Bridging Human and Machine: A Review of Human-System Interaction and Its Real-World Applications

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ABSTRACT

The rapid growth of computing has made effective human-computer interaction essential. It is important for the growing number of computer users whose professional schedules will not allow the elaborate training and experience that was once necessary to take advantage of computing. Increased attention to usability is also driven by competitive pressures for greater productivity, the need to reduce frustration, and to reduce overhead costs such as user training. As computing affects more aspects of our lives the need for usable systems becomes even more important. In this paper, types of HCI interaction systems are discussed briefly with their application areas and concluded with the future selection of research in order to carry out further.

Keywords: Human-Computer Interaction, Unimodal Interaction System, Multimodal Interaction Systems, Visual Based, Sensor Based, Audio Based.

I. INTRODUCTION

As progress in HCI is making user interfaces easier to learn and use, they are becoming more difficult to build. Simple command line interfaces were difficult to use but easy to program. Modern direct manipulation and virtual environment interfaces are easier to understand and use, but harder to program, largely because they have possible execution paths. The area of Computer Science in HCI studies and develops the abstractions, techniques, languages, and tools to address this problem. This section of the overview discusses research and practice in the field of user interface software. An important concept in user interface software is to separate the design of an interactive system into distinct levels, i.e., the conceptual, semantic, syntactic, and lexical levels, and to develop a design for each level. Another significant concept is the User Interface Management System (UIMS), which provides a separate software component that conducts all interactions with the user, distinct from the application program that performs the underlying task. It is analogous to a database management system in that it separates a function used by many applications and moves it to a shared subsystem.

In addition, we will consider interaction styles, from conventional command language and menu-based styles to newer direct manipulation and virtual environment styles and interaction techniques for using devices to perform tasks in an interface. In a graphical direct manipulation style of user interface, a set of objects is presented on a screen, and the user has a repertoire of manipulations that can be performed on any of them. This means that the user has no command language to remember beyond the standard set of manipulations, few cognitive changes of mode, and a reminder of the available objects and their states shown continuously on the display. Examples are spreadsheets, the Xerox Star desktop and its descendants such as the Apple Macintosh, and, of course, many video games.

Recent work has carried the user's illusion of manipulating real objects still further. By coupling the motion of the user's head to changes in the images presented on a head-mounted display, the illusion of being surrounded by a world of computer-generated images or a virtual environment is created. Hand-mounted sensors allow the user to interact with these images as if they were real objects located in space surrounding him or her.

II. LITERATURE REVIEW

Most researchers in HCI take interest in developing new design methodologies, experiencing with new hardware devices, prototyping new software systems, and exploring new paradigms for interaction. Designs in HCI aim to create user interfaces which can be operated with ease and efficiency. Many digital products that require users to interact with them to accomplish their tasks have not necessarily designed with the users in mind. The designer always claims how usable the products are; however, an even more basic requirement is that the interface should allow the user to carry out relevant tasks completely. In other words, the design must be both usable and useful for the user and it must be a user-centered design.

Opinion mining or sentiment analysis is the automated detection of evaluations from an unfastened text. This research vicinity has been partially stimulated with the aid of the business purpose of giving cheap, certain and

timely patron comments to corporations. Before the net, agencies would have to rely on particularly sluggish and steeply priced methods of gaining purchaser remarks, consisting of telephone or mail surveys, interviews, and consciousness businesses. Online, however, they'll be capable of gain comments from online consumer critiques, blogs, remarks and chat room discussion, assuming that a pc application can clear out the applicable statistics from the relaxation of the internet or a particular critiques website. In this context, the intention of opinion mining is to identify high quality and poor evaluations in unfastened text and to collaborate this opinion with application objects.

Textual content mining packages have additionally been advanced in psychology, conversation studies, and control and corpus linguistics. For example, a few mental issues may be quite reliably diagnosed in sufferers primarily based upon a simple word frequency evaluation of speech, political statements and enterprise venture statements had been analyzed for the electricity of variables such as optimism; and a thing evaluation throughout a wide range of text genres has diagnosed that the degree of creator involvement in a text as opposed to an informational orientation is something that has a tendency to be constant inside genres however varies between genres.

Opinion mining is often cut up into two consecutive responsibilities: detecting which textual content segments incorporate critiques and the polarity and perhaps electricity of that opinion. A simple method analyzes how often positive and negative words arise or how regularly they co-occur in sentences with given goal of system reliability. At the same time as complete gadget comprehension of textual content is presently impossible, computational linguistics techniques can in part examine the structure of textual content, using it to greater appropriately come across sentiment. This method might incorporate negating phrases like “not”, booster words like “very” and grammatical systems common in sentiment-bearing sentences. It is based upon fairly grammatically correct English to function successfully, however, which makes it less beneficial in environments like social community sites with a great deal casual language.

Many unique aspects of emotion can be measured, which includes: individuals self-report of emotions, neurological changes, autonomic system reactions, and bodily movements – including facial actions. Those appear to overlap among exclusive feelings main them to be described as syndromes instead of clear sets of identifiable capabilities. There are fundamental or fundamental feelings which are rather universally known and reputedly experienced by means of people, and that these exist as a result of evolutionary pressure. As an instance, autonomic changes and cognitive strategies all through worry prepare someone to run far away from the threat. In assist of this, there's medical proof that at least five distinctive feelings such as

- Worry
- Disgust
- Anger
- Happiness and
- Disappointment

These are demonstrably exclusive within the feel of activating one of a kind mixtures of brain areas adding surprise gives an essential list of six primary emotions. Evidence found in assist of emotions being simple is fixed of six trendy traits common to all simple emotions and three sorts of feature that exist however range among feelings: signals physiology and antecedent events.

The above listing excludes a few feelings taken into consideration critical by the way of others, such as tension, guilt, shame, envy, jealousy, compassion and love. Non-basic feelings are occasionally visible as mixtures of simple emotions and appear to differ greater between cultures. Emotion perception is tradition-unique due to the fact a few societies describe feelings never seemingly experienced someplace else. From the angle of felt human stories instead of on the neurological or descriptive tiers, evidently, there are two essential dimensions in preference to a number of different forms of emotions. First, the valence of a skilled emotion is the diploma to which it's significantly positive or negative. Secondly, the extent of arousal felt is the quantity of power perceived. This assertion apparently contradicts the neurological evidence above of as a minimum five feelings and the linguistic proof within the form of the existence of a wide range of non-synonymous phrases for emotions.

III. TECHNIQUES

Abowd and Beale defined this framework of interaction as translation between languages. They state both a common interaction framework and a translation within the framework. Abowd and Beale framework concentrate on four components and each has its own unique language. Those are;

- User
- Input
- System
- Output

The primary goal of Human-Computer Interaction is to improve the interactions between users and computers. It makes computers more operational and receptive to the user's wants. Human-computer interaction develops or improves certain goals in designing devices. Five important goals are:

- Usability
- Effectiveness
- Safety
- Utility
- Efficiency

HCI, as the name suggests, comprises three major parts within the framework: the user, the computer, and the interaction indicate the ways they work together to achieve goals. Figure 1 shows three main components of human-computer interaction.

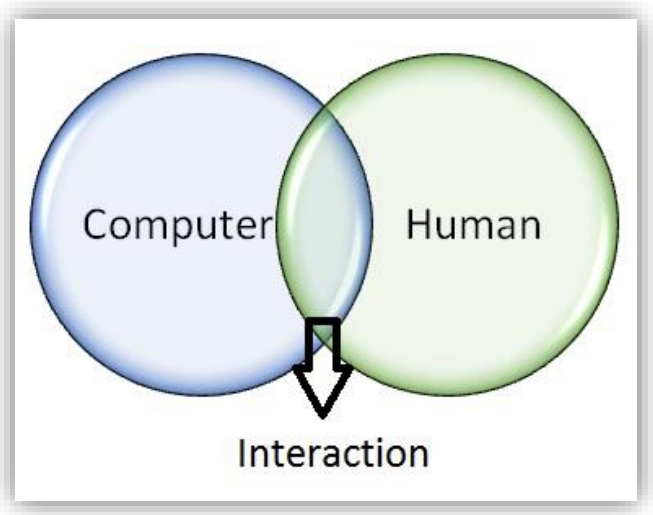

Figure 1: Human-Computer Interaction

There are two kinds of interaction systems exists in the current scenario. They are

- Unimodal Human Interaction System (UHIS)
- Multimodal Human Interaction System (MHIS)

Among these unimodal systems are globally used which is nothing but a single channel used to ensure the user to interact with the computer. In this paper, unimodal systems are briefly explained with respect to their system usage.

❖ **Unimodal Interaction Systems**

An interface mainly relies on number and diversity of its inputs and outputs which are communication channels that enable users to interact with the computer via this interface. Each of the different independent single channels is called a modality. The modality of a system is defined by each of its different independent single channels that ensure user to interact with the computer. An HCI system having a single such channel, that is, is based on a single modality is termed as Unimodal. These systems can be broadly classified into three subcategories:

- Visual Based
- Audio-Based
- Sensor Based

➢ **Visual-Based HCI**

In Visual-based interaction systems, human responses are recognized as a visual signal. Considering the extent of applications and variety of open problems and approaches, researchers tried to tackle different aspects of

human responses which can be recognized as a visual signal. Some of the below research areas have made this as one of the most widespread and popular research concentrations.

- Facial Expression Analysis (Recognition)
- Gesture Recognition
- Body Movement Tracking (Large Scale)
- Gaze Detection (Eyes Movement Tracking)

Facial expression analysis deals with the recognition and noting down of the expressions and emotions of the user visually. Body movement tracking and gesture recognition are main concentrations in this area covering most of the newly developed applications and relative designs. Gaze Detection is not a direct form of human-computer interaction in the sense that it is primarily used for a better understanding of user's attention, intent and focus in sensitive situations. Recently launched, Samsung SIII has a gaze detection technology which senses users focus and turns off if the user's attention is not directed. Similar researches are being carried and researchers are trying to integrate other types of HCI (such as audio, sensor-based) with the visual-based interactive systems.

- **Audio-Based HCI**

The audio-based interaction between a computer and a human is another important area of HCI systems. It deals with the processing of information acquired by the audio signals incoming from the user side. While the nature of audio signals may not be as variable as visual signals but the information gathered from audio signals can be more trustable, helpful, and in some cases unique providers of information. Comparing these systems with Visual-based systems, the information gathered by these systems is more reliable and helpful due to the fact that the nature of sound signals not as variable as visual signals. Research areas in this branch are divided into following categories:

- Speech Recognition
- Speaker Recognition
- Auditory Emotion Analysis
- Human-made noise / Signal Detections
- Musical Interaction

Historically, speech recognition and speaker recognition have been the main focus of researchers.
Recent endeavors to integrate human emotions in intelligent human-computer interaction initiated the efforts in the analysis of emotions in audio signals. Other than the tone and pitch of speech data, typical human auditory signs such as sigh, gasp, and etc helped emotion analysis for designing more intelligent HCI system. Music generation and interaction is a very new area in HCI with applications in art industry which is studied in both audios- and visual-based HCI systems.

- **Sensor-Based HCI**

Sensor Based HCI consists of the most number of applications and it is a combination of a wide range of areas. The commonality of these different areas is that at least one physical sensor is used between user and machine to provide the interaction. While this remains the most utilized field of HCI, integrated applications such as OmniTouch, are finding their own scope and innovation in the market. Some of the sensors as listed below, range from very sophisticated to be primitive.

- Pressure Sensors
- Taste/Smell Sensors
- Pen-Based Interaction
- Mouse & Keyboard
- Joysticks
- Motion Tracking Sensors and Digitizers
- Haptic Sensors

Some of these sensors have been around for a while and some of them are very new technologies. Pen-Based sensors are specifically of interest in mobile devices and are related to pen gesture and handwriting recognition areas. Motion tracking sensors/digitizers are state-of-the-art technology which revolutionized movie, animation, art, and video-game industry. They come in the form of wearable cloth or joint sensors and made computers much more able to interact with reality and human ability to create their world virtually.

❖ **Multi-Modal Interaction Systems**

A classic example of a multimodal system is the “Put That There” demonstration system. This system allowed one to move an object into a new location on a map on the screen by saying “put that there” while pointing to the object itself then pointing to the desired destination. Multimodal interfaces have been used in a number of applications including map-based simulations, such as the aforementioned system; information kiosks, such as AT&T’s MATCHKiosk and biometric authentication systems. Multimodal interfaces can offer a number of advantages over traditional interfaces. For one thing, they can offer a more natural and user-friendly experience. For instance, in a real estate system called Real Hunter, one can point with a finger to a house of interest and speak to make queries about that particular house. Using a pointing gesture to select an object and using speech to make queries about it illustrates the type of natural experience multimodal interfaces offer to their users. Another key strength of multimodal interfaces is their ability to provide redundancy to accommodate different people and different circumstances. For instance, MATCHKiosk allows one to use speech or handwriting to specify the type of business to search for on a map. Thus, in a noisy setting, one may provide input through handwriting rather than speech. Few other examples of applications of multimodal interaction systems are listed below:

- Smart Video Conferencing
- Intelligent Homes/Offices
- Driver Monitoring
- Intelligent Games
- E-Commerce
- Helping People with Disabilities

IV. CONCLUSION

In this research work, human-computer interaction literature is reviewed as well as technical matters like interaction styles are studied and advantages and disadvantages are dogged. Searched for better interaction styles among the existing ones and at the same time found dome best "fit" in between a human and a computer in terms of interaction. While designing moral, effective and user-friendly interfaces for an academic supportive device, several disputes have to be considered. This research suggests a theoretical support in the area of human-computer interfacing in designing academic supportive devices. This paper deliberated the promising use of Human-Computer Interaction in academic supportive devices to attain top levels of interaction between the user and academic devices. Clearly analyzed all existing techniques in human-computer interaction, in order to increase the efficiency of academic supportive devices. However, the implementation of suggested interaction styles and models offer a visual basis for the future research.

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