Taxonomy of Human Computer Interaction Techniques

Deepika
M.Tech. Scholar
Department of Computer Science and Applications
Ch. Devi lal University, Sirsa- 125055, Haryana (India)

Manju
Lecturer
Department of Computer Engineering
CDL Govt. Polytechnic ES, Nathusari Chopta, Sirsa- 125055

Dr. Harish Rohil
Asst. Professor
Department of Computer Science and Applications
Ch. Devi lal University, Sirsa- 125055, Haryana (India)

Abstract - Human–computer Interaction (HCI) involves the study, planning, and design of the interaction between people (users) and computers. The techniques of HCI become very popular and new techniques have been developed from the last few years which include the development from text-based like using a keyboard to graphic user interface (GUI) based on a mouse, from cumbersome data gloves and tracking devices to visual-based computer application. HCI is also sometimes referred to as man–machine interaction (MMI) or computer–human interaction (CHI). For HCI, usability is the main key concept. There are many different methods for interacting with the machine. So this paper, discusses the various HCI methods from input device like keyboard, mouse to gesture recognition.

Keywords- human-computer interaction, gesture recognition, man–machine interaction, MMI, computer–human interaction, CHI.

1. INTRODUCTION

In the present day framework of interactive, intelligent computing, an efficient human–computer interaction is assuming utmost importance in our daily lives. HCI is the way of communication with the computer [1]. Now a day, only input devices are not sufficient or natural to communicate with the computer. Many modern devices come into era. This paper's main goal is to discuss the various techniques of HCI that are able to communicate with computer in almost every situation. Discussion of various methods are included in this paper some of which provide natural way to interact with the computer for example vision based method which will be discussed later. For HCI, we not only need two dimensional interactions but want to interact in virtual environment which understand other aspects of human behavior or state that can be used to model communication between a human and the environment [6]. There are many methods to communicate with the computer but to attain the natural method is a crucial part of HCI because if it does not segment the object of interest properly further analysis would be impossible. The taxonomy for HCI is mainly divided into two main methods one is by input devices which include keyboard, mouse etc and other is by hand gestures method which is further subdivided into data gloves based and vision based [5]. All these methods are discussed in detail in the next sections.

The content of this paper is organized as follows. Section 2 gives the introduction of HCI. Section 3 shows the taxonomy of HCI. The paper is concluded in Section 4.

2. HUMAN COMPUTER INTERACTION (HCI)

HCI is the study of how people interact with computers and to what extent computers are or are not developed for successful interaction with human beings. There is a great demand of good technique for HCI because to be a good programmer, one must be sympathetic to the nature and needs of the computer. But the nature and needs of the computer are utterly alien to the nature and needs of human beings who will eventually the human being who will eventually use it [2]. As its name implies, HCI consists of three parts: the user, the computer itself, and the ways they work together. The study of relationships between people and computers/computer mediated information is also the definition of HCI. The components of HCI are:

1. User
2. Computer
3. Interaction

User: By "user", we may mean an individual user, a group of users working together.

Computer: When we talk about the computer, we're referring to any technology ranging from desktop computers, to large scale computer systems. For example, if we were discussing the design of a Website, then the Website itself would be referred to as "the computer". Devices such as mobile phones or VCRs can also be considered to be “computers”.

Interaction: There are obvious differences between humans and machines. In spite of these, HCI attempts to ensure that they both get on with each other and interact successfully. In order to achieve a usable system, you need to apply what you know about humans and computers, and consult with likely users throughout the design process. In real systems, the schedule and the budget are important, and it is vital to find a balance between what would be ideal for the users and what is feasible in reality.

For HCI one must understand usability. Usability is one of the key concepts in HCI. It is concerned with making systems easy to learn and use.

Usability is defined as a measure of the effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in a particular environment.”

A usable system is one which consists of following characteristics:

- easy to learn
- easy to remember how to use
- effective to use
- efficient to use
- safe to use
- enjoyable to use

3. TAXONOMY OF HCI

HCI can be done by various ways. The GUI has dominated the way we interact with computer.

For years, human-computer interaction was mostly based on mouse and keyboard to control the computer. In the last few years, new input techniques have been developed that are richer and less prone to many shortcomings of keyboard and mouse interaction. Now more natural techniques have been developed. So the human-computer interaction research and development was therefore becoming an interest by many researchers in this recent year. There are several techniques introduced for the new Era of human-computer interaction such as mechanical devices, gestures etc [8].

Methods which are used for human computer interaction is shown in Figure 1. This Figure presents the various techniques used for human computer interaction from input devices to hand gestures. These methods are discussed in detail in this paper with their merits and demerits.

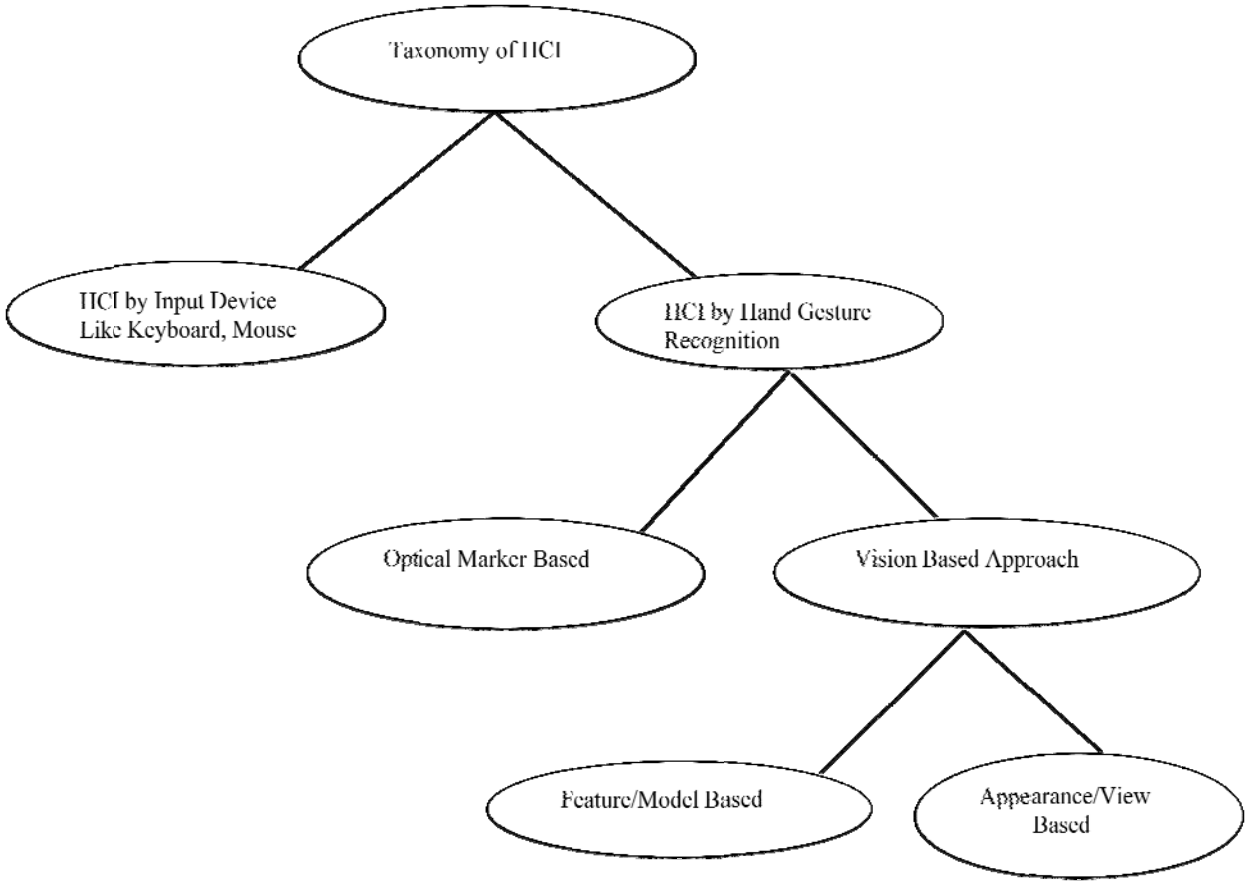

Figure 1. Taxonomy of Human Computer Interaction Techniques

3.1 HCI by Input Devices like keyboard, Mouse etc: There are many techniques for interacting with the computer. Input devices is one out of them which is very popular till now. Input devices are used for giving the input to the

computer on which the processing takes place and then some output comes by the output devices. For years, human-computer interaction was mostly based on mouse and keyboard to control the computer. These devices are very old and popular devices. In current application, keyboards, mice, wands, and joysticks are still the most popular and dominant devices [5]. Still the work for input is going on by these devices. Although input devices are very popular but there are some limitations related to these devices. These are 1) The traditional human computer interactive way may become a bottleneck in the effective utilization of available information 2) They are inconvenient and unnatural 3)The conventional Human Computer Interaction devices such as keyboard, mouse, joysticks, roller-balls, touch screens, and electronic pens are inadequate for latest Virtual Environment (VE) applications 4) These devices restrict the complete utilization of high performance hardware due to their limited input characteristics 5) This method is still very popular but if a person is physically disabling ,this method is not consider well in that case [7] [1]. Due to the presence of these limitations, the VE applications offer the opportunity to integrate various latest technologies to provide a more immersive user experience like body movements known as gestures.

3.2 HCI by Gesture Recognition: Gestures are expressive, meaningful body motions involving physical movements of the each and every part of the body such as hand and arms etc. with the intent of: 1) conveying meaningful information or 2) interacting with the environment. They constitute one interesting small subspace of possible human motion [1]. A gesture may also be perceived by the environment as a compression technique for the information to be transmitted elsewhere and subsequently reconstructed by the receiver. In other words, a gesture is a meaningful concept of motions done by human and is of supreme importance in designing an intelligent and efficient human–computer interface [11]. Gestures method is needed because each sensing technology varies along several dimensions, including accuracy, resolution, and latency, range of motion, user comfort, and cost.

Today, gesture recognition, and especially hand gesture recognition, has different and considerable applications, such as; vision and robotic, computer games, communication deaf people with computer, and emotional recognition. Hand gesture technique can be classified into two different methods. It can be done by mechanical devices like data glove devices in which user has to wear device in hand and other method is vision based hand gesture recognition technique in which segmentation has to be done for hand [4][12].

3.2.1 Magnetic or Optical Markers-Based: This is one method in HCI by gesture recognition which includes hand. The early technology of hand gesture detector used mechanical device to retrieve the information of the hand gesture. One of the example included data glove devices which user send the information to the computer system through the movement of fingers. Data glove is quite popular at the several years ago [10].The data glove based techniques involve cumbersome hardware, such as sensory gloves, which makes them inadequate for low cost real time applications. The glove-based interaction is more intuitional, but it is expensive and users have to wear special equipment. Any practical implementation of gesture recognition typically requires the use of different imaging and tracking devices or gadgets. These include instrumented gloves, body suits, and marker based optical tracking. Glove-based gestural interfaces typically require the user to wear a cumbersome device and carry a load of cables

connecting the device to a computer. This hinders the ease and naturalness of the user's interaction with the computer. So to avoid the limitations of this technique, vision based approach comes to handle HCI [4] [11].

3.2.2 Vision-Based Approaches: Vision-based hand tracking or gesture recognition is a robust, accurate, and easily accessible manner Vision-based technique. While tracking devices can detect fast and subtle movements of the fingers when the user's hand is moving, a vision-based system will at best get a general sense of the type of finger motion. Again, vision-based devices can handle properties such as texture and color for analyzing a gesture, while tracking devices cannot. Vision-based techniques can also vary among themselves in 1) the number of cameras used; 2) their speed and latency 3) the structure of environment (restrictions such as lighting or speed of movement); 4) any user requirements (whether user must wear anything special) 5) the low-level features used. The vision-based hand gesture slowly replaces the role of data glove with non wearable devices because it is more naturalness without using any devices in the hand and user friendly which is important in human-computer interaction. Compared with data glove, it look cumbersome and limitation in the movement of hand. Because vision is one of the six physical media that computer must be instantiated perceptibly when communicated to humans. Hence, vision-based approach is more than wearable devices in hand gesture recognition. Vision Based methods require only a camera, thus realizing a natural interaction between humans and computers without the use of any extra devices [11] [3]. These systems tend to complement biological vision by describing artificial vision systems that are implemented in software and/or hardware. In vision based hand gesture recognition system, the movement of the hand is recorded by video camera(s). This input video is decomposed into a set of features taking individual frames into account. The hands are isolated from other body parts as well as other background objects. The isolated hands are recognized for different postures.

The vision based methods are further classified into two major categories:

3.2.2.1 Feature/Model Based: In feature/model based methods, one needs to extract models or features from images .This approach has several disadvantages that have kept it from real-world use. First, at each frame the initial parameters have to be close to the solution, otherwise the approach is liable to find a suboptimal solution (i.e. local minima). Secondly, the fitting process is also sensitive to noise (e.g. lens aberrations, sensor noise) in the imaging process. Finally, the approach cannot handle the inevitable self-occlusion of the hand [5] [6].

3.2.2.2 Appearance/view Based Approaches: In appearance/view based methods, images can be used directly for hand gesture recognition. However, the performance of appearance-based approaches is degraded by variations in illumination, cluttered backgrounds, and user variance [9].

4. CONCLUSION

In this paper, we discussed the various methods of HCI which include traditional as well as modern methods with their merits and demerits. The various methods discussed tell the interaction or communication of human and machine. To overcome the limitations of traditional methods, new methods like hand gesture interaction can serve as improving the interaction between human and computer. The evolution of computer technology have reached that

human can interact with computer by using non-verbal language. In order to increase the accuracy rate, user satisfactions, and reduce the error rate and also included expenses, some new and modern methods has been discussed. By enhancing gesture technology into the system, many limitations have been improved like cost, time etc.

REFERENCES

[1] Yee Yong Pang, Nor Azman Ismail, Phuah Leong Siang Gilbert," A Real Time Hand Gesture Interaction", Fourth Asia International Conference On Mathematical/ Analytical Modeling And Computer Simulation, Pages 237-241, 2010.

[2] Erika Rogers, "Introduction To Human Computer Interaction", RAS/IFRR Summer School on "Human-Robot Interaction" , 2004.

[3] Vladimir I. Pavlovic, Student Member, IEEE, Rajeev Sharma, Member, IEEE, and Thomas S. Huang, Fellow, IEEE, "Visual Interpretation of Hand Gestures for Human-Computer Interaction: A Review", IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 19, No. 7, Pages 677-695, 1997.

[4] Mr. Chetan A. Burande, Prof. Raju M. Tungnayat and Prof. Nitin K. Choudhary, "Advanced Recognition Technique for Human Computer Interaction", pages 480- 483, 2010.

[5] Ehsan ul haq, Mirza Waqar Baiq and Hyunchal Shin, "New Hand Gesture Recognition Method for mouse operation", 2011.

[6] Harshith.C, Karthik.R.Shastry, Manoj Ravindran, M.V.V.N.S Srikanth, Naveen and Lakshmikhanth, "Survey On Various Gesture Recognition Techniques For Interfacing Machines Based On Ambient Intelligence", International Journal of Computer Science & Engineering Survey (IJCSES) Vol.1, No.2 Pages 31-42, 2010.

[7] Yepeng Guan, Mingen Zheng, "Real Time Gesture Recognition For Natural HCI",7th World Congress On Intelligent Control And Automation, Pages 2433-2436, 2008.

[8] Kuan Yu Chen,Cheng Chin CHIEN,Wen Lung Chang,Jyh Tong Tang, "An Integrated Color and Hand Gesture Recognition Approach for an Autonomous Mobile Robot", 3rd International Conference On Image And Signal Processing, Pages 2496-2500, 2010.

[9] Tomasz Kapuscinski and Marian Wysocki," Hand gesture recognition for man -machine interaction" Second Workshop on Robot Motion and Control, October 18-20,pages 91-96,2001.

[10] J.David and Z. David, "A Survey of Glove-based Input", IEEE Computer & Graphics & Applications, vol.4, Pages 30–39, 1994.

[11] Ehsan ul haq, Mirza Waqar Baiq and Hyunchal Shin,"New Hand Gesture Recognition Method for mouse operation", 2011.

[12] Filipe Tomaz and Tiago Candeias and Hamid Shahbazkia, "Improved Automatic Skin Detection in ColorImages**"** Proc. VIIth Digital Image Computing: Techniques and Applications, Sun C., Talbot H., Ourselin S. and Adriaansen T. (Eds.), Pages 420-427, 2003.