ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2016

A Novel Approach for Inbuilt Virtual Input Devices for Human Computer Interaction

Gadiparthi Manjunath[1], Nune Sreenivas[2]

Assistant Professsor, Dept. of ITSC, Addis Abab Institute of Technology, AAU, Ethiopia[1]

Assistant Professsor, Dept. of SECE, Addis Abab Institute of Technology, AAU, Ethiopia[2]

ABSTRACT. In this paper, we present "Inbuilt Virtual Input devices for Human Computer Interaction (IVI for HCI)" an attempt to bring one of the interactive display innovations for input devices. These Advanced Interactive Holographic Displays provide human computer interaction in free space. In future everyone will start browsing data in free space. It can be better than all other existing technologies. My intention is to bring out an inbuilt Holographic display technology with real time interactive touch experience inside the desktop monitor instead of using separate devices for virtual display input unit.

KEYWORDS: Virtual Keyboard, Virtual Mouse, Object Detection, Finger Detection, Camera, Infra-Red Filter, Frame Capturing.

I. INTRODUCTION

As the demand of ubiquitous computing thrives, the Human-computer interaction (HCI) issue has become very significant. Ordinary keyboards and mouses however, are limited in conveying complex or multi-dimensional information. Virtual keyboard and mouse systems are proposed as a new generation of HCI devices and paradigms. A virtual keyboard and mouse is known as a touch-typing device that does not have a physical manifestation of the sensing area, that is, the sensing area which acts as a button is not present a button but instead is programmed to act as one [1].

To date, there exist a number of virtual HCI implementations reaching various levels of sophistication. Examples of such systems are touch-pads, miniaturized keypads, cyber-gloves [2] and pressure-sensitive bands [3], to name a few. However, in all these cases complex pick-up devices, add-ons, or surgical implants are always required, making the HCI system expensive, inconvenient and less attractive. On the other hand, vision-based devices are less intrusive to human users, and provide fairly high flexibility and accuracy for both implementation and application. So the Virtual Keyboard and Mouse is the another example of today's computer trend of "Smaller and Faster". The virtual keyboard and mouse technology is the latest development and uses the sensor technology and artificial intelligence to let users to work on any flat surface. Virtual Keyboard and mouse, being a small, handy, well-designed and easy to use application. Virtual keyboard and mouse is the most important part of virtualization as it cannot be obsoleted from the computer part. Hence there is a need for replacing the virtual input devices.

II. DESIGN

The design of the Virtual keyboard and mouse system consists of minimum use of hardware devices and maximum dependence on software.

2.1 System design

The inbuilt virtual keyboard and mouse system is designed keeping in mind to avoid the hardware devices that are present physically. The design consists of following modules:
CMOS wireless camera

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2016

Infra-red band pass filter
Keyboard Projector with intensity control
Infra-red laser diode
Double Concave lens
Diffraction grating
Holographic film
Current controller circuit
Software for Key-stroke detection
LM-1117 voltage converter

All these modules are used to design a proper and highly efficient Inbuilt Virtual Input devices for Human Computer Interaction.

2.2 Hardware design

The Hardware of the system is most important part of the system as exact configuration of components is required to simplify the proposed model. The first sensor part of the system CMOS [3] wireless camera is integrated in the desktop monitor with Infra-red band pass filter which limit the camera sensing capacity to only Infra-red light. Limiting the sensing capacity of camera is useful in detection of finger touching the virtual projected keyboard and mouse layout as it is the least interfering light in any environment.

Second part of the design is a input device projector [4] that is used to project a fixed design. This projector projects a visible laser beam passing through biconcave lens [5] and a holographic [6] keyboard and mouse layout plate thus projecting the shadow of keyboard and mouse. The intensity of the laser diode is controlled by limiting the current flowing to the laser diode. Current limiting is controlled through current controlling circuit which consists of variable resistor to change the intensity of laser diode. The third part of the design is Infra-red laser diode that is used to generate a layer of linear Infra-red light parallel to the surface on which keyboard and mouse layout is projected. Since the infra-red laser cannot emit a linear diffracted [7] beam to cover the whole keyboard and mouse layout without diverging. Therefore we need to pass the laser light through Biconcave lens adjusted in such a distance that emerging of parallel laser beam to pass through Diffraction plate which diverge the beam linearly hovering over the whole surface of keyboard and mouse layout.

2.3 Software/Algorithm Design

The design of software starts from the image processing algorithm which is the most important part of stroke detection [17]. Now the camera is only able to detect objects blocking infra-red light from the Infra-red laser [16] beam plane. Starting with capturing image frames from a CMOS camera and transmitting frames to the PC using frame capturing code written. This capturing of image should be such that the generated image is mirror image of the original image. Image frames generating from CMOS camera consist of infra-red images as the camera lens is integrated with infra-red band pass filter. The image contains lot of noise and high frequency regions where object edges to be extracted; therefore a two steps are performed before moving into stroke detection. Firstly Gaussian [9] filter is used to remove the white noise that is present everywhere in the whole frequency range of image spectrum [10]. It also has linear graph according to which there is no sharp/abrupt change in frequency band, thereby increasing the accuracy of detecting sharp edges of object which are generally in high frequency region of image histogram. Secondly threshold function is used to omit the region of non-object and showing the region of objects touching the surface. Stroke detection is started with point of interest's extraction where centroid of all the touching points is calculated using cvFindContour [11] function. This function provides a co-ordinate that is average area of the fingertip. The co-ordinate value extracted is need to find out for actual key pressed at that location, which is done through a method of predefined [12] keyboard and mouse with fixed co-ordinate location are stored in a one-dimensional array. The mapping of generated co-ordinate with beforehand preserved co-ordinate of keyboard and mouse pattern is done through comparison of coordinated to find out minimum difference of displacement between co-ordinates. This comparison does a very efficient computation as uses tree [13] structure for comparison. After the comparison of co-ordinates the nearest key value is found out

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2016

which is injected into Operating system through available API for windows system allowing to inject the nearest key found out. Finally the key pressed is found out for virtual keyboard. This process is repeated for the virtual mouse.

III. IMPLEMENTATION

Virtual keyboard and mouse use image processing algorithm in OpenCV to decease the processing time. It gives user an idea to connect with their desktop using a virtual environment.

3.1 Hardware

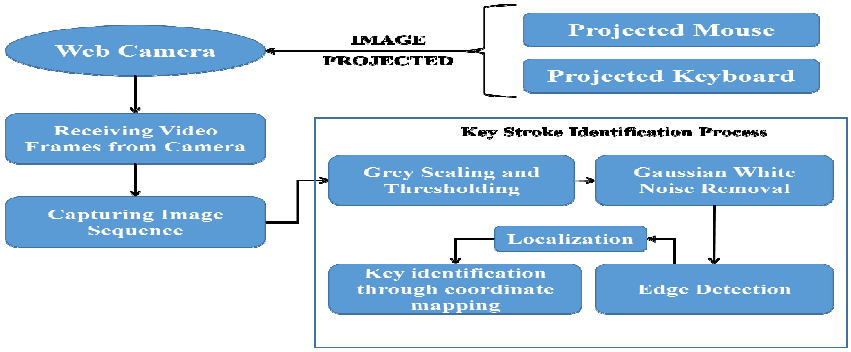
The described components for hardware are used to make a proper prototype that could match the requirement of software design.

The laser plane generating component is kept at the lowest section of the monitor touching the surface so to minimum distance between surface and laser plane. Laser keyboard and mouse generating diode is connected with current controlling circuit using potentiometer used to control the intensity of keyboard and mouse layout. Intensity of keyboard and mouse layout is independent of image processing algorithm. The whole hardware is powered with rechargeable 9v battery.

Figure: Prototype model for inbuilt virtual input devices

3.2 Algorithm

Design of algorithm is needed to be integrated with the hardware for proper working of the hardware. The camera is fixed at the bottom of the monitor for transmission of video frames. Rate of sending video frames is able to match with the transfer speed bandwidth allowing 30fps to be transferred easily. Software designed is completed after writing the code in openCV and compiling using g++ compiler generating object file, configuration file and application file. Application file generated is used to do the real time image processing using data send from camera. The processing of real time video frames [14] coming from camera is continuously going through. If any key event is found the API informs the OS to print that corresponding key. The application runs in the background to make user feel like actual keyboard and mouse



ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2016

3.3 New Feature

The virtual keyboard and mouse has a feature of auto switch off mode. This feature allows the projected key-board and mouse layout to switch off the keyboard and mouse projector laser diode until the user finger comes near the keyboard and mouse region. An photodiode [15] is put just above the plane laser which continuously checks if the no signal is received for 300seconds then it switch off of the key-board and mouse layout projector to save power It switch on automatically by just hovering hand over the key-board and mouse layout.

IV. ADVANTAGE

The most important advantage of this system is to make the system independent of on-board processing which uses most of the battery power as well as the independency of each module makes it easier for upgrade to new feature. And also this design makes use of less hardware components and also the cost effective. This design is useful for the companies, universities to minimize the cost in establishing the huge number of desktops for practice and research.

V. CONCLUSIONS

In this paper, we proposed the inbuilt virtual keyboard and mouse in the desktop monitor and are implemented with minimum use of complex hardware that provides a better result without much complexity. We are sure that this prototype model brings an evolution in desktop computers with less hardware devices. More gesture based feature can be added that will make it more close to the virtual devices.

REFERENCES

1. Kölsch, M. and Turk, M. “Keyboards without Keyboards: A Survey of Virtual Keyboards,” Workshop on Sensing and Input for Media-centric Systems, Santa Barbara, CA, June 20-21, 2002.
2. D. H. Won, H. G. Lee, J. Y. Kim and J. Park, “Development of A Wearable Input Device Recognizing Human Hand and Finger Motions as A New Mobile Input Device,” International Conference on Control, Automation and System, pp. 1088-1091, 2001
3. Sense board Tech. AB, http://www.senseboard.com
4. www.dfrobot.com http://www.dfrobot.com/index.php?route=product/product&product_id=931#.U0rB4vTIuuI)
5. BI-CONCAVE LENS (BCC), http://www.lambda.cc/bi-concave-lens-bcc/
6. http://www.slideshare.net/priyalbhagat/laser-protection-virtual-keyboard
7. Kolsch, M. and Turk, M.” Keyboards without Keyboards: A survey of Virtual Keyboards,” n. pag. University of California, Nov. 05, 2003 (http://www.create.ucsb.edu/sims/PDFs/Koelsch_an d_Turk_SIMS.pdf).
8. Lawrence Erlbaum Associates Inc, “Human Computer Interaction,” pp 89-129, 2002(http://www.almaden.ibm.com/u/zhai/papers/Zhai HunterSmithHCIGalley.pdf).
9. Alpern, M., “Projection Keyboards,” Oct. 28, 2003 (http://www.alpern.org/weblog/stories/2003/01/09/ projectionKeyboards.html).
10. Baxes, G. A. “Digital Image Processing – Principles and Applications, America, 1994.
11. Gonzalez, R. and Woods, R.,”Digital Image Processing,,” India, 2002.
12. Wijewantha N. S.,” VistaKey: A Keyboard Without A Keyboard – A Type Of Virtual Keyboard,” Final year project thesis, Informatics Institute of Technology, Wellawatta, Sri Lanka, April 2004.
13. Hirsh, L., “Virtual Keyboard Replicates Real Typing,” Oct. 23, 2003 (http://www.wirelessnewsfactor.com/perl/story/147 62.html).
14. Wrolstad, J., “Laser Device Projects Full-Size Keyboard for Handhelds,” Oct. 28, 2003 (http://www.wirelessnewsfactor.com/perl/story/177 56.html).
15. Khar, A., “Virtual Typing,” Oct. 28, 2003 (http://www.pcquest.com/content/technology/10303 0402.asp).
16. Aid Inc, “LightKey Visualize A Virtual Keyboard. One With No Moving Parts,” Nov. 12, 2003(http://www.advancedinput.com/AIDpdfDownloads/AIDLightKey.pdf)
17. Virtual Wireless Keyboard System with Coordinate mapping, International Journal of Advances in Engineering & Technology, July, 2014.