INTRODUCTION

1.1 HUMAN COMPUTER INTERACTION

Human Computer Interaction (HCI) is a multidisciplinary field concerned with the application of computer science, psychology, cognitive science, ergonomics and many other disciplines in industry and commerce multidisciplinary research in human computer interaction (HCI) as shown in fig1.1 HCI is the study of how people interact with computers and to what extent computers are or are not developed for successful
interaction with human beings. Historically, computer system developers have not paid much attention to computer ease-of-use [1]. Many computer users still feel that computer makers are still not paying enough attention to making their products user-friendly and intuitive to use. An important HCI factor is that different users form different conceptions or mental models about their interactions and have different ways of learning, keeping knowledge and skills (different cognitive styles as in thinking). In addition, cultural and national differences play a part. Another consideration in studying or designing HCI is that user interface technology change rapidly, offering new interaction possibilities to which previous research findings may not apply [2]. Finally, user preferences change as they gradually master new interfaces.

Fig 1.1 Multidisciplinary research in human computer interaction (HCI).

A socio technological discipline whose goal is to bring the power of computers and communications systems to people in ways and forms that are both accessible and useful in our working, learning, communicating, and recreational lives. Toward this end,
technologies such as the graphical user interface, virtual environments, speech recognition, gesture and handwriting recognition, multimedia presentation, and cognitive models of human learning and understanding are developed and applied as part of HCI research agendas [3]. HCI is socio technological because it concerns how people, both as individuals and as groups, use and are affected by computer and communication systems. As such, HCI draws on computer science, computer and communications engineering, graphic design, management, psychology, and sociology as it endeavors to make computer and communications systems ever more usable in carrying out tasks as diverse as learning a foreign language, analyzing the aerodynamics of a new airplane, planning surgery, playing a computer game, accessing information on the World Wide Web, or programming a VCR [4].

1.2 SIGNIFICANCE OF HCI

It is important due to following:

- **Quality of life.** Important applications of computers in medicine are possible only if they are both useful and easy to use by doctors, nurses, and aides; similarly, use of computers in education requires that they be both useful and easy to use by students and teachers. Computers can assist disabled individuals; at the same time, special techniques are needed to allow computers to be used by some who are disabled [5].

- **National competitiveness.** Information technology is one of the drivers for increased productivity. As more and more workers use computers in their jobs, training time and ease-of-use issues become economically more and more important.

- **Growth of the computer and communications industries.** Powerful, interesting, and usable applications are the fuel for continuing growth of these industries. The current growth cycle is the direct consequence of the graphical user interface developed by Xerox and commercialized by Apple and Microsoft, and of the lower computer costs made possible by the microprocessor. The resulting mass market supports commodity pricing for both hardware and software. Future
growth cycles will in part be driven by current HCI research, which will lead to new applications that are increasingly easy to use.

**National security.** Computer-based command, control, communications, and intelligence systems are at the heart of our military infrastructure. Interfaces between operators and computers are found in cockpits, on the bridge, and in the field. To be effective, these systems must have high-quality human-computer interfaces [6].

The world is in revolution. The only point of disagreement is the name used to describe the revolution: the computer/communications revolution, the information technology revolution, or convergence. Whatever the name, the revolution is fueled by the low cost of mass-produced computer processor and memory chips and by the inexpensive, high-bandwidth digital communications capabilities of the emerging national information infrastructure (NII).

The computer/communications revolution in which we are all participating both *enables* and *requires* advances in human-computer interaction. The revolution *requires* advances in HCI in order that the sophistication and power of computers be made widely available for use by the millions of people who simply want to do their jobs or play computer games or explore the World Wide Web without having to be computer experts [7]. The continuing growth of the computer and communications industries will be moderated without further developments in HCI to create more useful and usable applications.

### 1.3 HUMAN-COMPUTER INTELLIGENT INTERACTION (HCII)

The intelligent human-computer interaction (HCI) technologies play important roles in the development of advanced and ambient communication/computation. In contrast to the conventional mechanisms of passive manipulation, intelligent HCI integrates versatile tools such as perceptual recognition, machine learning, affective computing, and emotion cognition to enhance the ways humans interact with computers. Nonverbal information such as facial expression, posture, gesture, and eye gaze is suitable for behavior interpretation. Facial data analysis is one of the essential medium of perceptual
processing and emotion modeling. In recent years there has been a growing interest in improving all aspects of the interaction between humans and computers. It is argued that to truly achieve effective human-computer intelligent interaction (HCII) [8], there is a need for the computer to be able to interact naturally with the user, similar to the way human-human interaction takes place. Humans interact with each other mainly through speech, but also through body gestures, to emphasize certain part of the speech and display of emotions. Emotions are displayed by visual, vocal, and other physiological means. There is a growing amount of evidence showing that emotional skills are part of what is called “Intelligence”. One of the important way humans display emotions is through facial expressions [9].

1.4 BRAIN-COMPUTER INTERACTION (BCI)

Brain-computer interaction (BCI) could be the interface medium of the future. Instead of using peripheral input and output devices, the goal of BCI research is to enable direct interaction between humans and computers by directly receiving and transmitting signals to and from the brain. Contemporary physical interface devices would thus be eliminated [10]. Man-Machine interface has been one of the growing fields of research and development in recent years. Most of the effort has been dedicated to the design of user-friendly or ergonomic systems by means of innovative interfaces such as voice recognition, virtual reality [11]. A direct brain-computer interface would add a new dimension to man-machine interaction. Interesting research work in this direction has been already initiated, mainly motivated by the hope to create new communication channels for those with severe motor disabilities. There is a general consensus that BCI represents one of the new frontiers in science and technology. As example of BCI as shown in 1.2.

![EEG-Based Emotion Expressing Interface](image)

Fig 1.2. Brain computer interaction.
1. 4.1 BCI THROUGH EEG
The promise of Brain-Computer Interfaces (BCI) technology is to augment human capabilities by enabling people to interact with a computer through a conscious and spontaneous modulation of their brainwaves after a short training period. Indeed, by analyzing brain electrical activity online, several groups have designed brain-actuated systems that provide alternative channels for communication, entertainment and control. Thus, a person can write messages using a virtual keyboard on a computer screen and also browse the internet. Alternatively, subjects can operate simple computer games, or brain games, and interact with educational software. Researchers have also been able to train monkeys to move a computer cursor to desired targets and also to control a robot arm. Work with humans has shown that it is possible for them to move a cursor and even to drive a mobile robot between rooms in a house model [12].

A BCI has been developed cerebral electric activity is recorded via the electroencephalogram (EEG): electrodes, attached to the scalp, measure the electric signals of the brain. These signals are amplified and transmitted to the computer, which transforms them into device control commands. The crucial requirement for the successful functioning of the BCI is that the electric activity on the scalp surface already reflects motor intentions, i.e., the neural correlate of preparation for hand or foot movements [13]. The BCI detects the motor-related EEG changes and uses this information, for example, to perform a choice between two alternatives: the detection of the preparation to move the left hand leads to the choice of the first, whereas the right hand intention would lead to the second alternative. By this means it is possible to operate devices which are connected to the computer; such a communication can even be realized via the global information [14].

1.5 AUTOMATIC FACIAL EXPRESSION RECOGNITION (AFER)
The method used in recent times for automatic facial expression recognition is are based on two basic step: first extract features, then these features are used as input into a classification system and the outcome is one of the preselected emotion categories. The methods differ only in the way the features are extracted from the videos and in the
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classifiers used to distinguish between the different emotions. The recognition system acquires a particular image and after pre processing a set of facial features are extracted from the image which are used as input to the classifiers, which detects the emotion exhibited, and displays its class. In general, there are five major stages in AFER processing.

1) Image Acquisition
2) Pre-Processing
3) Feature Extraction
4) Classification
5) Post Processing

1.5.1 Measuring Facial Expressions

Few studies have measured how the face moves as an expression forms (Landis, 1924), (Frois-Wittmann, 1930), (Thompson, 1941) and (Fulcher, 1942). The central reason for this is the fact that research focused on facial expressions is limited due to the lack of adequate techniques for measuring the face. More recent approaches to facial measurement have varied in methodology, from measurements of specific changes to a particular part of a face (Birdwhistell, 1970), to verbal descriptions of facial gestalts (Young and Decarie, 1977). Knowledge of the muscles of the face allows us to characterize exactly what is happening as an expression is emerging. Since everyone’s face is different it is difficult to characterize an expression any other way. For this reason a thorough understanding of the face is required prior to devising a scheme for the characterization and measurement of facial expression.

1.6 BACKGROUND

Facial expressions provide an important behavioral measure for the study of emotion, cognitive processes, and social interaction. Facial expressions play a major role in how people communicate information. They serve as a window to display one’s own emotional state. They make behavior more understandable and effective to others, and they
supplement verbal communication. Facial expression recognition through a computer system is challenging application in human computer interaction. This involves many complex issues like psychological, neuro medical and anatomical fields. This is also very much dependent on social behavior. Basically, one may consider an expression as a vector in the seven dimensional fields, on which basis vectors are fundamental expressions. These fundamental expressions categorized by psychologists are happiness, sadness, fear, anger, disgust, surprise and the seventh expression 'neutral' for convenience [15][16]. However in everyday life, such prototypic expression occur relatively rarely, and in addition some facial expressions may have a similar gross morphology but indicate varied meaning for different expression intensities. A neutral face is a relaxed face without contraction of facial muscles and without facial movements. It is the state of a face most of the time, especially during unconscious state or when a person sleeps. In contrast for a face with an expression, the facial muscles are some how contracted. Hence, facial expressions are deformations of the neutral face due to a person's psychological state [17]. When speaking, a person's expression is deformed from neutral face because of the movement of the mouth and other muscular motions induced by the dramatic content of speech. It is the psychology of a person that determines his emotions and hence expressions. The fundamental work of facial expression was carried and many prominent scientist like Charle Darwin (Human Evolution,1872), Paul Ekman and Friesen (FACS coding,1976), cognitive psychologists (Bruce and Young), 1986, (Ellis,1992), neurophysiologists (Perret, Hietanen, Oram and Benson, 1992), (Rhodes, Brake and Atkinson, 1993), social psychologists, (Shepherd, 1994), computer scientists (Kohonen, Oja, and Sirohey, 1995), cognitive scientist (Poggio, 1998), (Cootes, 2000) and Jeams A Cohen, John Allen, and Eddie Harmon-Jones (Electroencephalogram (EEG) technique, 2005),

1.7 THE ORGANIZATION OF THE THESIS

The works in the thesis are described in five chapters as follows:  
Chapter 2: Research in Facial Expressions

The development of a computational model of facial expression involves a comprehensive understanding of expression. This is a complicated task and is a
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multidisciplinary area of research. While developing a facial expression recognition system, multiple factors affecting and 'expression' should be taken into consideration. Broadly these factors are anatomical, neurological and psychological factors. Almost all researches can be classified through the above-mentioned factors, yet some researchers have overlooked these factors and directly developed computational models. No researcher has taken into consideration all factors simultaneously. Western academicians and scholars have pursued researches in this direction. But this research provides a new dimension in the India context, as Indian faces, is hardly touched by it.

Chapter 3: Facial expression database of Indian faces with facial action coding system (FACS)

Facial expression recognition system work under the specified facial database. The western researchers had developed standard database for facial expression recognition, but it has not been tested for Indian faces. The goal of this research is to develop an Indian facial expression database with facial action coding system (FACS) correlation. Moreover, the western models lack the categorization under the various age groups. My research is focused on especially Indian faces and hence I have proposed to develop own database, which is consistent with the expression and also the action units (AU). The goal of my database is to develop a set of appropriate images of Indian faces that can be used in the generation of an expression space. For the images to be deemed appropriate, I have taken care that images provide a means of measuring the variation in shape and texture of an individual regardless of identity while minimizing the variation in illumination, pose and orientation.

Chapter 4: Recognition of Facial Expression Through Electroencephalogram (EEG) Technique

Emotion is an important aspect of the mind, and these emotions are exhibited through facial expressions. Feedback and arousal theories suggest that the brain processes the emotional significance of the situation and produces responses mainly through facial expression appropriate to the stimulus. A person with a 'disgust' expression, responding to an offensive taste or smell, can be taken as an example. The neurons present in the
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Brain activate different parts of the brainstem system, producing and controlling emotional responses and exhibiting or inhibiting them through facial expressions. Fundamental expression related to happiness, sadness, fear, anger, surprise, disgust, and neutral. Attempts have been made to express an expression in terms of anatomical facial action coding system (FACS), which involves anatomical aspects of the face. As the expression are controlled by the brain, it is useful to correlate the expressions with the brain. The objective of the present work is to report the experimental work carried out in this direction. For this experiment, portable Electroencephalograph (EEG) system has been used to record the electrical signals from the brain for a given subject.

Chapter 5: Result and Conclusion
This section provides concluding remarks and gives scope for the future work.

REFERENCES


