Gesture Recognition and Control

Part 1 - Basics, Literature Review & Different Techniques

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Abstract This Exploratory paper series reveals the technological aspects of Gesture Controlled User Interface (GCUI), and identifies trends in technology, application and usability. It is found that GCUI now affords realistic opportunities for specific application areas, and especially for users who are uncomfortable with more commonly used input devices. It further explored collated chronographic research information which covers the past research work in Literature Review. Researchers investigated different types of gestures, its uses, applications, technology, issues and results from existing research.

Key Words: Gesture recognition, GCUI, HMI, LIF, Computer Vision and Image Processing, Neural network approaches, Statistical template matching, Model & Image Technique, Off-line & On-line Gestures.

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1. Introduction

Gesture recognition is a phenomenon in engineering 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 this 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 communicate 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.

While we may have a repertoire of gestures all our own with a few borrowed from favorite movie stars, there are quite a few that are universally understood. These are culture-specific and referred to as emblems. Such gestures are often handed down through generations and become an integral part of the communal identity. Cultures that are widely publicized due to television and other multi-media have their gestures adopted universally and integrated into various other cultures and lifestyles.

2. Literature Review [4,5]

Moniruzzaman Bhuiyan and Rich Picking in Centre for Applied Internet Research (CAIR), Glyndŵr University, Wrexham, UK proposed a review of the history of Gesture controlled user interface (GCUI), and identifies trends in technology, application and usability. Their findings conclude that GCUI[1] affords realistic opportunities for specific application areas, and especially for users who are uncomfortable with more commonly used input devices. They have tried collated chronographic research information which covers the past 30 years. They investigated different types of gestures, its users, applications, technology, issues addressed, results and interfaces from existing research. They consider the next direction of gesture controlled user interfaces as rich user interface using gestures seems appropriate for current and future ubiquitous and ambient devices.

Moniruzzaman Bhuiyan, Rich Picking of Institute of Information technology, University of Dhaka, Dhaka, Bangladesh; Centre for Applied Internet Research, Glyndwr University, Wrexham, United Kingdom on September 2011 in Journal of Software Engineering and to meet the challenges of ubiquitous computing, ambient technologies and an increasingly older population, research-ers have been trying to break away from traditional modes of interaction. A history of studies over the past 30 years reported in this paper suggests that Gesture Controlled User Interfaces (GCUI) now provide realistic and affordable opportunities, which may be appropriate for older and disabled people. They have developed a GCUI prototype application, called Open Gesture, to help users carry out everyday activities such as making phone calls, controlling their television and performing mathematical calculations. Open Gesture uses simple hand gestures to perform a diverse range of tasks via a television interface. They describes Open Gesture and reports its usability evaluation. They conclude that this inclusive technology offers some potential to improve the independence and quality of life of older and disabled users along with general users, although there remain significant challenges to be overcome.

Stefan Waldherr, Roseli Romero, Sebastian Thrun describes a gesture interface for the control of a mobile robot equipped with a manipulator. The interface uses a camera to track a person and recognize gestures involving arm motion. A fast, adaptive tracking algorithm enables the robot to track and follow a person reliably through office environments with changing lighting conditions. Two alternative methods for gesture recognition are compared: a template based approach and a neural network approach. Both are combined with the Viterbi algorithm for the recognition of gestures defined through arm motion (in addition to static arm poses). Results are reported in the context of an interactive clean-up task, where a person guides the robot to specific locations that need to be cleaned and instructs the robot to pick up trash.

J. Koster of University of Twente, Human Media Interaction, March 2006 proposed that gestures are not often used to control domestic appliances in a modern household. They describes a research project on the current use of gestures in domestic appliances and possible usage in the future. First, a literature survey is done in different gesture input possibilities, also advantages and disadvantages are discussed. After that, a few current domestic appliances with their input possibilities are reviewed. To give an overview in the applied gesture field, a research in domestic appliances with the use of gestures is presented. Using the described input methods, new gesture control methods are introduced in the domestic field. A remote control with touchpad or capacitive field controls came out as an interesting device. A small qualitative user study is done with a concept 2D paper model of a remote control to evaluate its usability. Seven users from different ages executed tasks and a small questionnaire to get their opinions. It is concluded that a remote control with a touch sensitive interface in combination with a displayed remote control screen is preferred above the traditional remote control using push buttons.

Rafiqul Zaman Khan and Noor Adnan Ibraheem of Department of Computer Science, A.M.U. Aligarh, India in International Journal of Artificial Intelligence & Applications (IJAIA), in July 2012 proposed hand gesture recognition: a literature review. They told that hand gesture recognition system received great attention in the recent few years because of its manifoldness applications and the ability to interact with machine efficiently through human computer interaction. They presented a survey of recent hand gesture recognition systems. Key issues of hand gesture recognition system are presented with challenges of gesture system.

Xin Wei Sha, Giovanni Iachello, Steven Dow, Yoichiro Serita, Tazama St. Julien, Julien Fistre of School of Literature, Communication, Computing and Culture / GVU Center Georgia Institute of Technolgy proposed Continuous Sensing of Gesture for Control of Audio-Visual Media. They describes how continuous sensing of gesture can be achieved by using low power wireless sensors to enable expressive control of real-time generation of audio and visual media. Requirements for this type of application are analyzed, and our customized Berkeley Tiny OS motes are compared with other existing wireless sensing platforms. The software and hardware architecture is discussed, together with an analysis of its features and limitations and the development challenges they faced. Finally, hints are given to what kind of sensor networks gesture controlled AV media systems will need in the near future.

Rajesh Kannan Megalingam, Sai Manoj Prakhya, Ramesh Nammily Nair, Mithun Mohan of Amrita Vishwa Vidyapeetham, Amritapuri, Clappana, Kerala, India proposed Unconventional Indoor Navigation: Gesture Based Wheelchair Control. They told that, there are large numbers of people in the world with debilitating physical disabilities and elderly who experience significant difficulties in performing even very basic tasks such as locomotion, speaking, writing etc. The worst affected class of physically challenged are those who have become paralyzed over a significant percentage of their bodies, i.e. quadriplegics. These people find it extremely difficult to perform any task that requires even small amount of force. So they proposed a gesture based wheelchair for the benefit of physically challenged and elderly to navigate inside house without much effort. Our proposed system uses a small camera mounted very close to the user's hand, which tracks the small movements of their fingers to understand the direction of movement of the wheelchair. A recognition system which identifies the gesture is then interfaced to the wheelchair control system in order to move it to the desired location. For point to point navigation without human intervention they propose two unconventional methods: Line Following Navigation (LFN) and Location Aware and Remembering Navigation (LARN). These two methods are simple and cost effective for indoor positioning or navigation.

Joshua R. New Knowledge Systems Laboratory Jacksonville State University Jacksonville proposed a method of temporal hand gesture recognition Ongoing efforts at his laboratory have been aimed at developing techniques that reduce the complexity of interaction between humans and computers. In particular, he have investigated the use of a gesture recognition system to support natural user interaction while providing rich information content. He present additions to a platform independent, gesture recognition system which previously tracked hand movement, defined orientation, and determined the number of fingers being held up in order to control an underlying application. The additions provide the functionality to determine a temporal gesture, such as movement of the hand in a circle or square. This technique has proven to replace the common "clickfest" of many applications with a more powerful, context-sensitive, and natural interface. In addition, the Simplified Fuzzy ARTMAP (SFAM) learning system could easily be trained to recognize new gestures that the user creates and map these to a specific action within the application. He also present sample images and results.

Dr. R. V. Dharaskar S. A. Chhabria Sandeep Ganorkar proposed robotic arm control using gesture and voice in International Journal of Computer, Information Technology & Bioinformatics (IJCITB) They told that human-robot voice interface play a key role in many application fields. Hand gesture is a very natural form of human interaction and can be used effectively in human computer interaction (HCI). They propose a "Human Machine Interfacing Device" utilizing hand gestures to communicate with computers and other embedded systems acting as an intermediary to an appliance. Developments in field of communication have enabled computer commands being executed using hand gestures. They discusses hand glove-based techniques that use sensors to measure the positions of the fingers and the position of the hand in real-time. Interaction using gesture technology for effective communication empowering physically challenged to interact with machines and computing devices including 3-D graphic interactions and simulations. They focus on wireless data gloves that are proposed to be used for gesture recognition and accordingly robot movement will take place.

Grant R. McMillan Air Force Research Laboratory (AFRL/HECP) proposed the technology and application of gesture based control. He told the technology for using hand, body and facial gestures as a means for interacting with computers and other physical devices. He discusses the rationale for gesture based control technology, methods for acquiring and processing such signals from human operators, applications of these control technologies, and anticipated future developments.

Junhaeng Lee, T. Delbruck, Paul K. J. Park, Michael Pfeiffer, Chang-Woo Shin1, Hyunsurk Ryu, and Byung Chang Kang Samsung Advanced Inst. of Technology, Samsung Electronics Co. Ltd. Republic of Korea Institute of Neuro informatics, University of Zurich and ETH Zurich, Switzerland proposed gesture-based remote control using stereo pair of dynamic vision sensors. They describe a novel gesture interface based on a stereo pair of event-based vision sensors and neuro morphic event processing techniques. The motion trajectory of a moving hand is detected every 3 ms by spatiotemporally correlating the output events of the DVSs by using leaky integrate-and-fire (LIF) neurons after the stereo vergence fusion. The trajectory of each gesture is automatically spotted by setting the threshold of LIF neurons, and, subsequently, sixteen feature vectors are extracted from each spotted gesture trajectory. The thresholds of LIF neurons are adaptively adjusted based on the disparity obtained from the stereovision to achieve distance invariant performance of gesture spotting. Gesture patterns were classified by using hidden Markov model (HMM)-based gesture models. The implemented system was tested with 6 subjects (3 untrained subjects and 3 trained subjects) producing continuous hand gestures (22 trials of 9 successive gestures for each subject). Achieved recognition rates ranged from 91.9 % to 99.5% depending on subject.

3. **Overview of Gesture Technology** [3,6,7]

Humans naturally use gesture to communicate. It has been demonstrated that young children can readily learn to communicate with gesture before they learn to talk. A gesture is non-verbal communication made with a part of the body. We use gesture instead of or in combination with verbal communication. Using this process, human can interface with the machine without any mechanical devices. Human movements are typically analyzed by segmenting them into shorter and understandable format. The movements vary person to person. It can be used as a command to control different devices of daily activities, mobility etc. So our natural or intuitive body movements or gestures can be used as command or interface to operate machines. 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.

Interface with computers using gestures of the human body, typically hand movements. In gesture recognition technology, a camera reads the movements of the human body and communicates the data to a computer that uses the gestures as input to control devices or applications. For example, a person clapping his hands together in front of a camera can produce the sound of cymbals being crashed together when the gesture is fed through a computer. One way gesture recognition is being used is to help the physically impaired to interact with computers, such as interpreting sign language. The technology also has the potential to change the way users interact with computers by eliminating input devices such as joysticks, mice and keyboards and allowing the unencumbered body to give signals to the computer through gestures such as finger pointing.

Unlike haptic interfaces, gesture recognition does not require the user to wear any special equipment or attach any devices to the body. The gestures of the body are read by a camera instead of sensors attached to a device such as a data glove. In addition to hand and body movement, gesture recognition technology also can be used to read facial and speech expressions (i.e., lip reading), and eye movements.

3.1 GESTURE RECOGNITION AND PEN COMPUTING

In some literature, the term gesture recognition has been used to refer more narrowly to non-text-input handwriting symbols, such as inking on a graphics tablet, multi-touch gestures, and mouse gesture recognition. This is computer interaction through the drawing of symbols with a pointing device cursor (see discussion at Pen computing).

3.2 GESTURE ONLY INTERFACES

The gestural equivalent of direct manipulation interfaces is those which use gesture alone. These can range from interfaces that recognize a few symbolic gestures to those that implement fully fledged sign language interpretation. Similarly interfaces may recognize static hand poses, or dynamic hand motion, or a combination of both. In all cases each gesture has an unambiguous semantic meaning associated with it that can be used in the interface. In this section we will first briefly review the technology used to capture gesture input, then describe examples from symbolic and sign language recognition. Finally we summarize the lessons learned from these interfaces and provide some recommendations for designing gesture only applications.

3.3 TRACKING TECHNOLOGIES

Gesture-only interfaces with syntax of many gestures typically require precise hand pose tracking. A common technique is to instrument the hand with a glove which is equipped with a number of sensors which provide information about hand position, orientation, and flex of the fingers. The first commercially available hand tracker, the Data glove, is described in Zimmerman, Lanier, Blanchard, Bryson and Harvill (1987), and illustrated in the video by Zacharey, G. (1987). This uses thin fiber optic cables running down the back of each hand, each with a small crack in it. Light is shone down the cable so when the fingers are bent light leaks out through the cracks. Measuring light loss gives an accurate reading of hand pose. The Data glove could measure each joint bend to an accuracy of 5 to 10 degrees (Wise et. al. 1990), but not the sideways movement of the fingers (finger abduction). However, the Cyber Glove developed by Kramer (Kramer 89) uses strain gauges placed between the fingers to measure abduction as well as more accurate bend sensing (Figure XX). Since the development of the Data glove and Cyber glove many other gloves based input devices have appeared as described by Sturman and Zeltzer (1994).

3.4 NATURAL GESTURE ONLY INTERFACES

At the simplest level, effective gesture interfaces can be developed which respond to natural gestures, especially dynamic hand motion. An early example is the Theramin, an electronic musical instrument from the 1920's. This responds to hand position using two proximity sensors, one vertical, the other horizontal. Proximity to the vertical sensor controls the music pitch, to the horizontal one, loudness. What is amazing is that music can be made with orthogonal control of the two prime dimensions, using a control system that provides no fixed reference points, such as frets or mechanical feedback. The hands work in extremely subtle ways to articulate steps in what is actually a continuous control space. The Theramin is successful because there is a direct mapping of hand motion to continuous feedback, enabling the user to quickly build a mental model of how to use the device.

3.5 GESTURE BASED INTERACTION

The Cyber Glove captures the position and movement of the fingers and wrist. It has up to 22 sensors, including three bend sensors (including the distal joints) on each finger, four abduction sensors, plus sensors measuring thumb crossover, palm arch, wrist flexion and wrist abduction. (Photo: Virtual Technologies, Inc.)

Once hand pose data has been captured by the gloves, gestures can be recognized using a number of different techniques. Neural network approaches or statistical template matching is commonly used to identify static hand poses, often achieving accuracy rates of better than 95% (Väänänen and Böhm 1993). Time dependent neural networks may also be used for dynamic gesture recognition [RE**F],** although a more common approach is to use Hidden Markov Models. With this technique Kobayashi is able to achieve an accuracy of XX% (Kobayashi et. al. 1997), similar results have been reported by XXXX and XXXX. Hidden Markov Models may also be used to interactively segment out glove input into individual gestures for recognition and perform online learning of new gestures (Lee 1996). In these cases gestures are typically recognized using pre-trained templates; however gloves can also be used to identify natural or untrained gestures. Wexelblat uses a top down and bottom up approach to recognize natural gestural features such as finger curvature and hand orientation, and temporal integration to produce frames describing complete gestures (Wexelblat 1995). These frames can then be passed to higher level functions for further interpretation.

Although instrumented gloves provide very accurate results they are expensive and encumbering. Computer vision techniques can also be used for gesture recognition overcoming some of these limitations. A good review of vision based gesture recognition is provided by Palovic et. al. (1995). In general, vision based systems are more natural to use that glove interfaces, and are capable of excellent hand and body tracking, but do not provide the same accuracy in pose determination. However for many applications this may not be important. Sturman and Zeltzer point out the following limitations for image based visual tracking of the hands (Sturman and Zeltzer 1994):

Figure 3.1: Cyber Glove

- The resolution of video cameras is too low to both resolve the fingers easily and cover the field of view encompassed by broad hand motions.
- The 30- or 60- frame-per-second conventional video technology is insufficient to capture rapid hand motion.
- Fingers are difficult to track as they occlude each other and are occluded by the hand.

There are two different approaches to vision based gesture recognition:

MODEL BASED TECHNIQUE: This technique try to create a three-dimensional model of the users hand and use this for recognition, and image based techniques which calculate recognition features directly from the hand image.

IMAGE BASED TECHNIQUE: Rehg and Kanade (1994) describe a vision-based approach that uses stereo camera to create a cylindrical model of the hand. They use finger tips and joint links as features to align the cylindrical components of the model. Etoh, Tomono and Kishino **(1991)** report similar work, while Lee and Kunii use kinematic constraints to improve the model matching and recognize 16 gestures with XX% accuracy (1993). Image based methods typically segment flesh tones from the background images to find hands and then try and extract features such as fingertips, hand edges, or gross hand geometry for use in gesture recognition. Using only a coarse description of hand shape and a hidden markov model, Starner and Pentland are able to recognize 42 American Sign Language gestures with 99% accuracy (1995). In contrast, Martin and Crowley calculate the principle components of gestural images and use these to search the gesture space to match the target gestures (1997).

3.6 TYPES OF GESTURES

Most of the researches are based on hand gestures. Direct control via hand posture is immediate, but limited in the number of Choices. There are researches about body gesture, finger point movement. In the early stage, researchers used gloves with microcontroller and connected with the device through a wire. Head gesture and gesture with voice were also in the research, but hand gesture was the most dominant part of gesture control system. In computer interfaces, two types of gestures are distinguished:

OFFLINE GESTURES: Those gestures that are processed after the user interaction with the object. An example is the gesture to activate a menu.

ONLINE GESTURES: Direct manipulation gestures. They are used to scale or rotate a tangible object.

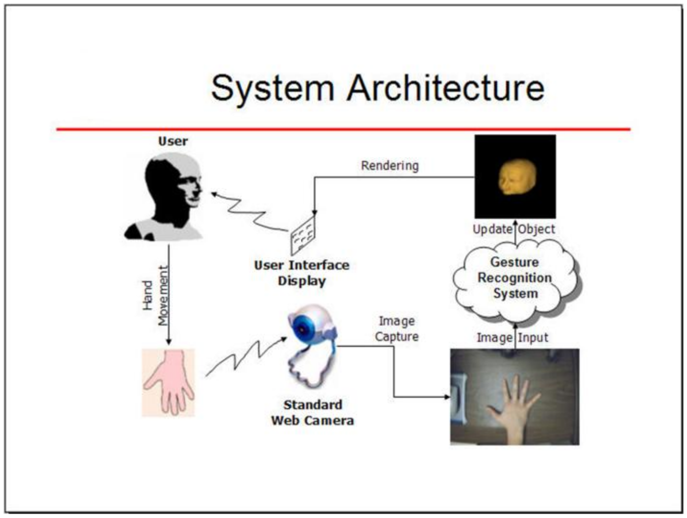

Figure 3.2: System Architecture

Here we can see that the user action is captured by a camera and the image input is fed into the gesture recognition system, in which it is processed and compared efficiently with the help of an algorithm. The virtual object or the 3-d model is then updated accordingly and the user interfaces with machine with the help of a user interface display.

3.7 USERS

Most of the research of the survey use or target the general users of any age. Initially it was mostly for computer users to work on the objects or presentation. Wheelchair users are also highly considered for accelerometer based gesture controlled system. Most of the investigations are focused on elderly and disable people.

3.8 APPLICATIONS

Gesture recognition is useful for processing information from humans which is not conveyed through speech or type. As well, there are various types of gestures which can be identified by computers.

- **Sign language recognition**. Just as speech recognition can transcribe speech to text, certain types of gesture recognition software can transcribe the symbols represented through sign language into text.
- **For socially assistive robotics**. By using proper sensors (accelerometers and gyros) worn on the body of a patient and by reading the values from those sensors, robots can assist in patient rehabilitation. The best example can be stroke rehabilitation.
- **Directional indication through pointing**. Pointing has a very specific purpose in our society, to reference an object or location based on its position relative to ourselves. The use of gesture recognition to determine where a person is pointing is useful for identifying the context of statements or instructions. This application is of particular interest in the field of robotics.
- **Control through facial gestures**. Controlling a computer through facial gestures is a useful application of gesture recognition for users who may not physically be able to use a mouse or keyboard. Eye tracking in particular may be of use for controlling cursor motion or focusing on elements of a display.
- **Alternative computer interfaces**. Foregoing the traditional keyboard and mouse setup to interact with a computer, strong gesture recognition could allow users to accomplish frequent or common tasks using hand or face gestures to a camera.
- **Immersive game technology**. Gestures can be used to control interactions within video games to try and make the game player's experience more interactive or immersive.
- **Virtual controllers**. For systems where the act of finding or acquiring a physical controller could require too much time, gestures can be used as an alternative control mechanism. Controlling secondary devices in a car, or controlling a television set are examples of such usage.
- **Affective computing**. In affective computing, gesture recognition is used in the process of identifying emotional expression through computer systems.

- **Remote control**. Through the use of gesture recognition, "remote control with the wave of a hand" of various devices is possible. The signal must not only indicate the desired response, but also which device to be controlled.
- Researches show that gesture based applications can be used for many different things, entertainment, controlling home appliance, tele-care, tele-health, elderly or disable care. The scope of the application shows us the importance of more researches in a gesture controlled system. Most applications are to replace traditional input devices like keyboard and mouse, accessible application for elderly-disable like accelerometer. Initial applications were on pc applications for text edit, presentation. Gesture visualization has been included for feedback and training. Using digital camera rather than sensor has provided new dimension to develop gesture based user interface development. Now people can interact with any media using gesture to control wide range of applications.

3.9 TECHNOLOGY [8]

The ways of recognizing the gesture can be considered as a significant progress of the technology. Progress of image processing technology has played an important role here. Gestures have been captured by using infrared beams, data glove, still camera, wired and many inter-connected technologies like gloves, pendant, infrared signal network server etc in the past. Recent vision technique, video and web cam based gesture recognition has made it possible to capture any intuitive gesture for any ubiquitous devices from the natural environment with 3D visualization. Lenman has developed a prototype for remote control of home electronics, such as TV and CD-player. It describes a project that explores computer vision based analysis of hand gestures for developing new forms of HCI. Gesture based research are now moving towards everyday application for even older adults with simple and inexpensive implementation.

3.10 COMMERCIAL PRODUCTS

First commercial products of gesture technology for general user launched in 2003, 23 years after the research works started. Still games industry is the main target of the products. But health, care homes industries are also getting focus gesture recognition becomes intuitive and natural. There are important issues addressed by the researchers based on traditional system, usability. Natural intuition of the gesture control was addressed by most of the research. Natural connection with the group work like meeting, gesture recognitions , providing feedback of the gestures through visualization, sound etc, gesture training, common or unusual gesture are some issues which give a direction towards further research for elderly.

3.11 CURRENT OPPORTUNITIES FOR GESTURE TECHNOLOGY

It's to find the place where gesture commands are captured as a command or users can get the feedback. There is a special interest for the place, or interface of gesture commands as HCI is progressing rapidly in recent years. Gestural interfaces are electronic analogues to pencil and paper. Gestural interfaces have a number of potential advantages and couple of potential disadvantages. There are varieties of interfaces in the researches in the table like natural (using IR beam with black box), large screen, PC/Laptop based, LED light, audio-visual, mobile handheld etc. From the study we can see the opportunities of implementing the technology in different areas. The list, but not last, can be following –

3.11.1 ENTERTAINMENT

Gesture technology can provide more entertainment opportunity for any type of users. GestureTek many different ways of entertainment using gesture such as interactive advertisement, signage, movies, screens. Sony Eyetoy, Microsoft's X-box have demonstrated different entertainment opportunities such as playing music, personalized gaming etc.

3.11.2 ARTIFICIAL INTELLIGENCE

People, devices and computation are going to integrate more with each other and will soon become part of our daily life. Using gesture based technology will play important part in this intelligent life. Gesture from any part of the body can provide the commands of communication or even to control the curtain of the window. Robotic industry is also using gesture technology to manage and control the activities of the robot as part of the Human Robot interaction. Like Select-and-Point, many researches are easily accepted by users and it can significantly improve users' interaction with various devices in a ubiquitous computing environment. Based on networking technologies and hand gestures, users can connect multiple devices.

3.11.3 SIMULATION

Body gesture creates the simulation of human body activities in the screen. Physical simulation can improve the realism of the resulting gestural animation in several ways. GestureTek develops a stimulating computer- generated virtual reality therapy world that guides patients through clinician-prescribed interactive rehabilitation exercises, games and activities that can target specific body parts. Patient performance is measured and recorded.

3.11.4 TRAINING & EDUCATION

The technology solution can be developed for training and education purpose. In the rehabilitation or fitness centres, it can train people automatically based on the user's profile, body structure. Taking natural input from the body movements is the most important advantage here over mouse or keyboard.

3.11.5 ASSISTIVE LIVING

Technologies such as multi-agent systems, safe communications, hypermedia interfaces, rich environments, increased intelligence of home appliances, and collaborative virtual environment are now converging and represents an important enabling factor for the design and development of virtual elderly support community environments. TeleCARE aims to design and develop a configurable framework for virtual communities focused on supporting assistance to elderly people.

3.11.6 ELDERLY USERS

Some research provides us with a new interface and intuitive interaction style in our daily computer use. With simple selection and pointing hand gestures, users can eliminate cumbersome processes in managing connections and controls between multiple devices as well as in sharing information/data.

3.12 FUTURE WORK

Technologies developed based on gesture are now really affordable and converged with familiar and popular technologies like TV, large screen. It's ubiquitous and non-intrusive as we can install a camera or remote with the TV. From this paper we can see the trends of gesture controlled communication systems. Easing of the technology use, affordability and familiarity indicate that gesture based user interface can open new opportunity for elderly and disable people. The older population (65+) numbered 36.3 million in 2004, an increase of 3.1 million or 9.3% since 1994 and it's growing over time. There will be more elderly people and fewer younger ones to care for them. So we need to invest much more heavily in Assistive Living solutions. The research 'A gesture controlled communication aid for elderly and disabled people' can be a significant task for future**.** The two important aims of the research are to identify the different gestures of elderly and disabled people for communication and to design a rich augmented-reality interface for communication via ubiquitous device such as a television set.

3.13 INPUT DEVICES

The ability to track a person's movements and determine what gestures they may be performing can be achieved through various tools. Although there is a large amount of research done in image/video based gesture recognition, there is some variation within the tools and environments used between implementations.

- **Depth-aware cameras:** Using specialized cameras such as time-of-flight cameras, one can generate a depth map of what is being seen through the camera at a short range, and use this data to approximate a 3d representation of what is being seen. These can be effective for detection of hand gestures due to their short range capabilities.
- **Stereo cameras:** Using two cameras whose relations to one another are known, a 3d representation can be approximated by the output of the cameras. To get the cameras' relations, one can use a positioning reference such as a lexian-stripe or infrared emitters. In combination with direct motion measurement (6D-Vision) gestures can directly be detected.
- **Controller-based gesture:** These controllers act as an extension of the body so that when gestures are performed, some of their motion can be conveniently captured by software. Mouse gestures are one such example, where the motion of the mouse is correlated to a symbol being drawn by a person's hand, as is the Wii Remote, which can study changes in acceleration over time to represent gestures.
- **Single camera:** A normal camera can be used for gesture recognition where the resources/environment would not be convenient for other forms of image-based recognition. Although not necessarily as effective as stereo or depth aware cameras, using a single camera allows a greater possibility of accessibility to a wider audience.

Conclusion

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. Gesture recognition can be conducted with techniques from computer vision and image processing. There are many challenges associated with the accuracy and usefulness of gesture recognition software. For image-based gesture recognition there are limitations on the equipment used and image noise. Images or video must be under consistent lighting, or in the same location. Items in the background or distinct features of the users should not make recognition difficult.

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