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AN OVERVIEW OF HUMAN COMPUTER INTERACTION AND ROLE OF GESTURES

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***Abstract*— Since its emergence, Human Computer Interaction(HCI) has risen as a field of study for a powerful collaboration between user and computers. This paper exhibits an understanding of the idea of human computer collaboration. Also, we present a briefing of evolution of HCI and how gestures provide a reliable means of interaction to facilitilate an increasingly natural technique for interacting with our computers. This paper gives an overview of existing writing in regards to gesture recognition for communication between a human and computer by classifying it as per hand motions and eye motions. The usage of motions as a characteristic interface attracts the consideration for research in novel strategies. Further, study of noteworthy studies in vision based systems is additionally discussed about. The key purpose of this paper is to depict the usefulness of human computer interaction and to exhibit a rundown of progress accomplished till date which can further enhance the current gesture recognition systems for future direction.**

***Keywords*— Evolution of HCI, Gesture Recognition, Hand Gestures, Interaction in HCI**

I. INTRODUCTION

Human Computer Interaction (HCI) is a field of study that came into see in the mid 1980s. From that point forward, HCI has broadened quickly and invariantly. As a field of study, collaboration between humans and computer is multidiscipliniary which envelops software engineering, behavioral sciences, cognitive science and other diverse fields of study. Human Computer Interaction is defined as a subject which manages with the structure, assessment and execution of intelligent processing frameworks used by people and with the study of significant events comprising them [1]. The UI (User Interface) or human–machine interface is the component of the machine which coordinates this cooperation. In addition, user experience design interrogates whether individuals will utilize the system. This is accomplished through a good interaction design. Usabilty of the design is likewise a major factor which influences the viability of correspondence wherein client fulfillment, clearness and utility are among the quality attributes to improve the client experience. Membrane switches, rubber keypads and touchscreens are some of the early inventions in the area of the Human Machine Interface which we can perceive and get in contact with while natural interfaces, for example, gestures are discussed later in this paper.

II. INTERACTION IN HCI

The "Human Computer Interaction" as the term recommends is the means by which a human interacts with a PC. Connection among users and environment is smoothened by observing the usability. Convenience contemplates the style and clearness with which the communication with a program is structured. A user experience design is answerable for each user confronting part of a system wheras interaction design, which is a part of user experience design depends just on the association among clients and computers. A natural or intuitive "HCI" is having the capacities to react and detect appropriately as indicated by affective feedback of the user and detect as well as interpret the user's affective states. Three significant ideas to enhance the perception in human-computer communication later on are "dynamic visualizations, multimodal interaction", and "cooperative exploration" [2] .

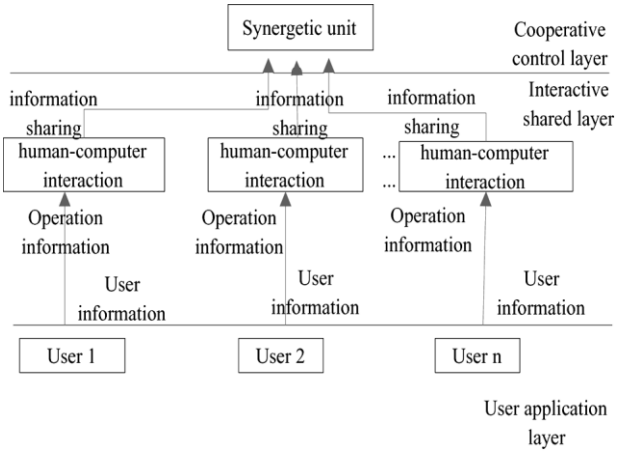

Fig 1: Human Computer Interaction with various users

III. EVOLUTION OF HCI

The fundamental objective of Human Computer Interaction is to encourage the association between users and computers by developing the computer more responsive to their requirements. With the appearance of ENIAC (Electronic Numerical Integrator And Computer) in 1946, the world's first general-purpose computer, plugboards and switches were utilized as an input device for interaction with the system. The main people who associated with PCs were information technology specialists. Then after, personal computing came into see in the later 1970s being launched by Apple and IBM among others which started occurring at home and working premises. With

the development of personal computing software such as spreadsheets and text editors ; programming languages, hardware and operating systems, plausible computer users increased. HCI surfaced during the 1980s ;since its beginning , HCI(Human Computer Interaction) broadened its scope by comprising multiple disciplines, such as computer science, science of cognition and engineering psychology. Much enhanced systems were available to common consumers for working with more rigorous calculations.

Therefore, PCs were never again cumbersome, costly tools particularly worked for specialists in specific conditions. There was a need to plan such a human-PC collaboration, that was likewise simple and effective for less experienced and non - technically skilled users. Early in the generation of computers, there were no networks and memory was a ton costly. Computers were built for computation, not information processing. Today, memory and data transmission are rich to the point that most calculation is in the task of handling and distributing `information [3]. Figure 1 illustrates the flow of interaction between a user and computer. With the nonstop headway in innovation, Human Computer Interaction today isn't simply constrained to equipment gadgets, for example, console and mouse association but has reached out to progressively normal interfaces such as touch screens, voice recognition and gesture recognition. Having the option to cooperate with the system intuitively is getting perpetually significant in numerous fields of Human Computer Interaction for which gestures can play a fundamental role. Data gloves and suits are turning out to be famous step by step as input devices in human computer interaction. Wearables help to perceive the environment in an augmented reality environment. Consoles and terminals are only antiques of the present innovations; a lot more coming novel advances will change the manner in which we interface with computers.

IV. GESTURE RECOGNITION

For interaction with a virtual environment, conventional 2-D keyboard-, touch pen-, and mouse-based graphical user interfaces are often ineffective. Rather, devices that sense the position and direction of hand and head, speech and sound, direction of gaze, facial expression, and other pertinent features of human behavioral patterns can be used to represent interaction between a human with the environment. These relevant aspects are what we refer to a gestures which are expressive, significant body motions .Gestures serve two main purpose; firstly rendering relevant knowledge and secondly, communication with the environment" [4] .They can include identification of hand poses, fingers, arms, gestures in virtual reality ,eye gestures such as eye tracking through direction of eye gaze, head and face gestures such as looks of happiness, contempt , nodding of head and body gestures which involves full body motion. Gesture recognition, a perceptual user interface refers to recognizing gestures made by the user. A computer interprets the gestures made by the user and execute those commands based on those gestures through various mathematical algorithms and tools. For instance Microsoft's Kinect is used for depth based gesture recognition. This paper discusses various methodologies which are being used for tracking gestures. Belonging to the category of gesture styles, Semaphoric Gestures are widely used nowadays which employ the use of hand or arms for communication with the system. These gestures can be static, dynamic or stroke in nature. Static semaphoric gestures are when a user assumes a particular configuration for instance static movement of a hand like number of fingers, wherseas semaphoric gestures are dynamic if there is a dynamic movement of the hand, arm or head. For example when a user makes a dynamic movement such as waving motion it falls in the category of dynamic semaphoric gestures. Some gestures are a combination of both static as well as dynamic gestures as in the case of sign language. Another kind of semaphoric motions are stroke motions which speak to strokes or checks made with a mouse or touch input which are mapped onto different interface commands. Mouse strokes are used for back and forward control of an internet browser.

V. METHODOLOGY

A. Hand Gestures

Hand motions have a key job for a natural, innovative interface and is a modern strategy for non-verbal communication. Hand motions are executed for an assortment of uses in human computer interaction for communication through sign language and for individuals with disabilities. Visual understanding of gestures through hand can assist in accomplishing the usability required for HCI has been discussed about by Pavlovic et al . (1997). Figure2 shows the procedure for recognition of hand gestures. Vision-based examination and translation of hand motions through "3D hand models and appearance based models" has been discussed about by Pavlovic et al.(1997). 3D hand models utilize the joined and connected prototypes of the hand or arm which assists to identify various types of gestures. While in "appearance based model", the appearance is connected to the image which is perceived as a specific motion and perceives a smaller class of gestures comparitively. Rautaray et al. (2015) have discussed that the 3D model based representations are less favored than the apprearance based because of difficulty in implementation. They lead to computational issue that have not been managed for the real time requirements of HCI while "Appearance-based models" function well under controlled circumstances yet appear to do not have the non- specificity desirable for HCI.

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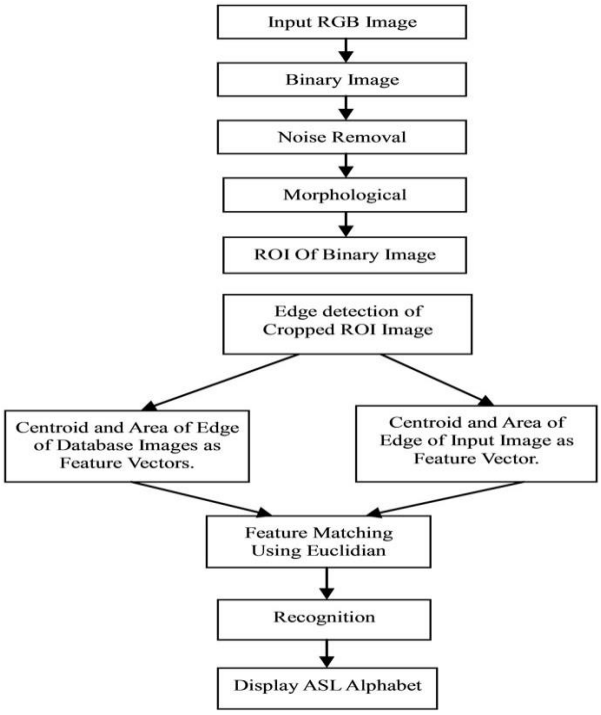

Fig 2: Flowchart for hand gesture detection

The "vision based gesture recognition" in [7] recognizes mutiple users by taking two hand input. In order to capture video images of the screen, three cameras were used by making some modifications on the two camera based technique. Utilizing a "Click Detecting algorithm of two hands "[7], input is applied and afterward moving the fingers on the screen, the input positions are recognized with the fetched fingertip positions and cameras parameters .

By using three cameras, two hands could be fed as input simultaneously. In [8] "AdaBoost" procedure is applied for the automatic recognition of user's hand from the streamed video which depends on "Haarlike features". A multiclass Support Vector Machine is used for grouping and hand signals are trained depending on the "Hu invariant features" [8]. An application system is developed with motion recognition interface. Joslin et al.(2005) have presented dynamic gesture recognition for hand motions. The visual data from the camera is drawn. If exactness and reliability were expanded, sensors and cameras could turn out as essential innovation for gesture recognition interfaces in the future has been discussed in [10]. The transformation from two dimension to full three dimensional space occurs of the categorized data. In order to perceive and distinguish various gestures, even those which have the same combination of fingers, Hidden Markov Model(HMM) is utilized in [10]. A "separable convolutional neural network(CNN)" is proposed in [11] for recognition of a "dynamic gesture". Furthermore, "HoloLens", an augmented reality wearable glass is used to describe the feasibility of the proposed technique. "A directional pulse coupled neuron network(DPCNN)" method is put forth by [12] to perceive realtime motions by changing over the gesture identification problem into the problem of shortest path. Moreover, they have presented an "early recognition algorithm" dependent on the "adaptive window" for better interaction encounters among human and robots. Dong et al. in [12] found "DPCNN algorithm" preferred in execution over different algorithms and is compelling and strong for gesture recognition at real time. "Depth -based gesture recognition" has been discussed about in [13] in respect of the impacts of the cost efficient "Kinect and OpenNI software libraries" on research in gesture recognition. Microsoft's Kinect console, is a motion sensing input device through which the client can collaborate with the content on the screen by means of movements. The communication follows the client's gestures and reacts in real time. It is studied in [13] that "Kinect and the OpenNI libraries" for hand detection will in general depend more on applications, and the "OpenNI handtracking" strategy is sufficient for the applications tried recently. "Segmentation" most normally achieved utilizing "depth thresholding" or region growing methods is discussed in [13] .Tracking of hand gesture is done in [13] utilizing "Kalman filters" and classification of gestures is accomplished with a variety of algorithms, including "Hidden Markov Models, k-Nearest Neighbors , Artificial Neural Networks , Support Vector Machines , and Finite State Machines" .The customary hand identification and tracking techniques are being supplanted by off-the-shelf arrangements, for example, "Prime Sense's NITE module" for the "Open NI" structure 3is demonstrated in[13].An innovative methodology of recognition of hand movement dependent on discovery of some shape based characteristics for perceiving diverse hand patterns is discussed by [14]. Only one camera is utilized to catch the hand gesture which is then after utilized as an input for the method presented in [14]. The methodology in [14] comprises of four fundamental steps, which incorporates "segmentation, orientation detection, feature extraction and classification" .This methodology can help visually impaired individuals as they can utilize these diverse hand gestures for texting content on an electronic medium like MS Office. Shape based methodologies guarantee straightforwardness, higher recognition rate and a less evaluation time when contrasted with other strategies. The disadvantage of this technique is, it doesn't follow any well ordered methodology to define certain criterion for gesture recognition. However contrasted with the system utilized in [15], the achievement rate has expanded from "91% to 92.3%" however the constraints need to be taken of in further approaches for segmentation. An innovative strategy for hand gesture determination was proposed by [16] with identification rate of "90.45% which is based on a hand gesture fitting procedure via a new Self-Growing and Self-Organized Neural Gas(SGONG) network". SGONG is able to represent very effectively the structure of the hand, reduces the noise in images, uses color space and thus provides robust extraction of features.

B. Eye Gestures

Electrooculography(EOG) is a technique which determines the standing potential that occurs between the front and the back of the human eye while electroculogram is the electrical signal which is produced by the corneo-retinal potential difference. There are three types of recognition in eye tracking:

1) Recognition of Basic Eye Moving Mode
2) Recognition of Blink Mode
3) Fixation Mode and the Midas Touch Problem

In [17] standards of producing EOG and techniques for sampling the signals of EOG are presented. Features of eye

gestures are dissimilar from each other. The same study suggests that different templates and criteria in identification algorithms must be set for every indivisual through this higher eye gesture recognition precision can be attained for an effective Human-Computer Interaction. Gaze gestures are the in built sequences of eye movements which have a tremendous number of utilizations in HCI. For instance, gaze gestures can be useful for people with motor disabilities. The localisation technique of eye centre presented in [18] provides an efficient and robust way for collecting eye centre coordinates whose patterns specifically gaze gestures, can be then after assessed, it also proved better than 10 other similar functionality algorithms in terms of accuracy.

The various methodologies applied for recognition of gestures can be summarized as shown in Table 1

Reference	Body movement (gesture)	Method
[5]	Hand Gestures	Vision based using "3D" and "appearance based models"
[7]	two hand input	Vision based using "Three cameras positioning method"
[8]	hand gesture	Vision based "Ada Boost algorithm"
[9]	"dynamic hand gestures"	Vision based (2D to 3D module)
[11]	dynamic hand gestures	"A 3D separable Convolutional Neural network" ,hand gesture library is built through "HoloLens"
[12]	dynamic real time gestures	"directional pulse coupled neuron network (DPCNN) algorithm"
[14]	Hand gesture	"shape based approach"
[16]	Hand gesture	"Self-Growing" and "Self Organized Neural Gas(SGONG) network"
[18]	Gaze gestures	"Eye center localization"

Table1: Various methodologies reviewed on gesture recognition

VI. CONCLUSION

Human computer interaction is a growing field in terms of technology and research. Our effort is to present a basic idea of human computer interaction and various methodologies which are applied for tracking gestures. The emphasis of our survey is laid on hand gestures and eye gestures. The major algorithms and techniques surveyed for this purpose include the Hidden Markov Model, Click Detecting Algorithm, Ada Boost Algorithm, shape based approaches and eye center localization. Also, we studied that neural networks are becoming an increasing area of research for dynamic hand gesture recognition. In today's scenario, in an era of interactive, intelligent computing identifying gestures is an innovation for an intuitive interface and can be termed as an integral perspective in this direction. The immense prospects related to the application of recognition systems for hand gestures especially for people with disabilities consistently continues rousing the developments required to generate the consistent, productive, precise and robust systems for gesture recognition. Over the span of years, HCI has broadened its scope from desktop to mobile games, commerce, education and other numerous domains. More future work can be carried in voice based interfaces, which is an emerging area of research in HCI. Innovative augmented reality and virtual reality wearables can be developed to facilitate user experience for effective interaction. We hope that in the future, based on current methodologies, many other novel approaches will evolve which will contribute to the advancements in Human Computer Interaction.

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