International Journal of Information & Computation Technology.
ISSN 0974-2239 Volume 2, Number 2 (2012), pp. 57-62

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Hand Gesture Recognition Method for Human Machine Interface

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Abstract

In today's digitized world, processing speeds have increased dramatically, with computers being advanced to the levels where they can assist humans in complex tasks. Yet, input technologies seem to cause a major bottleneck in performing some of the tasks. So we have come up with the idea of virtual mouse where we can operate the screen simply with the help of hand gestures. A virtual mouse is software that allows users to give mouse inputs to a system without using an actual mouse.

Keywords*:* Complex tasks, Technologies, Virtual Mouse, Hand Gestures, Mouse.

Introduction

A **virtual mouse** is software that allows users to give mouse inputs to a system without using an actual mouse. To the extreme it can also be called as hardware because it uses an ordinary web camera. Virtual mouse which uses web camera works with the help of different image processing techniques. In this the hand movements of a user is mapped into mouse inputs. A web camera is set to take images continuously.

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.

There is no other more popular navigation/interaction device than the mouse. Overcoming the restrictions a corporeal device has would enrich the experience of interaction. Keeping this in mind, we present an idea of implementing a virtual mouse system as an alternative.

Virtual Mouse is:

- User makes a specified hand gesture that is captured by a camera.
- Object recognition techniques are used to extract information from the capture.
- This is then translated to some meaningful event on the screen.

Figure 1: Flow Chart

Why VIRTUAL MOUSE is needed:

- Mouse is a physical device subject to mechanical wear and tear.
- It is not easy to adapt to different environments and is often limited by environment.
- Limited functions even in present operational environments.
- VIRTUAL MOUSE hopes to fulfill these requirements of the user by overcoming normal physical barriers.

Literature Survey

Existing System

Trackball: The user rolls the ball with the thumb, fingers, or the palm of the hand to move a cursor.

Disadvantages

- Usually not as accurate as a mouse.
- Ball mechanism of trackballs requires more frequent cleaning than a mouse.
- Not very user friendly.

Mechanical Mouse: A single ball that could rotate in any direction.

Disadvantages

- Cannot provide high precision performance.
- Has specific surface requirements to operate.
- Needs more desk space when compared with a trackball.

Proposed System

Any new product should either make human life more comfortable, more productive or more fun. It provides greater flexibility than the existing system. It can provide more functions depending on the choice of object. It is easy to modify and adapt. It is less prone to physical damage due to absence of a fixed physical device. VM avoids the mouse-related wrist damage like CTS & RSI. Also, there is a certain degree of fun & entertainment associated with the whole idea.

The Proposed Method

Viola & Jones Algorithm

We use Viola-Jones Face Detection algorithm in this paper . At a high level, the algorithm scans an image with a window looking for features of a human face. If enough of these features are found, then this particular window of the image is said to be a face. In order to account for different size faces, the window is scaled and the process is repeated. Each window scale progresses through the algorithm independently of the other scales. To reduce the number of features each window needs to check, each window is passed through stages. Early stages have less features to check and are easier to pass whereas later stages have more features and are more rigorous. At each stage, the calculations of features for that stage are accumulated and, if this accumulated value does not pass the threshold, the stage is failed and this window is considered not a face. This allows windows that look nothing like a face to not be overly scrutinized. To more thoroughly understand the algorithm, some specifics need to be defined including features, a special representation of the image known as the Integral Image,and a stage cascade.

Hand Detection

Most of hand detection methods are sensitive to complicated background. Skin color based hand detection is unreliable for the difficulty to be distinguished from other skin-colored objects and sensitivity to lighting conditions. Approaches using shape models require sufficient contrast between object and background. There has been some effort to detect hand in grey image like Adaboost. It’s similar to method in face detection and is adopted in our hand detection. Hand detection in our method is an initial step of interaction.

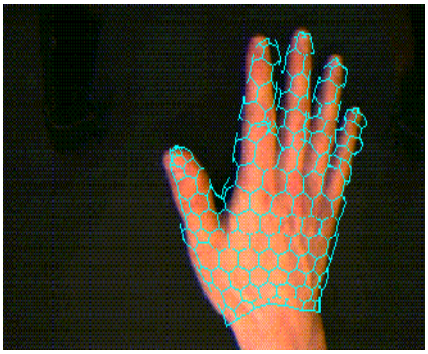

Figure 2: Hand tracking

Gesture Recognition

Gesture recognition is a topic in computer science and language technology with the goal of interpreting human gestures via mathematical algorithms. Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Current focuses in the field include emotion recognition from the face and hand gesture recognition. Many approaches have been made using cameras and computer vision algorithms to interpret sign language. However, the identification and recognition of posture, gait, proxemics, and human behaviors is also the subject of gesture recognition techniques.

Gesture recognition can be seen as a way for computers to begin to understand human body language, thus building a richer bridge between machines and humans than primitive text user interfaces or even GUIs (graphical user interfaces), which still limit the majority of input to keyboard and mouse.

Gesture recognition enables humans to interface with the machine (HMI) and interact naturally without any mechanical devices. Using the concept of gesture recognition, it is possible to point a finger at the computer screen so that the cursor will move accordingly. This could potentially make conventional input devices such as mouse, keyboards and even touch-screens redundant. Gesture recognition can be conducted with techniques from computer vision and image processing.

Figure 3: Gesture definition.

Modules

This interesting feature has many modules in it:

Video capturing module

- It will capture real time video. It require JMF framework which provides interface to access camera.
- Requirement: It needs a Peripheral webcam at least 30 frames/second, 640x480 resolution

Hand detection module

- Hand (palm) is detected from given image to detect gesture.
- Opt 1. Haar cascade training can be use for hand detection
- Opt 2. Template base matching can be use.

- Opt 3. Can put an restriction by using gloves of specific colour mostly Black or White.
- Opt 3 is more feasible in term of time as well effort.

Robot class module (Mouse functionality module)
Will implement single click, double click, right click, scroll functions by using robot class of java.

Other modules

- Other modules can require for image processing, UI module
- Language Used: JAVA
- Java serves as a bridge between various Operating systems. Also Java is widely considered to be the best in developing network applications.

Operating System: Windows 2000/XP and Vista
Any operating system can be used having good compatibility. It should support web camera installation since web camera is the major device used to capture images.

Processor Requirements: Intel Pentium IV
Main Memory : 512 MB RAM
Hard Disk : 80 GB

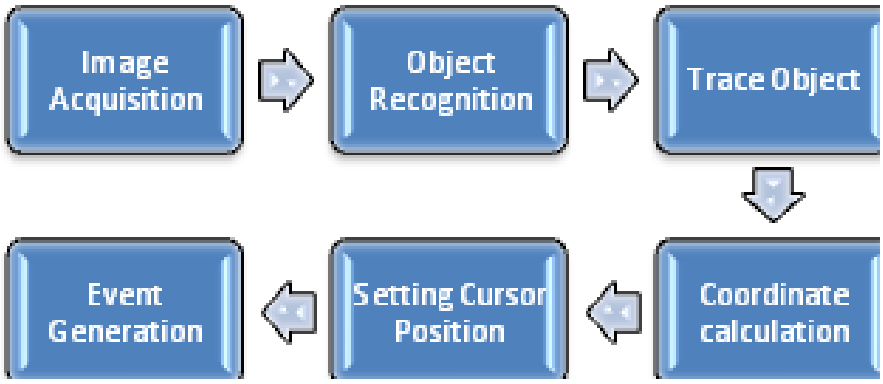

Figure 4: Flow of the system

Conclusion

We have presented a VIRTUAL MOUSE implementation using the Viola-Jones algorithm that achieves performance comparable to that of the Existing physical mouse. VIRTUAL MOUSE is an idea of implementing an adaptable, multi-functional navigation/interaction tool that overcomes physical barriers. The system will be 'real' enough to not affect the interaction much. Its ease of use is the foremost concern. The project goal will be to build a system that satisfies all three ideals. It has varied future

enhancement. Development for specific objects. Creation of particular action areas for utility. It has more advanced and highly specific functionality.

Acknowledgement

This Project itself is an acknowledgement to the inspiration, drive and technical assistance contributed by many individuals. Our work would have never seen the light of this day without the help and guidance we have received**.** I wish to present my sincere thanks to all my teachers, my H.O.D and especially my guide Prof. Sunita Barve for their unflinching support and persuasion that has led to the selection of this project topic.

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