**CHAPTER 1**

**INTRODUCTION**

**1.1 Overview**

PC innovation has massively grown over the previous decade and has turned into a vital piece of ordinary life. The essential PC hardware for Human Computer Interaction (HCI) is the mouse. The mouse isn't appropriate for HCI in some genuine circumstances, for example, with Human Robot Interaction (HRI). There have been numerous explores on elective strategies to the PC mouse for HCI. The most characteristic and natural strategy for HCI, that is a reasonable swap for the PC mouse is with the utilization of hand motions. This task is subsequently gone for examining and building up a Computer Control (CC) framework utilizing hand motions. Most workstations today are outfitted with webcams, which have as of late been utilized instability applications using face acknowledgment. So as to tackle the maximum capacity of a webcam, it tends to be utilized for vision-based CC, which would adequately dispose of the requirement for a PC mouse or mouse cushion. The handiness of a webcam can likewise be extraordinarily stretched out to other HCI application, for example, a communication via gestures database or movement controller. HCI utilizing hand motions is instinctive and powerful for balanced connection with PCs and it gives a Natural User Interface (NUI). There has been broad research towards novel gadgets and strategies for cursor control utilizing hand signals. Other than HCI, hand motion acknowledgment is additionally utilized in communication via gestures acknowledgment, which makes hand motion acknowledgment much increasingly noteworthy. Human Computer Interface mainly focus on the development of an efficient and easy to use interfaces. The personal computers have a variety of options to interact with different applications efficiently with the use of mouse, track-pad, Joystick etc. Nowadays touchscreen technology is available for devices like mobile phones. But this technology is still costly when used in the personal computers. And the devices currently used to interact are frequently breakable. Our objective was to make an alternative technology to interact with the computer which not as costly as the touchscreen technology and is easy to operate with.

**1.2 Problem Statement**

Generally, for personal use in computers and laptops we use a physical mouse or touchpads invented a long time ago and in this project requirement for external hardware is completely eliminated by using human computer interaction technology we detect hand movements and gestures for mouse movements and mouse events. Our software is targeted to people who have very limited physical movement like bedridden people. It could also be used by people using their personal computers in flights or in a car.

**1.3 Goals of the System**

* Capability to control the mouse without physically touching the system.
* A system that ensures vision-based machine.
* Capability of controlling mouse functions using hand gestures.
* To eliminate the limitations of stationary hand.
* To provide real time gesture-based tracking system.

**CHAPTER 2**

**LITERATURE STUDY**

**2.1 Mouse Cursor Control System Based on Hand Gesture**

Authors: Horatiu-Stefan Grif, Cornel Cristian Farcas

The paper presents a human computer interaction interface for mouse cursor control. The purpose of the implemented solution is to control the mouse cursor by user hand gestures captured through a webcam. For improving the gesture recognition based on the fluctuation of illuminance levels the finger strips colour detection was used. There were three different colour strips used. Along with this the hand was moved on the plain surface and its movement was captured by the external webcam. The hand gesture was recognised by the combination of colours detected. The results reveal the good behavior of the system in low light condition. The increased illumination can cause an effect on the detection of colour strips.

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| Pros | Cons |
| 1. Works well in low lighting.  2. It gives better precision than other similar applications. | 1. Use of external webcam.  2. Requires a stable background.  3. The gesture recognition task is influenced by the rotation of the hand on the plane of the pad. |

**2.2 Controlling Mouse Pointer Using Web Cam**

Authors: Gaurav Sahu, Sonam Mittal

This paper deals with the management and enhancement of human interaction with the digital world. Advancement in technology and advanced computing devices allow us to be in continuous touch with the digital world and at the same time restriction of information on traditional platforms like paper, digital screen etc. is overcome with this technology. This paper has proposed a way to control the mouse pointer using webcam. Here different colour strips are used on different fingers. Just the colour strip part is extracted from the image captured on basis of pre-defined colour information. The mouse tracking is done based on its movement. The different mouse pointer actions are performed based on the mappings of different colour strips for each action.

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| Pros | Cons |
| 1. All basic mouse functions can easily be carried out. 2. It can be applied to areas of Augmented Reality, Computer Gaming etc. | 1. Use of colour strips instead of actual finger detection. 2. Calculations used are complex which makes the system difficult to understand and extend forward. |

**2.3 Finger Gesture Control Computer Mouse with Image Processing**

Author: Heera Lal Bhadrecha

Controlling the mouse cursor movement and clicks events (Left click and Right click) of the computer mouse using finger motion and gestures. Finger gestures were acquired using a camera based on skin detection algorithm with different angle detected images. This method mainly focuses on the use of Web-Camera to create a cost-effective virtual mouse using webcam with image processing. Here the binary image of the hand is extracted from the captured image. Then the centroid and the extreme points are found out along with the angle made at the centroid. And based on these angles, the mouse cursor is controlled and different click events are been performed.

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| Pros | Cons |
| 1. Cost Effective 2. Vast range of applications. | 1. Limited functionality. 2. Output is fluctuated due to change in lighting. 3. Pc requires high computations capacity to run the complex functions. |

**2.4 Human hand gesture based system for mouse cursor control**

Authors: Horatiu-Stefan Grif, Trian Turc

The goal of the paper is to improve the recognition of the human hand postures in a Human Computer Interaction application, the reducing of the time computing and to improve the user comfort regarding the used human hand postures. The authors developed an application for computer mouse control. The application based on the proposed algorithm, hand pad colour and on the selected hand feature presents good behaviour regarding the time computing. They have used the hand angle to determine different hand gestures. These hand angles are been captured by the external web-camera which is focused on the blue background on which the hand moves. The user has an increased comfort in use of the system due to the proposed hand postures. Also, the system works well having the same behaviour under very low illuminance level and high illuminance level.

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| Pros | Cons |
| 1. Uses natural and more relaxed postures. 2. No additional noise removal filter is used. | 1. Works well only in well-lit environments. 2. A single colour background is required to detect the gestures. |

**2.5 Simulation of Mouse using Image Processing Via Convex Hull Method**

Authors: Ahemad Siddique , Abhishek Kommera ,Divya Varma

Computer and human life is co-related with communication. For better performance it is mandatory that the user interact with the machine to enhance productivity. Based on extrapolation of past trends and examination of technologies under development the following paper serves to be a new approach for controlling mouse movement using image processing technique. Most existing approaches involve changing mouse components or miniaturisation mouse design with advancement in computing. We propose to change the hardware design itself. The following paper is similar to the base research for Human Computer Interaction (HCI) which observe the way in which human interacts with computer and design technologies. The proposed paper makes use of image processing via Convex Hull Method and uses human hand gestures to replace mouse functions. The frame of reference is extracted from the captured image after which the finger tips are found. Based on these finger points and the area covered by a gesture, different hand gestures are found out.

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| Pros | Cons |
| It uses Convex Hull Algorithm , which makes hand detection easy. | 1. Heavy Software. 2. Requires latest technology for smooth operation. |

**2.6 Design and Development of Hand Gesture Based Virtual Mouse**

Authors: Kabid Hassan Shibly, Samrat Kumar Dey, Md. Aminul Islam, Shahriar Iftekhar Showrav

This paper proposes a virtual mouse system based on HCI using computer vision and hand gestures. Gestures captured with a built-in camera or webcam and processed with colour segmentation & detection technique. The user will be allowed to control some of the computer cursor functions with their hands which bear coloured caps on fingertips. Primarily, a user can perform left clicks, right clicks, and double clicks, scrolling up or down using their hand in different gestures. This system captures frames using a webcam or built-in cam and processes the frames to make them track-able and after that recognises different gestures made by users and perform the mouse function. So the proposed mouse system eliminates device dependency in order to use a mouse.

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| Pros | Cons |
| 1. Most mouse functions can be carried out. 2. It can be used for patients with very limited limb control. 3. It is also usable in sign language. | 1. External camera is required for the software to correctly detect the gestures. 2. The background highly influences the output generated. 3. Colour strips are used to detect different fingers. |

**2.7 Gesture Based Computing as an Alternative to Mouse by Calibrating Principal Contour Process Actions**

Authors: Chinnu Thomas, D.Lakshmi

The topic of user experience and interaction has been increasingly popular and widespread lately. Unlike decades ago, when people place most of their attentions on the quality and functionality, or brand of a product, at the present time, the user interaction experience and usability seems to be the vital element when people are considering and selecting a product. Gesture based computing enables humans to interface with the machine (HMI) and interact naturally without any dedicated devices. Building a richer bridge between machines and humans than primitive text user interface or even (graphical user interfaces) GUIs, which still limit the majority of input to keyboard and mouse. In fact we are bridging this gap by bringing intangible, digital information out into the tangible world, and allowing us to interact with this information via natural hand gestures. Gesture Based Computing provides an attractive alternative for human computer interaction (HCI).

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| Pros | Cons |
| 1. High Accuracy. 2. Recognition rate – 90.45% | 1. Use of external gloves for hand detection. 2. Time consuming. 3. Confusion between gestures. |

**2.8 Virtual Mouse Using Hand Gesture**

Authors: Abhilash S , Lisho Thomas, Naveen Wilson, Chaithanya C

This paper proposes a novel camera vision based cursor control system, using hand gestures captured from a webcam through a colour detection technique. The system will allow the user to navigate the computer cursor using their hand bearing colour caps or tapes and left click and dragging will be performed using different hand gestures. And also it performs file transfer between two systems in a single same network. The proposed system uses nothing more than a low resolution webcam that acts as a sensor and it is able to track the users hand bearing colour caps in two dimensions. Here the red colour strips are used. These red strips are extracted from the captured image based on the mask and then depending on the number of red objects contoured the dragging or clicking action is performed. The system will be implemented using the python and OpenCV. The hand gesture is the most effortless and natural way of communication. The output of the camera will be displayed on the monitor. Shape and position information about the gesture will be gathered using detection of colour . The file transferring scheme is implemented by using the python server programming.

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| Pros | Cons |
| 1. Its main aim is to focus on humans that don’t have control of their limbs. | 1. Very limited functionalities. 2. Lighting affects the results. |

**2.9 Hand Recognition and Gesture Control Using a Laptop Web-camera**

Authors: Zi Xian , Justin Yeo

Hand gesture recognition is a technology that is becoming increasingly relevant, given the recent growth and popularity of Virtual and Augmented Reality technologies. It is one key aspect to Human Computer Interface, allowing for two-way interaction in virtual spaces. However, many instances of such interaction are currently limited to specialized uses or more expensive devices such as the Kinect and the Oculus Rift. In this paper we explore the methods for hand gesture recognition using a more common device – the laptop web-camera. Here the edge detection is done on the captured image, then the background is elimination algorithm is applied to it and the threshold of resultant is calculated and from the resultant hand image the different hand gestures are been recognized. We explore and test three different methods of segmenting the hand and document the pros and cons of each method. We will also cover one method for hand gesture recognition.

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| Pros | Cons |
| 1. No external equipment. 2. Use of canny edge detection. | 1. Limited functionalities. 2. Low Accuracy. 3. Limited research performed. |

**2.10 Efficient Fingertip Tracking and Mouse Pointer Control for a Human Mouse**

Authors: Jiyoung Park, Juneho Yi

This paper discusses the design of a working system that visually recognizes hand gestures for the control of a window-based user interface. We present a method for tracking the fingertip of the index finger using a single camera. Our method is based on ‘CAMSHIFT’ algorithm and it tracks well the particular hand poses used in the system in complex backgrounds. We describe how the location of the fingertip is mapped to a location on the monitor, and how it is both necessary and possible to smooth the path of the fingertip location using a physical model of a mouse pointer. Our method is able to track in real time yet does not absorb a major share of computational resources. The performance of our system shows a great promise that we will be able to use this methodology to control computers in near future.

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| Pros | Cons |
| 1. Based on CAMSHIFT. 2. Easily able to follow the movement of hand. | 1. Research and Development is expensive and consumes a lot of data. |