Virtual Keyboard

Aakansha Yeole[1], S.Chitra V.Sriraman[2], Pooja Shinde[3], Priyanka Sadhwani[4]

Department of Electronics and Telecommunication

Watumull Institute of Electronics Engineering and Computer Technology

Worli, Mumbai-18,India

Abstract— **The paper deals with the enhancement of human interaction with the digital world. Miniaturization of computing devices allows us to be in continuous touch with the digital world. Restriction of information on traditional platforms like paper, digital screen etc is overcome with the help of this technology. Dependency on traditional hardware input devices like keyboard, mouse etc will be reduced considerably, thereby allowing portability. It makes use of hand movements/gestures to feed input to a computer or any other digital device.The Virtual Keyboard is an adaptation of the 6th sense technology developed by Pranav Mistry,PhD student at MIT media labs.It works on a similar principle of hand movement/gesture control to perform simple functions like Right/Left click, Scroll control etc, which would otherwise have to be performed with the help of a mouse or a keyboard.Image Processing technique is an important basis for the implementation of this technology.The key features of this technology include media player volume control, power point slide control, camera control, scrolling,mouse control, initiation and termination of call.**

Index Terms—**mouse control, hand movements or gestures, player volume control, power point slide control, camera control, scrolling, initiation and termination of call.**

I. INTRODUCTION

Humans communicate mainly by vision and sound. Due to the tremendous growth of digital world man and machine interface is required for communication. The keyboard and mouse are currently the main interfaces between man and computer. The advancement in modern technology has resulted in the evolution of various innovations like qwerty keypad, touch

screen etc .Another such innovation in this field is the sixth sense technology which acts as an interface between the digital information and the physical world. The scope of this project includes detection of the pointer using defined colour information for controlling computer functions like dial pad control and mouse control with clicks, power point slide

control, media player control without any contact to the screen. The device consists of software components like

MATLAB, Visual Basics and hardware components like camera, GSM modem, colour stickers and microphone. *The main aspect of this gesture based device is the capturing of hand movements by the camera which interprets and processes the acquired information*. The processing of this information, in the form of images is done with the help of MATLAB software version 7.MATLAB software consists of the Image Processing Toolbox and Acquisition Processing Toolbox which is used to analyze the contents of the image.

II. LITERATURE SURVEY

The evolution of this technology can be traced back to the 1990's. During this period, wearable computer was made by [
] Steve Mann, father of sixth sense technology. Sixth Sense technology (camera combined with light source) was developed in 1997 (headworn) and 1998 (neckworn), but the Sixth Sense name for this work was first coined and published in 2001. Mann referred to this wearable computing technology as affording a "Synthetic Synesthesia of the Sixth Sense", i.e. the idea that wearable computing and digital information can act as an additional (i.e. sixth) sense. He implemented the Sixth Sense technology as the neck worn projector with a camera system. He was a media lab student at that time. Another breakthrough in gesture recognition was carried out by Noriaki Kuwahara, Yanhua Sun and Kazunari Morimoto, however their work concentrated on recognition of hand movements related to sign language for aiding deaf people[10].One other way of implementing Gesture based recoginition was introduced by Jayang Liu, Zhen Wang, and Lin Zhong,Jehan Wickramasuriya and Venu Vasudevan, which uses microwave accelerometer for this purpose[11].
The "AllSee" system developed by Bryce Kellogg and his collegues is also an innovative step towards the development of gesture recognition for human-digital interaction[12].
Further development in this field was carried out by Pranav mistry,an Indian research assistant in MIT MedLab.Mistry developed new applications from this technology and coined the term 'Wear Ur World '(WUW).The limitation of the earlier prototype was that it consisted of a helmet with a large projector mounted on it which caused the problem, that if a person is projecting the data on the wall and suddenly turns to speak with someone, then the data would be projected onto that person. This limitation was overcome by the neckworn

518

pendent prototype. The initial prototype consisted of an ordinary webcam along with a battery powered 3M projector with an attached mirror. The cost was estimated to be roughly around $350. Mistry wore the device on a lanyard around his neck, and colored Magic Marker caps on four fingers (red, blue, green and yellow) helped the camera distinguish the four fingers and recognize his hand gestures with the software that Mistry created.

III. INTRODUCTION TO TOOLS

1**. Image Processing with MATLAB:**
Images are everywhere, from everyday devices like cameras and smart phones to specialized devices for medical imaging, automotive safety, industrial automation, and more. Each of these uses for image processing has unique challenges.

MATLAB and Image Processing Toolbox provide a flexible environment to explore design ideas and create unique solutions for Matlab toolbox used in our project are as follows:
• Image acquisition Toolbox.
• Image processing toolbox
• GUI builder.

a) *Image Acquisition Toolbox:*The Image Acquisition Toolbox is a collection of functions that extend the capability of the MATLAB® numeric computing environment. The toolbox supports a wide range of image acquisition operations, including. Acquiring images through many types of image acquisition devices, from professional grade frame grabbers to USB- based Webcam .Viewing a preview of the live video stream. Triggering acquisitions (includes external hardware triggers). Configuring call back functions that excuse when certain events occur. Bringing the image data into the MATLAB workspace.

b) *Image Processing Toolbox:* Image Processing Toolbox provides a comprehensive set of reference-standard algorithms, functions and apps for image processing, analysis, visualization and algorithm development. You can perform image enhancement, image deblurring, feature detection, noise reduction, image segmentation, geometric transformations, and image registration. Many toolbox functions are multithreaded to take advantage of multi core and multiprocessor computers.

Image Processing Toolbox supports a diverse set of image types, including high dynamic range, gigapixel resolution, embedded ICC profile, and tomographic. Visualization functions let you explore an image, examine a region of pixels, adjust the contrast, create contours or histograms, and manipulate regions of interest (ROIs). With toolbox algorithms you can restore degraded images, detect and measure features, analyze shapes and textures, and adjust colour balance.

c) *GUI Builder:* A graphical user interface (GUI) is a graphical display in one or more windows containing controls, called components that enable a user to perform interactive tasks. The user of the GUI does not have to create a script or type commands at the command line to accomplish the tasks. Unlike coding programs to accomplish

tasks, the user of a GUI need not understand the details of how the tasks are performed.GUI components can include menus, toolbars, push buttons, radio buttons, list boxes, and sliders just to name a few. GUIs created using MATLAB® tools, can also perform any type of computation, read and write data files, communicate with other GUIs, and display data as tables or as plots.[2]

2. **Webcam:**

Figure.1: Webcam

This Webcam is used to capture and recognises an object in view and tracks the user's hand gestures using computer-vision based techniques. It sends the data to the computer. The camera, in a sense, acts as a digital eye, seeing what the user sees. It also tracks the movements of the thumbs and index fingers of both of the user's hands. The camera recognizes objects around you instantly.

Single camera system:
This system would provide considerably less information about the hand. Some features (such as the finger against a background of skin in the example above) would be very hard to distinguish since no depth information would be recoverable. Essentially only "silhouette" (Detection of all skin within the hand without any feature detection information could be accurately extracted. The silhouette data would be relatively noise free (given a background sufficiently distinguishable from the hand) and would require considerably less processor time to compute than either multiple camera system. It is possible to detect a large subset of gestures using silhouette information alone and the single camera system is less noisy, expensive and processor hungry. Although the system exhibits more ambiguity Stereographic system and multiple two dimensional view system this disadvantage is more than outweighed by the advantages mentioned above. Therefore, it was decided to use the single camera system. [3]

3. Colour stickers (R G B)

Figure 2: Colour Stickers

Figure 2 shows colour stickers which are at the tip of the user's fingers. Marking the user's fingers with red, green, and blue tape helps the webcam recognize gestures. The movements and arrangements of these Markers are interpreted into gestures that act as interaction instructions for the projected application interface. [1]
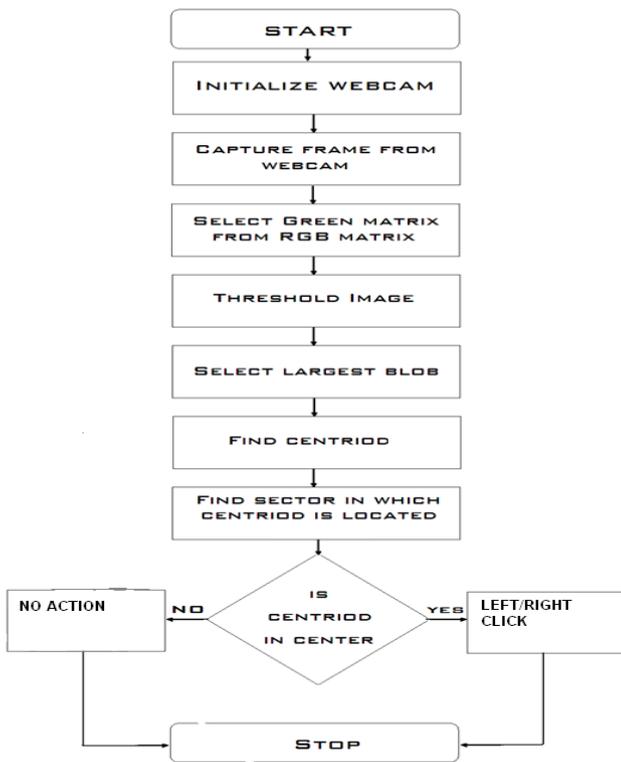
FLOW CHART:

Figure 3: Flow Chart

In the object tracking application one of the main problems is object detection. Instead of finger tips, a colour pointer has been used to make the object detection easy and fast. A circle blue sticker is used as a colour pointer in this study. To simulate the click events of the mouse three fingers with three colour pointers has been used.

The basic algorithm is as follows:
• Set a pointer in the image.
• Detect the pointer using the defined colour information.

• Define the region and the centre of the pointer and draw a

   bounding box around it.
• Track the motion of the pointer.
• Move the cursor according to the position of the centre of the pointer.
• Simulate the single and the double left click and the right click of the mouse [1].

IV. WORKING

As the related work shows, the choice of the algorithms chiefly depends on the environment in which the system is required to operate. A larger setup of the system in an open environment, such as a shopping mall or outdoors requires robust hardware that can cope with many users and difficult lighting conditions such as sunset. The choice of hardware to capture the users is a defining element of the reliability of the final system.[5]

a) Image acquisition setup: It consists of a web camera with suitable interface for connecting it to PC.
b) Processor: It consists of personal computer or a dedicated image processing unit.
c) Image analysis: Certain tools are used to analyze the content in the image captured and derive conclusions e.g. MATLAB 7.0.
d) Machine control: After processing, some conclusions have to be made in order to initiate control actions. In our case control actions are desktop control via mouse control.
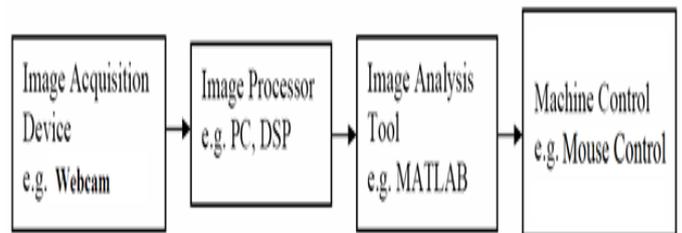

Figure.4: Block Diagram

Implementation of image processing:
As we all know, an image is defined as 2D function of $f(x,y)$ where x & y are spatial coordinates and amplitude at any pair of coordinates is called intensity of image at that point
   1. Initialize the webcam and capture the image.
   2. Then convert the captured colored image to gray scale image using image processing toolbox.The gray scale contains only brightness information about the image.
   3. Later use image segmentation to locate objects and their boundaries in an image. In image segmentation, thresholding is their gray scale value. If pixel intensity is less than threshold, corresponding pixel is black in resulting image. If pixel value has intensity greater than threshold, the resultant pixel is white which represents object.

520

4. Thus binary Images contain only black and white pixels which indicate that it keeps only the significant part of the image and removes the noise.

5. Thus the required target is white and the surrounding background is black. This is how image processing is carried out.

The implementation of our project is shown in a block diagram figure 5 as below:
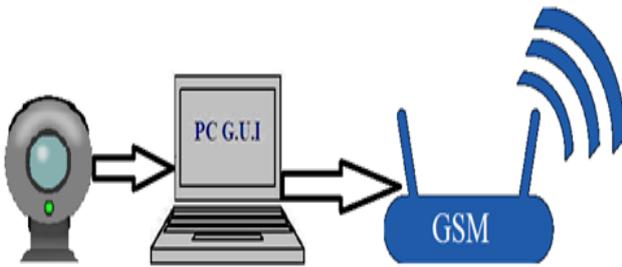

Figure.5: Block diagram to be implemented.

1. Webcam: All user finger activities and movements are track with a help of webcam. Webcam used is a normal Logitech webcam or an integrated webcam on laptop.
2. PC: As mentioned earlier image processor in our project is a personal computer and image analysis tool is MATLAB. So all the features and flow mentioned earlier are been incorporated on PC with help of MATLAB by using various algorithms. We are also using PC screen as output display instead of Projector as to minimize to hardware complexity and to have an easy demo setup. Thus laptop architecture is used where webcam on top of screen is used for project demo
3. GSM: GSM modem is connected to the PC via a USB/Serial converted. It's basically used for Dial pad control where calling functions is been taken care by GSM modem.

V. IMPLEMENTATION

1. User has to wear different colour sticker of fingertip so that finger can be recognised in a differential manner by the system.
2. Mouse movement control will be executed by tracking an index finger which is placed in front of webcam.
3. Left click will be executed by joining thumb and index finger in front of webcam.
4. Right click will be executed by joining thumb and index finger in front of webcam.
5. Dial Pad control: Dial pad will be shown at upper left area of screen. User can move mouse to required digits and can select digits by left click. The numbers will get accumulated in a text field. After entering all desired numbers in text field user can click the dial button to initiate call. Similarly by clicking on call end user can hang a particular call. (Optional: Calculator)
6. Thus with combination of mouse movement control, left click and rightclick control we can control the whole desktop thus making our project functionality as wide as actual mouse

control.(Mouse movement control with clicks, Power point slide control, Media player control, etc)
7. We have introduced a special function where user can execute these functions independent of whatever feature he is demonstrating.[4],[6]
- Image capture aka Screenshot (By joining index, middle and thumb at centre of screen)
- Volume of screen (By joining index, middle and thumb and scrolling up/down at rightmost area of screen)
- Scrolling Text (By joining index and middle finger and scrolling up/down at rightmost area of screen)
- Zoom in (By parting away two index fingers of both hand)
- Zoom out (By joining two index fingers of both hands)

VI. CONCLUSION

This project presented a vision-based hand tracking system that does not require any special device or instrument and can operate in real-time on a commodity PC with low-cost cameras. Specifically, the system can track the tip positions of the thumb and index finger for each hand, assuming that a calibrated cameras is viewing the hands placed in front of it. The motivation for this hand tracker was a desktop-based two-handed interaction system in which a user can select and manipulate 3D geometry in real-time using natural hand motions. The algorithmic details for the virtual keyboard were presented in this document. Virtual keyboard integrated with cloud computing will be capable of recognizing an object and will display the information about it automatically. It will also allow us to access information regarding the specific object in any way we need. The Virtual Keyboard prototype implements several applications that demonstrate the usefulness, viability and flexibility of the system. It allows us to interact with this information via natural hand gestures. It has the ultimate potential to become transparent user interface for accessing information about everything around us.

REFERENCES

[1] Kazim Sekeroglu, "Virtual Mouse Using a Webcam" July 9, 2012
[2] Y. Sato,Y. Kobayashi,H. Koike "Fast tracking of hands and fingertips in infrared images foraugmented desk interface",2000
[3] Z. Zhang, Y. Wu, Y.Shan, S. Shafer "Visual panel: Virtual mouse keyboard detection" July, 2003
[4] Shahzad malik "Real time hand tracking and fingertip tracking for interaction CSC2503E Project Report December 18,2003
[5] Georg Hackenberg, Rod McCall, and Wolfgang Broll " Lightweight

palm and finger tracking for real time 3D gesture control", March 24, 2011

[6]   Wayne Westerman " Finger identification and chordic manipulation of multi-touch surface",Spring 1999

[7]   http://www.slideshare.net/renjithravi/sixth-sense-technology

[8]   Arjun, K. R "Sixth Sense Technology" Seminar Report 2012.

[9]   Mistry Pranav "Sixth Sense." Weblog post Sixth Sense. Pranav Mistry,2010. Web..

[10]   Yanhua Sun,Noriyaki Kuwahara,Kazunari Morimoto "Analysis of Recognition System of Japanese Sign Language using 3D Image Sensor,2013:
http://design-cu.jp/iasdr2013/papers/1159-1b.pdf

[11]   Jiayang Liu, Zhen Wang, and Lin Zhong, Department. Of Electrical
Computer Engineering Rice University, Houston TX 77005 and Jehan Wickramasuriya and Venu Vasudevan, Pervasive Platforms & Architectures Lab Applications & Software Research Center, MotorolaLabs,2009;
http://www.ruf.rice.edu/~mobile/publications/liu09percom.pdf

[12]   UW team works on gesture recognition technology
http://allsee.cs.washington.edu/files/allsee.pdf

First Author Aakansha Yeole,final year student of Watumull Institute,Electronics and Telecommunication

Second Author S.Chitra V.Sriraman, final year student of WatumullInstitute,ElectronicsandTelecommunication

Third Author Pooja Shinde, , final year student of Watumull Institute,Electronics and Telecommunication

Fourth Author Priyanka Sadhwani,final year student of Watumull Institute,Electronics and Telecommunication