al.

III. SOFTWARE SPECIFICATION DETAILS

MATLAB:

MATLAB (matrix laboratory) is a multi-paradigm numerical computing environment and fourth-generation programming language. Developed by Math Works, 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++, Java, and Fortran. Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing capabilities. An additional package, Simulink, adds graphical multi-domain simulation and Model-Based Design for dynamic and embedded systems.

In 2004, MATLAB had around one million users across industry and academia. MATLAB users come from various backgrounds of engineering, science, and economics. MATLAB is widely used in academic and research institutions as well as industrial enterprises. MATLAB is a high-level language and interactive environment for numerical computation, visualization, and programming. Using MATLAB, you can analyze data, develop algorithms, and create models and applications. The language, tools, and built-in math functions enable you to explore multiple approaches and reach a solution faster than with spreadsheets or traditional programming languages, such as C/C++ or Java. You can use MATLAB for a range of applications, including signal processing and communications, image and video processing, control systems, test and measurement, computational finance, and computational biology. More than a million engineers and scientists in industry and academia use MATLAB, the language of technical computing.

Key Features:

- High-level language for numerical computation, visualization, and application development
- Interactive environment for iterative exploration, design, and problem solving
- Mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, numerical integration, and solving ordinary differential equations
- Built-in graphics for visualizing data and tools for creating custom plots
- Development tools for improving code quality and maintainability and maximizing performance
- Tools for building applications with custom graphical interfaces
- Functions for integrating MATLAB based algorithms with external applications and languages such as C, Java, .NET, and Microsoft Excel.

IV. HARDWARE SPECIFICATION DETAILS



Fig.2 WebCam

Features / Specifications:

- Interpolated 8.0 Mega Pixel Still Image Resolution.
- Interpolated 4.0 Mega Pixel Video Resolution.
- High quality 5G wide angle lens.
- Brightness controller Snapshot button.
- Built-in high sensitive USB microphone .
- Built-in 10 Photo frames.
- Auto Face Tracking Function.
- Multi-utility camera base for use on Monitors and Laptops.
- Image Sensor: High quality 1/4 CMOS sensor
- Max. Video Resolution: Max. Upto 2304 x 1728 pixels
- Max. Image Resolution: Max. Upto 3264 x 2448 pixels
- Frame Rates: 30 frames per second
- Colour Depth: 24-Bit True Colour
- Interface: USB 2.0, backward compatible to USB 1.1
- Focus: 5 cm to Infinity
- Microphone: Built-in high sensitive USB microphone
- Snap Shot Button: Built-in snap shot button
- White Balance: Auto
- Auto Compensation: Auto
- Auto Tracking: Auto face tracking function
- Zoom: 4X Digital Zoom
- Video Effects: 10 photo frames and 16 special effects
- OS Compatibility: Windows XP / Vista / 7 & 8
- Bundled Software: Driver for Windows with 10 Photo frames, 16 Special effects.
- Effective Pixels: 480K pixels (Interpolated 8M pixels still image & 4M pixels video)
- Night Vision: 6 LED's for night vision, with brightness controller.

V. METHOLOGY

• Image Acquisition:

The input images are captured by a webcam placed on a table or laptop. The system is demonstrated on a conventional PC/ Laptop computer running on Intel Pentium Dual Processor with 4GB of RAM. Each image has a spatial resolution of 620 x 480 pixels and a gray scale resolution of 32 bit. The system developed can process hand gestures at an acceptable speed. Given a variety of available image processing techniques and recognition algorithms, we have designed our preliminary process on detecting the image as part of our image processing.

The system starts by capturing a hand image from signer with a webcam setup towards certain angle with black background. The next process will convert the RGB image into grey scale with either black (0) or white (1). The edge of each object is then computed against the black background. The object can then be segmented and differs greatly in contrast to the background images.

• Pre-Processing:

Changes in contrast can be detected by operators that calculate the gradient of an image. One way to calculate the gradient of an image is the Sobel operator ,which creates a binary mask using a user-specified threshold value. The binary gradient mask shows lines of high contrast in the image. These lines do not quite delineate the outline of the object of interest. Compared to the original image, the gaps in the lines surrounding the object in the gradient mask can be seen.

The proposed system recognizes characters and symbols that are given in midair with the hand acting as the hand main object, from a Video camera or webcam. Therefore, the gesture and motion of the hand is of interest. To compute this motion, we used a Dynamic time wrapping approach to reconstruct gesture. Based on the user's pose, we extract the palm motion and gesture of the hand. There are also other ways to acquire this data, e.g. with sensors based on structured light like the Microsoft Kinect. But a vision based system has the advantage that there is much broader variety of sensors to choose from with varying resolutions and frame rates which can be important for the overall performance. To deal with sensor noise and occasional misclassifications, we applied a median filter to smooth the gesture.

- Image Segmentation:

Image Pre-processing is necessary for getting good results. In this algorithm, we take the RGB image as input image. Image segmentation is typically performed to locate the hand object and boundaries in image. It assigns label to every pixel in image such that the pixels which share certain visual characteristics will have the same label.

- Feature Extraction:

When gesture is given in air, users should tend to give on a video camera in front of them. We exploit this video by papering in to different frames of the hand gesture on a 2D plane, in front of the users, which has the advantage that it reduces the feature space. The beginning and ending of hand gesture can be easily detected because system provides different time slot and notify the same to users, user move their hands, correspondingly. We found that there were hand and hand movements while giving as is the case in traditional hand gesture. Character and symbol recognition from hand gesture are both based on Centroid, which is an established technique in hand gesture recognition.

VI. RELATED WORK

The gesture must be recognized first and thus web camera is used. simple Web Cam as a sensing element to detect the gestures and hand movements. The camera senses the colour bands and gestures which are then converted into digital form by using algorithms.

Accessing Camera: The steps to access camera are:

1. Checking Devices attached with PC
2. Getting Information about the attached devices
3. Initializing the device
4. Checking preview.

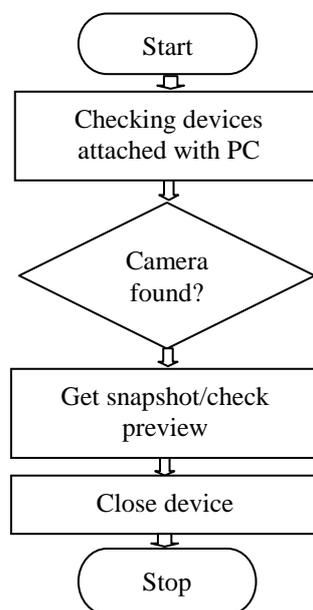


Fig.3 Flowchart of Accessing Camera

A. Detecting Gestures:

MATLAB captures image in RGB format, which contains three layers of Red, Green and Blue. The image in MATLAB appears in the form of a matrix. Each element of matrix shows the sum of all three layers of Red, Green and Blue colours, as shown in Fig. To detect a Red colour, we take the Red layer containing values of Red colour. The process flow chart is shown below.

To get red components, the red layer of that image is taken and this layer is then subtracted from the gray version of original image. The Noises are then filter out, this image is then converted into binary image, which has 1s at red components and 0s else where. The unnecessary components are then removed, the obtained image then have only red object components'. These components are then counted and bounded with boxes. The centre of these boxes is taken as (Xr, Yr) in Cartesian coordinates. These X and Y values will be used for further processing.

The steps to Detect Gestures are:

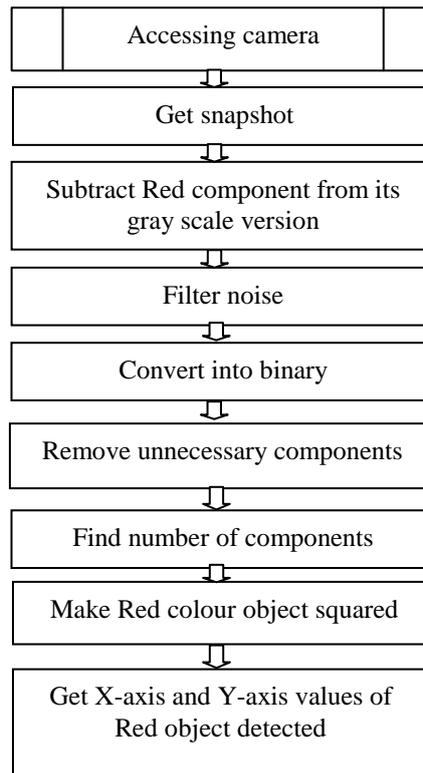


Fig.4 Flowchart of Detecting Bands Position

Process flow:

1.As soon as code is run, the computer will try to detect sequence of predefined combination of colour bands (C1,C2,C3,C4).

Table 1 predefined combinations of colour bands

C4	C3	C2	C1	OPERATION
			█	Cursor movement
		█		Left single click
		█	█	Left double click
	█			Right click
	█		█	Snapshot
	█	█		Air writing
	█	█	█	Gesture recognition
█				Stop

2. As soon as combination is detected the computer will get into loop and performs the dedicated task.
3. After giving particular colour code, the computer will continuously get into loop and monitor next particular code.
4. For cursor movement, when only red (C1) is detected the computer will wait until stop gesture i.e. only black colour that indicates the stop for the cursor motion.
5. During cursor movement monitoring is done on:
 - Stop
 - Left single click
 - Right click
 - Left double click

6. During Left single click monitoring is done on:

- Cursor motion(Drop and drag)
- Stop motion

7. During Right click monitoring is done on:

- Cursor motion
- Stop motion

8. During Gesture recognition monitoring is done on:

- Application opening
- Start motion
- Stop motion

9. During Air writing monitoring is done on:

- Start motion
- Stop motion

Algorithm:

- 1) Start.
- 2) Align the camera in proper position.
- 3) Start camera (Preview of 5-6 seconds will be given for proper orientation of hand gestures)
- 4) Here by starts the actual program for cursor movement using hand gesture
 - i) The camera will going to detect red colour object which is basically the red coloured paint or anything appearing to be red on our finger tip
 - ii) As soon as the camera detect the red coloured patch it will going to send the co ordinates of that patch to the routine cursor.m which executes a code thereby positioning the cursor where the patch is detected.
 - ii) Accordingly the entire gesture is converted into a gesture based cursor motion
- 5) After that Using the above theme open paintbrush in windows.
 - i) After that either a key press of speech or a different colour can be given as an input to the executing code for Air painting routine to get executed.
 - ii) After that apart from just detecting the patch location. The entire contour of he patch will be tracked using object tracking algorithm.
 - ii) Here we can get a painting get done using a simple hand gesture
- 6) Air writing
 - i) After that either a key press of speech or a different colour can be given as an input to the executing code for Air writing routine to get executed.
 - ii) After that apart from just detecting the patch location. The entire contour of he patch will be tracked using object tracking algorithm.
 - iii) Start the camera and give some alphabetical or numerical gesture being detected in front of camera
 - iv) Using the concept of segmentation and some statistical based approach a decision will be made about which letter the hand gesture actually indicates
 - v) Here we can get a writing(printed or painted) get done using a simple hand gesture.

VII. SYSTEM DEVELOPMENT

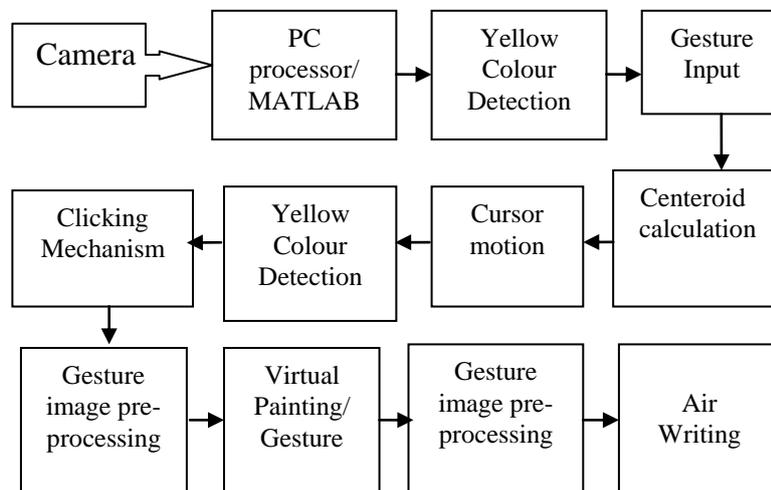


Fig. 5: functional Block Diagram

Description:

Camera: A camera is an optical instrument that records images that can be stored directly. These images may be still photographs or moving images such as videos or moves. It is used as a sensing element to detect the gestures and hand movements. The camera senses the colour bands and gestures which are then converted into digital form by using algorithms.

Processor/MATLAB: These algorithms are implemented using MATLAB programming. The camera captures an image in RGB format, To get red ,yellow, blue components, the individual layer of that image is taken and this layer is then subtracted from the gray version of original image. The Noises are then filter out, This 10 image is then converted into binary image, which has 1s at red components and 0s else where. The unnecessary components are then removed.

Yellow colour detection: The yellow colour detection is used to differentiate the gesture that is whether they are for clicking mechanism or for air writing/painting.

Centeroid calculation: The red and blue colour components are used to detect gesturers. These components are then counted and bounded with boxes. The centre of these boxes is taken as (Xr, Yr) and (Xb,Yb) in Cartesian coordinates. These X and Y values will be used for further processing.

VIII. OBJECTIVES

The main objective of this paper is to have an intelligent computer, which can understand human gestures, and to introduce new technology, by which humans can interact with computer. This paper deals with the controlling all operations of mouse such as right click, left click and movement of cursor over the desktop, drag and drop, snapshot, Air writing and painting through hand gesture.

IX. CONCLUSION

The purpose of designing this paper is to have an intelligent computer within the hands of common man, the paper has many features which will reduce a lot of human work. It will provide an easy access to computer. By using air writing and painting feature provided by paper will help user during seminar, teachers by eliminating the need of black board while delivering lectures.

X. APPLICATIONS

- Gesture based gaming.
- Human Motion Sensing.
- Human Psychology Detection.
- Painting in Ms-Paint.
- Operating On-Screen Keyboard.
- Air writing in seminars or in colleges.
- Air painting for artists, etc

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