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AN ANALYSIS OF AFFECTIVE COMPUTING

Pragya Singh Tomar[*1] & Brahma Datta Shukla[2]
[*1&2]Institute of Computer Science, Vikram University, Ujjain

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ABSTRACT

Nowadays, people spend a lot of time connecting with computers and technology. Because of the high expectations for everyday human-computer interaction, robots may learn from their surroundings and so converse more easily with people. Recent progress in the field of affective computing has arisen as a consequence of these efforts. The purpose of this paper is to highlight the definition, recent developments and applications of affective computing. The literature study reveals that emotions may be a potent tool for enhancing or hindering learning, and that affective computing can be beneficial to researchers. Wide affective computing systems are also expected to have beneficial impacts in various areas such as learning, gaming, entertainment, etc. For computer users or for HCI technology in the future, affective computing is likely to be a normal feature. With few potential concerns, this paper will also respond to this new field.

KEYWORDS: Affective computing, Human computer interaction (HCI), Emotion, Privacy Concerns.

1. INTRODUCTION

Affective computing is a comparatively recent area of research that gives computing machines an emotional ability. The function of emotions in decision-making, learning, memory and nearly all cognitive processes is highlighted by affective computing. Via advances in computers, sensors, algorithms, and data processing methods, machines can analyze emotions as effectively as human beings. According to Picard[1],' affective computing' defines the emotions linked to, resulting from or influencing computing. Machines should be able to interpret and react adequately to the emotional state of humans. The device will then be friendlier to the consumer. Emotion-assisted human-computer interfaces are projected to have a greater adoption rate and a broader range of applications. The problem for researchers is to figure out how to create these affective systems and integrate them with the ability to create fully intelligent and really personal systems. In the last half-century, machines have gone a long way from human intellect.

Today we live in a "culture of experience" where emotional intelligence and emotional control are seen as important to working life, business and products ([2], [3]). As a usability feature, users expect not only features, but also experiences that suit their expectations, emotional states, and interaction goals. As a result, the end user's perception of an application is the decisive element in its usability, posing a slew of new challenges in the area of human-computer interaction (HCI). HCI's key focus right now is the need to improve human-computer connections through justifications and explanations. As a result, new forms of 'natural' and 'indirect' interaction, rather than the traditional keyboard and mouse, are becoming increasingly popular. Natural interaction refers to allowing humans to connect with computers in ways that are similar to how they interact with other people. Both verbal (voice and non-voice vocalization) and non - verbal communication are involved (body gesture, gaze, movement, and facial expression). HCI is actively exploring with multimodal input methods like as speech, gesture, attitude, and facial expression to replace frequently impersonal equipment like as a keyboard and mouse with a non-tech savvy. Emotions are one of the primary factors that might boost the human-computer interaction. Literature illustrates numerous examples in which emotions play a crucial role in human beings' communication. So far, however, emotions have not played a most important task in HCI. Integrating the feelings in HCI, however desirable in many applications, is a difficult job. In computer systems, we are all familiar with services, including

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the tip of the day, birthday reminders, etc. While these are helpful in a normal working environment, when one is in a hurry to complete a quick piece of work, these are distractions.

Similarly, it would be good if the booting mechanism would postpone the thorough review of its file system when you are in a rush, and not force it only because a certain counter has reached a particular value. These are clear examples of how HCI can progress more effectively with the ability to understand and use end-user affective condition. In those cases where computers act when a social agent, there are many circumstances in which relationships with human machines can also be improved by understanding the user's affective states. The goal of this study is to explain why affective computing is important.

This article pulls together a number of current advances and applications in the field of human-computer interaction, as well as the obstacles faced by various researchers. Affective systems are not expected to replace affective persons. However, the relevance and usefulness of similar technologies in a range of field have been addressed, hoping that affective computing will help people in more creative ways in their daily lives.

2. RECENT PATTERNS AND DEVELOPMENT IN AFFECTIVE COMPUTATION

Human-computer interaction has come a long way in the decades since its inception in the field of human-computer interaction. However, the goal of being able to communicate with a computer with the same degree of comfort and ease as engaging with other people is still a long way off. This section discusses current breakthroughs in human-computer interaction (HCI), with the ultimate goal of making user interfaces more useable and valuable for humans to use.

Dr. Cynthia Breazeal of MIT started working on Kismet ([4],[5]), a robot with microphones and cameras that gave it an artificial sense of vision and hearing in the late 1990s. It could also detect motion and estimate the distance of an item in its visual field using its four cameras. It's a social robot that engages and interacts with people, as well as supporting their 'well-being' and knowing five distinct emotions: approval, prohibition, attention, comfort, and speech-neutral. The emotional system and the expressive motor system must function together at the right moment for the robot to do things correctly. Kismet, once touted by the Guinness Book as the 'Most Emotionally Aware Robot of the World'- Right now there is an exhibit at the MIT Museum in the US. Kirobo[6], a Japanese robot, took off for the International Space Station in August 2013. The robot, which can speak and recognise faces, is going to space with the primary task of keeping astronauts company. It can also help to build contact. By being able to process natural language and adapt to various facial expressions, it can also help to make interactions more relaxed.

Another goal of the project of Kirobo is to see whether or not devices such as this can be a source of emotional support over long periods of time for individuals separated. Japan's ageing population means that its people live more and more solitary lives, so researchers believe that in the future, robots that can interact and show emotion may prove invaluable[6]. Kirobo will give its first speech from the International Space Station on 6 September 2013 (as stated by the Times of India, Mumbai) during a session to review the progress of its out-of-the-world mission. Scientists have built an interactive life-size robot that functions as a stand-up comedian and has already garnered many laughs from the audience during its unique success in London, reported in an article in the August 2013 Times of India, Mumbai [7]. The humanoid was built for human connection as an interactive, customisable robot that may be programmed to speak or entertain.

Healey and Katevas11 set the robot on a stage in London as an experiment in audience interaction - with a robot involved in comedy. The audience's cameras captured facial expressions, looks and head motions as the audience watched the robot tell jokes. These human reactions to the performance of the robot were contrasted in contrast with responses to two human comedians performed before the robot went on stage.

Therefore, evidence shows that many new advances have been considered in different ways for human interactive interaction with computers. Pepper is a pro-active robot that has computers of various ways.

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The world's first personal robot capable of recognising emotional algorithms that allow it to understand its environment and respond to it (DNA newspaper, Mumbai 16th June, 2014). Mr. Bruno Maisonnier, the founder and CEO of Aldebaran, thought that the function of robots will be to enhance our everyday lives as kind and emotional companions. The following chapter was dedicated to further discussing the HCI function in various domains.

3. APPLICATIONS OF AFFECTIVE COMPUTING

In parallel, the HCI architecture studies a human and a machine because it is socio-technological and involves how people as individuals and in societies are affected by the computer and how they are using the computer and other communication systems[8]. In many domains of our everyday lives, HCI is used. Below, some domains are discussed:

A. For People who are Disabled

HCI plays a major role in promoting and meet the concerns of the disabled. In comparison to typical people, they require a specific type of interface. User friendliness, efficient and more productive ways of engaging using gestures, voices, facial expressions, and head motions are major aspects of such interfaces[9]. Several different gadgets might provide the particular interface. The word "interface" refers to "the complete system" from the user's perspective. The virtual keyboard, for example, is an on-screen replica of a standard keyboard that may be used for nearly any program as long as the user can handle a mouse, trackball, or other pointing device. Webcam-based systems, on the other hand, may manage facial characteristics to capture user movements without requiring the user to wear a headset, resulting in limited third-party help ([10],[11]). Eye tracking is frequently used in usability testing[12]. One or more cameras concentrate on one or both eyes and regulate the users' eye movements in an eye tracking system. The facial mouse [11] is a mouse emulation system that pays attention to the user's face movement. A camera is placed in front of the user, focused on the user's face. The face motion is extracted from the associated video using a user-independent motion extraction method. This action is used to move the mouse pointer, which is operated in a manner similar to that of standard mouse devices. Affective computing plays a significant role in recognizing individual needs and ensuring that handicapped persons may participate in significant life events.

B. IN E - LEARNING

E-learning has progressed from machine-assisted teaching to smart classrooms and mobile learning in the last decade thanks to the Intelligent Tutoring Platform (e-Learning with mobile devices). Today's e-learning is overwhelmingly learner-centered, with pervasive and personalized learning technologies[13]. The impact of emotions on learning is still a relatively unexplored subject. Recently, evidence has begun to highlight the essential importance of emotion in any learning endeavor and result, particularly in online learning ([13], [14]). Continuous and expanding investigation of Students' emotional states, and in particular the link between emotions and effective learning [14], reveals the usefulness of the complex collection of characteristics surrounding online learning. As a consequence, it appears to be an effective e-learning approach, as negative emotions like boredom and fury reduce cognitive effort and, as a result, hinder the fulfillment of learning objectives. These findings demonstrate the importance of emotions in learning.

C. IN AUTOMOBILES INDUSTRY

The worldwide industrial automation market has reached $152 billion in total size, according to DNA, Mumbai (dated August 6, 2013), and the automation sector has grown at a 6% annual rate since 2003. Computer interfaces are becoming smarter every day in this industry, not only providing navigation aids and crash avoidance warnings to drivers, but also competing for their attention with potentially catastrophic consequences in sensing the driver's mental state, such as when he is irritated, intoxicated, or needs to take a nap so that HCI can improve h A basic example of a smart interface is Google's self-driving automobiles[16], which are more autonomous and self-sufficient than all other automobiles. The software comes in the form of a modular kit that can be installed on any vehicle. It is capable of autonomous navigation and scans the vehicle's surroundings using radar and laser beams, allowing it to drive practically automatically. This is clearly not a simple undertaking; even the greatest GPS system will not enough to pilot a driverless automobile 24 hours a day, seven days a week. When it's the autonomous vehicle's turn to drive, it compares the data it collects from all of these sensors and cameras to previously collected data to assist distinguish between a human and a light post. There are several drawbacks, such as self-driving cars that cannot handle heavy rain or travel on snow-covered roads. It cannot figure out where to go or what to do in the center of the

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lane, such as finding a stalled car above the crest of a hill or recognizing debris "and how to deal with "unusual accidents" on the road, such as finding a stranded car above a hill's crest or recognizing debris[17]. "It should be mentioned that in order to fulfill the goals of safety, success, and enjoyment, these uncommon incidents must be tackled by human factors and HCI in order to deal with drivers' strengths and weaknesses[18]. This type of innovation will be realized in the future decade and will serve as the foundation for a new technology revolution [16].

D. DESIGN OF ROBOTS

Robots are no longer limited to the category of large industrial equipment used for welding and assembly operations by qualified personnel in organized production environments. Robots are starting to work in situations that are unstructured, dynamic, and unexpected, such as homes, businesses, hospitals, and museums. In such circumstances, they must communicate with people and adjust their behavior in real time. They may also be required to detect and track human movement, respond to queries, examine text data, and avoid obstacles by moving in accordance with commands. They must also communicate not only with qualified robot specialists, but also with people from all walks of life, such as children, housewives, medical personnel, and others, in order to fulfill social and intellectual duties without having prior knowledge of robot operation[19]. AIBO[20], ASIMO[21], Keepon[22], AUR[23], and 'Improv' Robots[24], for example, are entertainment robots. When Sony launched the Entertainment Robot, also known as AIBO (Artificial Intelligence RoBOt), in 1999, it was a watershed moment in the realm of entertainment in Japan. Another example is mentor robots like 'Basketball Coach'[25] and'Chips'[26]. A robot basketball coach, as described by Liu et al.[27], analyzes people's physiological signals as they shoot baskets (heart rate and galvanic skin response). The robot adjusted the game's difficulty level based on how nervous the players looked to be. The researchers discovered that the style of interactive robots is important in a variety of aspects, including entertainment, engagement, and so on. As a result, emotional computing plays a crucial role in the development of interactive robots.

E. ENVIRONMENT AND SMART COLLABORATION FOR BUSINESS

The second example is in the business world, where a smart environment is required for quickly developing business. The term "smart environment" refers to physical surroundings that promote and enable better communication, more inventive thinking, faster decision-making, and increased productivity. Throughout these environments, there will be large group monitors, high-end analyst workstations, multi-touch tables, digital dashboards and ambient screens, telepresence and video conferencing equipment, various cameras and microphones, room and person sensors (motion detectors, acoustic analyzers, body trackers, eye trackers), Space monitors, and biometric verification (lights and speakers that can be software controlled). A few examples of intelligent and smart gadgets utilized in Naval Space and Warfare (SPAWAR) systems are the Navy Command Center of the Future (CCoF), Smart Video Conferencing[30], and Intelligent Homes and Offices[31] ([28],[29]).

F. THE GAME'S LAYOUT

Emotions play a critical part in creating compelling games, according to the gaming industry ([32], [33], [34], [35]). Affective gaming's present focus is mostly on perceiving and detecting players' sentiments, as well as modifying game response to these emotions, such as lowering tensions and regulating anxiety levels ([36], [37]). As a result, there is a growing interest in approaching game studies from a human-computer interaction perspective. Several academics have investigated unique forms of interaction in order to foster cooperation and strategies to suit user demands for educational game design[38]. Other studies, such as anger[39], focus on human behavior and physiological reactions. Through the study of video game play, gain a deeper understanding of interface design for developing affective computers. By working closely with game developers, researchers[40] tried to establish heuristics and usability guidelines for creating and testing fun in video games in terms of research in Game Usability[40]. The results of the literature ([41],[42]) suggested that in children's computer game design, games should be designed in such a way that the player has the freedom to explore and therefore the game should be controlled by means of a spontaneous, self-initiated and self-regulated act.

Many applications exist from the HCI perspective. We must examine if new types of input will replace well-established interaction mechanisms as we adopt them. Traditional interaction models may be preferable in terms of performance and may give a better experience for users, whilst newer varieties can provide expanded features

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for youngsters and persons with impairments. However, there are a number of drawbacks to using affective computing.

4. AFFECTIVE TECHNOLOGY'S POTENTIAL IN COMPUTING

As previously noted, affective technologies enable a broad range of intriguing new and helpful uses; yet, the capacity to feel, measure, monitor, convey, control, and influence emotion through technology may also be used for destructive or otherwise unwanted ends. However, practically every technology has a bad side, and affective computing is no exception. This presents a number of social, legal, and philosophical issues, including:

A. Humans' privacy

Emotional lives are incredibly private, and they should not be impacted by work. As a result, it's critical to treat affective information with the utmost respect and discretion, as there's a possibility of it being misused. For example, a driver may wish for the car's navigation system to detect and adjust its voice to his mood, which may improve driving safety; however, it may not be a good idea to reveal this information to the insurance provider or for medical claims, which may raise the cost of the individual's policy if it is discovered that he frequently drives while angry. This scenario [15] considers the possibility that humans may not want to reveal their emotional state, and that forcing a computer to show its internal state on a regular basis might become quite bothersome. What is the ideal technique to portray the emotional situation, and what elements are dependent on that balance? The use of emotion in the decision-making process of machines is a tricky subject. It's important to find a middle ground where positive outcomes may be utilised without devolving into illogical behavior.

B. Inaccuracies and the impact of false information

Another issue is the consistency with which people interact with machines, which is affected by a variety of factors such as the context in which the end user works, his or her state of mind, the working environment, and so on. In order to know whether you are lying or not, or what your precise state of mind is, an end user will expect a computer to never be flawless. Manipulation of emotions and moods may be necessary or acceptable, and may take the form of social limitations, drinking or eating chocolates, or other external stimuli. Controlling one's inner feelings may be ethical by society's standards, but there's a risk that the machine (intelligent interface with emotional capacity) will try to manipulate them by knowing the end user's exact state of mind and having access to their affective state when communicating with the machines.

C. End-user expectations for interfaces

Most people are unfamiliar with the concept of machines adjusting their behavior based on the consumer's perceived emotional state. Despite the fact that a computer is only a machine, many people find it difficult to relate to this concept. A poll was done to acquire a feeling of the space, as well as people's reactions to such a development. The survey consisted of four categories and was based on "The survey focused on the." The respondent's demographic information is captured in the first part. The second portion looks at how people utilize computers and the internet in their daily lives. Respondents are provided alternatives pertaining to the kind of applications they use on a regular basis in order to be able to pick from the list in this category. The 'frustrating experiences and challenges individuals (end users) have when working with the computer' is the third section of the questionnaire. We'd like to talk about "anything that bothers end users when dealing with computers" in this section of the poll. The survey's last component focuses on the nature of the system's end-users' thoughts. The purpose is to figure out if the system (computers) might recognize the end user's emotional state and mood during interaction, as well as comprehend the system's end users' desires (computers). A total of 104 persons were polled, including students and employees from all backgrounds. Women account for 24% of the total, while males account for 76% of the total. Between the ages of 16 and 30, 82 percent of the population is between the ages of 16 and 30. A career history accounts for 52 percent of the total, while academics and others account for 48 percent. Many individuals use computers on a regular basis at their employment and at home, according to research. The same is true while using the Internet. Figure 1 depicts the same data, but Figure 2 depicts the entire spectrum of consumption patterns.

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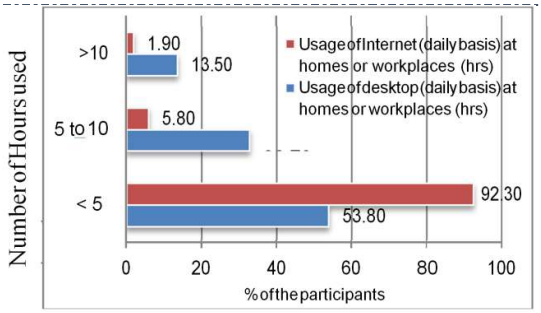

Figure 1 shows the percentage of persons who use computers and the Internet.

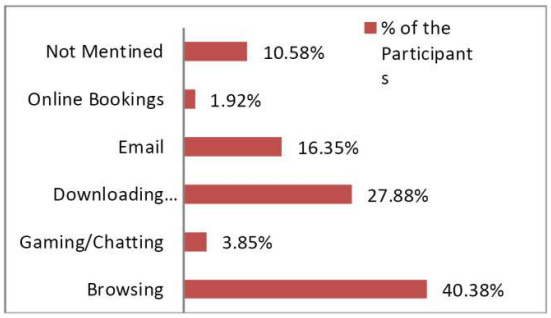

Figure 2 percent distribution of consumption patterns when people are annoyed if an issue exists.

People use computers for email, the Internet, word processing and presentations, chatting, and application creation the majority of the time. People have noticed that the system does not always behave as it should (due to a sluggish network, hanging separate programs, options that are not communicating or restricted, hardware and software difficulties, and so on), causing them to become upset. When there are any such concerns and they can't proceed any farther, 40.38 percent of people claim they get frustrated when they search the internet. How does the end user respond in such instances? Our survey reveals that 47 percent (of the total) of end users feel angry at their desktop while dealing with computers while facing certain problems (desktop). 51% (of the total) feel helpless and 2% (of the total) do not respond at all if there is such a problem.

The capacity of the desktop to recognize the end user's emotional state while speaking is the focus of our research. 61 percent of respondents believe that the gadget (desktop) should be able to comprehend their emotional state in order to maximize their relationship. Only these respondents had any helpful insights into their computer system's behavioural indicators and perceptions based on their emotional states, and only around 1% of them could provide a practical response.

Some of their points of view are listed below:

When reading or composing an email, the following choices may be useful:

- It automatically rates which emails are the most important to read based on the end user's priorities.
- Playing music in accordance with the user's mood.
- Disruptive pop-ups, scrolling text, moving visuals, and other elements should be handled appropriately depending on the end user's emotional state.

Depending on the emotional state of the end user, the following options may be beneficial when searching the Internet:

- If a page takes longer to load than normal, a notice may appear stating that it is taking an unusually long time to load and that the user should be calm and patient.

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• The website should appear as soon as the end user clicks, or it should display some lovely photographs instead of a dull error message.

• Research the end user's behavior and employ just screen advertising.

Color and typeface appear to be among the syntactic features that may be modified to fit the user's emotional state, based on the above suitable talks and observations. In HCI, this can also include the use of audio and other cues. The degree of information in produced messages, message prioritization, the form of crucial assistance, and so on are some of the additional variables that may be tweaked. This necessitates abstracting and describing the HCI process using emotion as a parameter. Some of the participants may object to the device's capacity to recognize and respond to emotions. According to them, interacting with the gadget has little to do with the users' emotional states. In some ways, these findings are unsurprising, because most users regard a computer system as merely a machine, and hence are unable to envision the possibilities that emotion detection might provide. It's also conceivable that when a human buddy is represented by a machine, the behaviors that he or she takes are deemed improper or do not have the same outcome. A system that can comprehend people's anger should be able to respond in a variety of ways. Can it allow the user to pick the best strategy from all of them, as Picard suggested, or would it be necessary to hide the specifics of these methods in order for them to work and the user not to feel manipulated? As a result, this is unquestionably a conducive setting for active experimentation, as well as a significant challenge in resolving these concerns.

5. CONCLUSION

Affective computing has exploded in popularity in recent years. There is evidence that emotion, particularly perception, critical thought, decision-making, creative thinking, and other aspects of intelligence, are active components of intelligence. Affective computing is being used in a variety of ways, including learning, entertainment, social growth, and so on. It's an attempt to provide computers emotive qualities in several sectors by adding balance and reason to their analytical talents. The established fact is that each technology appears to come via its advantages and disadvantages. Many problems about affective technology are raised in this study, including privacy violations, mistakes in determining affects, and their expectations. The market for emotional computing should be aware of the flaws, and it is believed that in the future, this will be a common feature for computer users or HCI technology. In this regard, innovation, teaching, and research will involve a holistic perspective and a thorough knowledge of key disciplinary frameworks and paradigms. Affective computing has the potential to broaden and improve the application range of computers in general.

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