SEMINAR REPORT

on

BLUE EYES TECHNOLOGY

Submitted in partial fulfillment of the requirements for the award of the degree of

B.Sc. COMPUTER SCIENCE

MAHATMA GANDHI UNIVERSITY
KOTTAYAM

Submitted by

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S N ARTS & SCIENCE COLLEGE
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CERTIFICATE

This is to certify that this seminar report entitled "BLUE EYES TECHNOLOGY" is submitted by ABHINANDH K.J(190021031034) in partial fulfilment of requirement of B.Sc computer science of S.N ARTS & SCIENCE COLLEGE KEDAMANGALAM affiliated to Mahatma Gandhi University, Kottayam during the VIth semester.

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DECLARATION

I hereby declare that the seminar entitled ”BLUE EYES TECHNOLOGY has been carried out individually. The project has been submitted to Sree Narayana Arts and Science College, Kedamangalam for the partial fulfillment of the degree of B.sc Computer Science under Mahatma Gandhi University.

Place :Kedamangalam

Date :

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ABSTRACT

Is it possible to create a computer, which can interact with us as we interact each other? For example imagine in a fine morning you walk on to your computer room and switch on your computer, and then it tells you “Hey friend, good morning you seem to be a bad mood today. And then it opens your mail box and shows you some of the mails and tries to cheer you. It seems to be a fiction, but it will be the life lead by “BLUE EYES” in the very near future.

The basic idea behind this technology is to give the computer the human power. We all have some perceptual abilities. That is we can understand each other’s feelings. For example we can understand ones emotional state by analyzing his facial expression. If we add these perceptual abilities of human to computers would enable computers to work together with human beings as intimate partners. The “BLUE EYES” technology aims at creating computational machines that have perceptual and sensory ability like those of human beings.

CONTENTS

1. INTRODUCTION

Imagine yourself in a world where humans interact with computers. You are sitting in front of your personal computer that can listen, talk, or even scream aloud. It has the ability to gather information about you and interact with you through special techniques like facial recognition, speech recognition, etc. It can even understand your emotions at the touch of the mouse. It verifies your identity, feels your presents, and starts interacting with you .You asks the computer to dial to your friend at his office. It realizes the urgency of the situation through the mouse, dials your friend at his office, and establishes a connection.

Human cognition depends primarily on the ability to perceive, interpret, and integrate audio-visuals and sensoring information. Adding extraordinary perceptual abilities to computers would enable computers to work together with human beings as intimate partners. Researchers are attempting to add more capabilities to computers that will allow them to interact like humans, recognize human presents, talk, listen, or even guess their feelings.

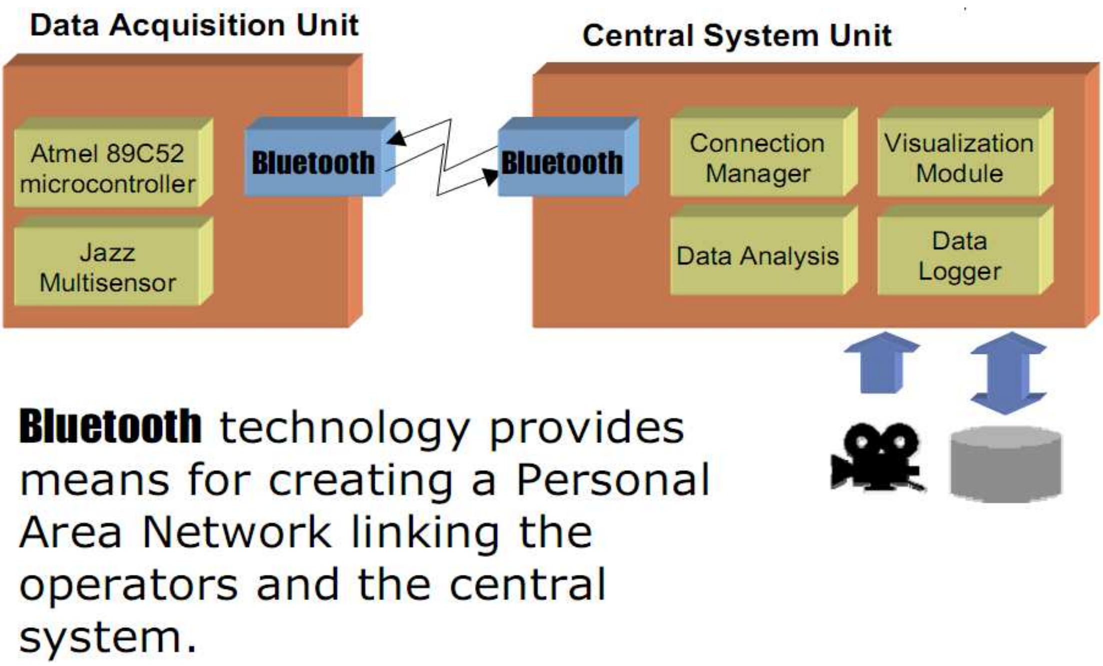
The BLUE EYES technology aims at creating computational machines that have perceptual and sensory ability like those of human beings. It uses non-obtrusive sensing method, employing most modern video cameras and microphones to identify the user's actions through the use of imparted sensory abilities. The machine can understand what a user wants, where he is looking at, and even realize his physical or emotional states.

2. SYSTEM OVERVIEW

Blue eyes system monitors the status of the operator's visual attention through measurement of saccadic activity. The system checks parameters like heart beat rate and blood oxygenation against abnormal and triggers user defined alarms.

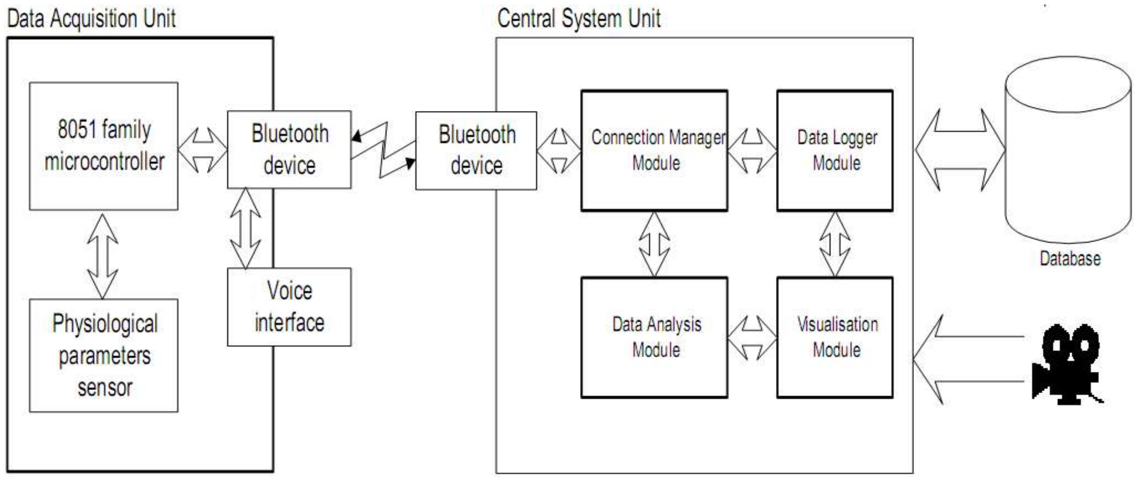
BlueEyes system consists of a mobile measuring device and a central analytical system. The mobile device is integrated with Bluetooth module providing wireless interface between sensors worn by the operator and the central unit. ID cards assigned to each of the operators and adequate user profiles on the central unit side provide necessary data personalization so the system consists of

- Mobile measuring device (DAU)
- Central System Unit (CSU)



(Fig. System Overview)

The overall System diagram is as follows:-



(Fig. System Diagram)

2.1. THE HARDWARE

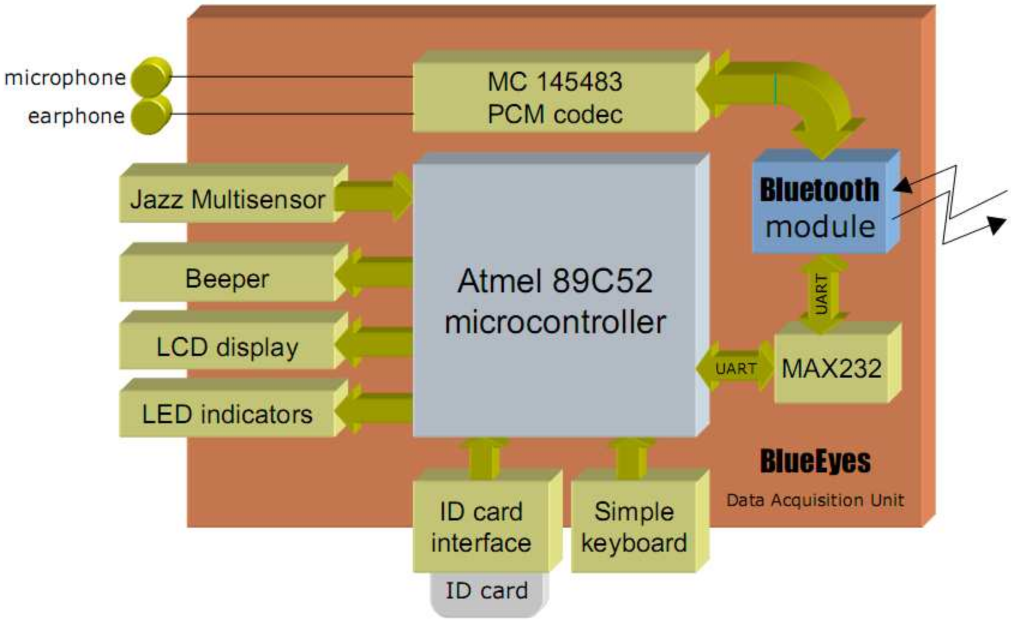
2.1.1. Data Acquisition Unit

Data Acquisition Unit is a mobile part of the Blue eyes system. Its main task is to fetch the physiological data from the sensor and to send it to the central system to be processed. To accomplish the task the device must manage wireless Bluetooth connections (connection establishment, authentication and termination). Personal ID cards and PIN codes provide operator's authorization. Communication with the operator is carried on using a simple 5-key keyboard, a small LCD display and a beeper. When an exceptional situation is detected the device uses them to notify the operator. Voice data is transferred using a small headset, interfaced to the DAU with standard mini-jack plugs.

The Data Acquisition Unit comprises several hardware modules

- Atmel 89C52 microcontroller - system core
- Bluetooth module (based on ROK101008)
- HD44780 - small LCD display
- 24C16 - I2C EEPROM (on a removable ID card)

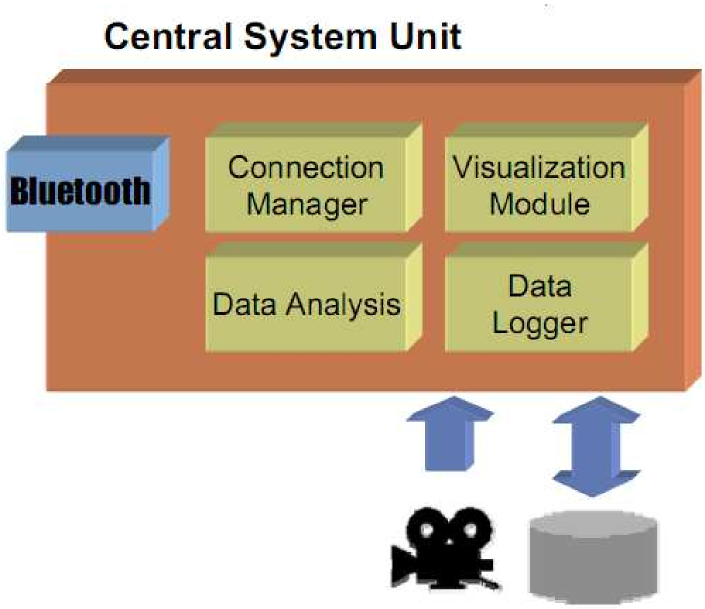
- MC145483 – 13bit PCM codec
- Jazz Multisensor interface
- Beeper and LED indicators ,6 AA batteries and voltage level monitor



(Fig. DAU Components)

2.1.2. <u>Central System Unit</u>

Central System Unit hardware is the second peer of the wireless connection. The box contains a Bluetooth module (based on ROK101008) and a PCM codec for voice data transmission. The module is interfaced to a PC using a parallel, serial and USB cable. The audio data is accessible through standard mini-jack sockets To program operator's personal ID cards we developed a simple programming device. The programmer is interfaced to a PC using serial and PS/2 (power source) ports. Inside, there is Atmel 89C2051 microcontroller, which handles UART transmission and I2C EEPROM (ID card) programming.



(Fig. CSU Components)

2.2 THE SOFTWARE:

Blue Eyes software's main task is to look after working operators' physiological condition. To assure instant reaction on the operators' condition change the software performs real time buffering of the incoming data, real-time physiological data analysis and alarm triggering.

The Blue Eyes software comprises several functional modules System core facilitates the transfers flow between other system modules (e.g. transfers raw data from the Connection Manager to data analyzers, processed data from the data analyzers to GUI controls, other data analyzers, data logger etc.). The System Core fundamental are single-producer-multi-consumer thread safe queues. Any number of consumers can register to receive the data supplied by a producer. Every single consumer can register at any number of producers, receiving therefore different types of data. Naturally, every consumer may be a producer for other consumers. This approach enables high system scalability – new data processing modules (i.e. filters, data analyzers and loggers) can be easily added by simply registering as a costumer.

Connection Manager is responsible for managing the wireless communication between the mobile Data Acquisition Units and the central system. The Connection Manager handles:

- communication with the CSU hardware
- searching for new devices in the covered range
- establishing Bluetooth connections
- connection authentication
- incoming data buffering
- sending alerts

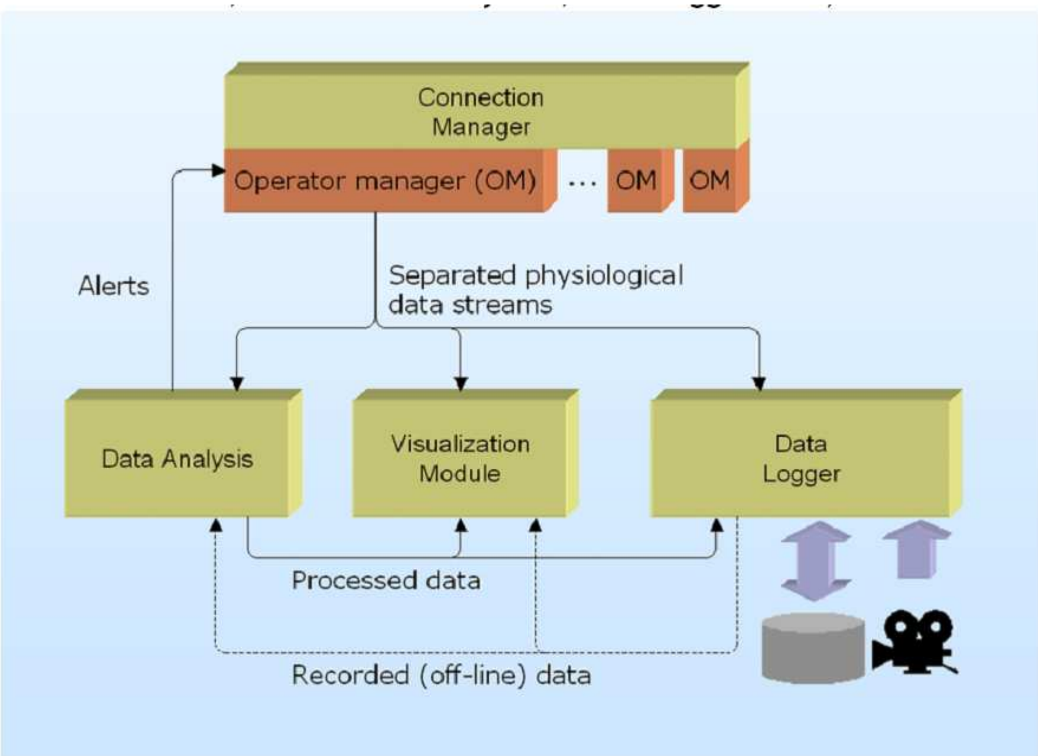
Data Analysis module performs the analysis of the raw sensor data in order to obtain information about the operator's physiological condition. The separately running Data Analysis module supervises each of the working operators.

The module consists of a number of smaller analyzers extracting different types of information. Each of the analyzers registers at the appropriate Operator Manager or another analyzer as a data consumer and, acting as a producer, provides the results of the analysis. The most important analyzers are:

- Saccade detector - monitors eye movements in order to determine the level of operator's visual attention
- Pulse rate analyzer - uses blood oxygenation signal to compute operator's pulse rate
- Custom analyzers - recognize other behaviors than those which are built-in the system. The new modules are created using C4.5 decision tree induction algorithm

Visualization module provides a user interface for the supervisors. It enables them to watch each of the working operator's physiological condition along with a preview of selected video source and related sound stream. All the incoming alarm messages are instantly signaled to the supervisor. The Visualization module can be set in an off-line mode, where all the data is fetched from the database. Watching all the recorded physiological parameters, alarms, video and audio data the supervisor is able to reconstruct the course of the selected operator's duty. The physiological data is presented using a set of custom-built GUI controls:

- a pie-chart used to present a percentage of time the operator was actively acquiring the visual information
- A VU-meter showing the present value of a parameter time series displaying a history of selected parameters' value.



(Fig.5 Software Analysis Diagram)

3. EMOTION COMPUTING

Rosalind Picard (1997) describes why emotions are important to the computing community. There are two aspects of affective computing: giving the computer the ability to detect emotions and giving the computer the ability to express emotions. Not only are emotions crucial for rational decision making as Picard describes, but emotion detection is an important step to an adaptive computer system. An adaptive, smart computer system has been driving our efforts to detect a person's emotional state. An important element of incorporating emotion into computing is for productivity for a computer user. A study (Dryer & Horowitz, 1997) has shown that people with personalities that are similar or complement each other collaborate well. Dryer (1999) has also shown that people view their computer as having a personality. For these reasons, it is important to develop computers which can work well with its user.

3.1 THEORY

Based on Paul Ekman's facial expression work, we see a correlation between a person's emotional state and a person's physiological measurements. Selected works from Ekman and others on measuring facial behaviors describe Ekman's Facial Action Coding System (Ekman and Rosenberg, 1997). One of his experiments involved participants attached to devices to record certain measurements including pulse, galvanic skin response (GSR), temperature, somatic movement and blood pressure. He then recorded the measurements as the participants were instructed to mimic facial expressions which corresponded to the six basic emotions. He defined the six basic emotions as anger, fear, sadness, disgust, joy and surprise. From this work, Dryer (1993) determined how physiological measures could be used to distinguish various emotional states. The measures taken were GSR, heart rate, skin temperature and general somatic activity (GSA). These data were then subject to two analyses. For the first analysis, a multidimensional scaling (MDS) procedure was used to determine the dimensionality of the data.

3.2 RESULT

The data for each subject consisted of scores for four physiological assessments [GSA, GSR, pulse, and skin temperature, for each of the six emotions (anger, disgust, fear, happiness, sadness, and surprise)] across the five minute baseline and test sessions. GSA data was sampled 80 times per second, GSR and temperature were reported approximately 3-4 times per second and pulse was recorded as a beat was detected, approximately 1 time per second. To account for individual variance in physiology, we calculated the difference between the baseline and test scores. Scores that differed by more than one and a half standard deviations from the mean were treated as missing. By this criterion, twelve score were removed from the analysis. The results show the theory behind the Emotion mouse work is fundamentally sound. The physiological measurements were correlated to emotions using a correlation model. The correlation model is derived from a calibration process in which a baseline attribute-to emotion correlation is rendered based on statistical analysis of calibration signals generated by users having emotions that are measured or otherwise known at calibration time.

4. TYPES OF EMOTION SENSORS

For Hand:

- Emotion Mouse
- Sentic Mouse

For Eyes:

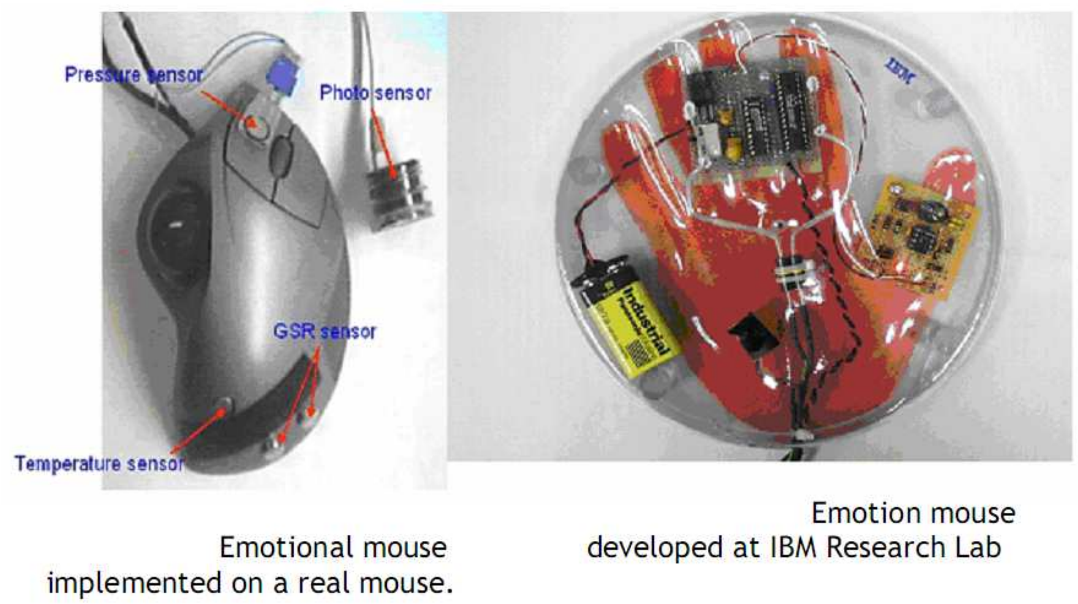
- Expression Glasses
- Magic Pointing
- Eye Tracking

For Voice:

- Artificial Intelligence Speech Recognition

4.1 HAND

4.1.1 Emotion Mouse



(Fig.6 Emotional Mouse)

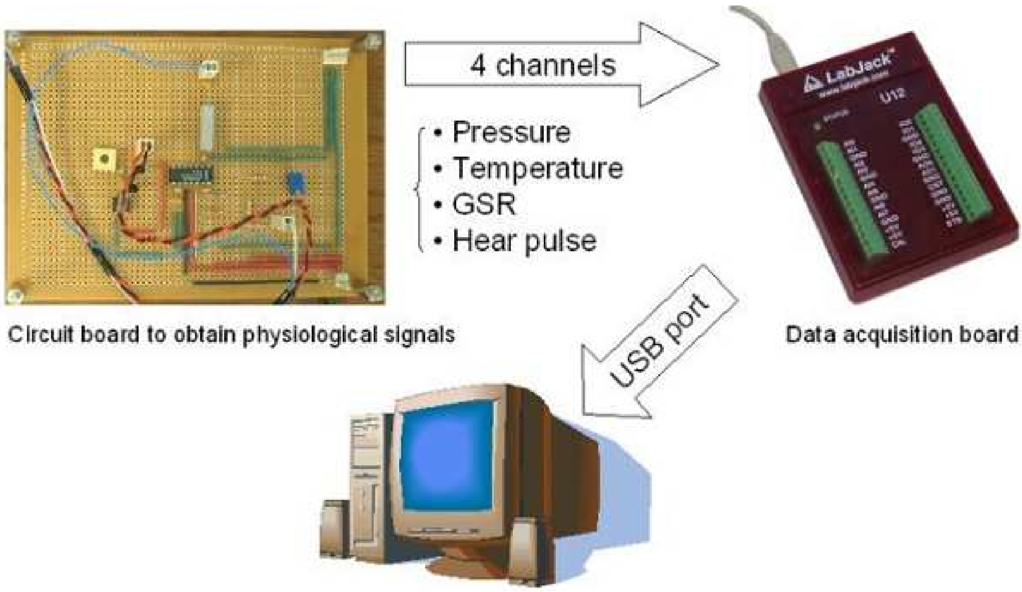
One proposed, non—invasive method for gaining user information through touch is via a computer input device, the mouse. This then allows the user to relate the cardiac rhythm, the body temperature, electrical conductivity of the skin and other physiological attributes with the mood. This has led to the creation of the “Emotion Mouse”. The device can measure heart rate, temperature, galvanic skin response and minute bodily movements and matches them with six emotional states: happiness, surprise, anger, fear, sadness and disgust. The mouse includes a set of sensors, including infrared detectors and temperature-sensitive chips. These components, User researchers’ stress, will also be crafted into other commonly used items such as the office chair, the steering wheel, the keyboard and the phone handle. Integrating the system into the steering wheel, for instance, could allow an alert to be sounded when a driver becomes drowsy.

❖ Information Obtained From Emotion Mouse

1) Behavior
    a. Mouse movements
    b. Button click frequency
    c. Finger pressure when a user presses his/her button

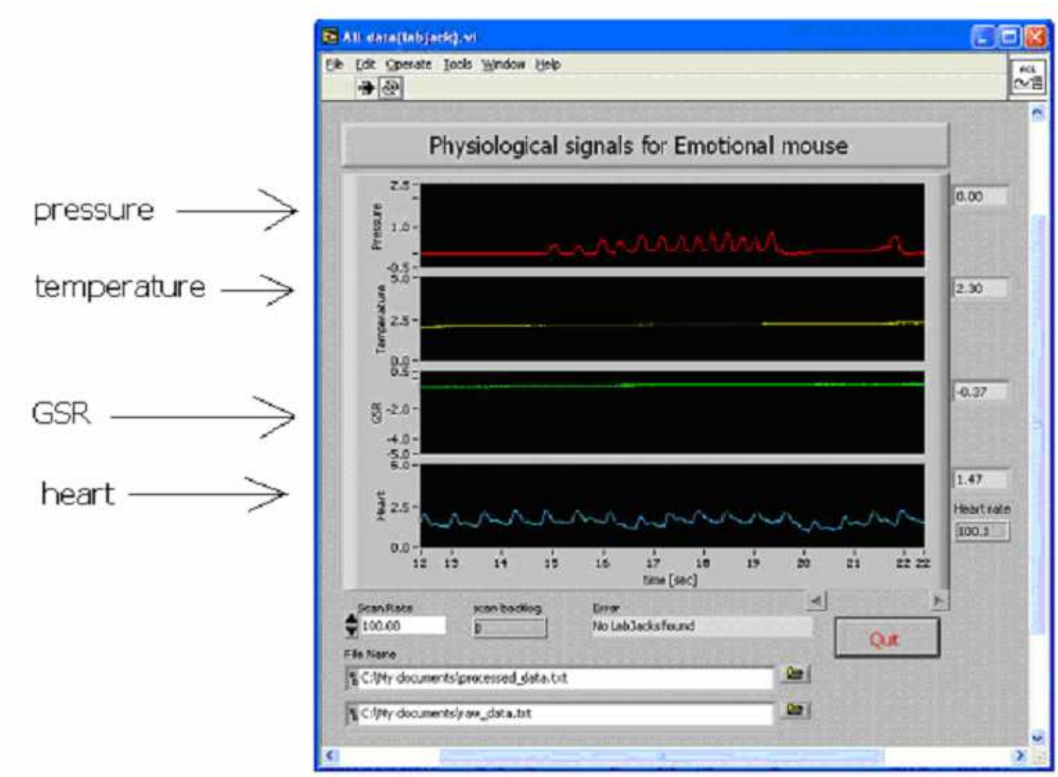
2) Physiological information
    a. Heart rate (Electrocardiogram (ECG/EKG), Photoplethysmogram (PPG))
    b. Skin temperature (Thermester)
    c. Skin electricity (Galvanic skin response, GSR)
    d. Electromyographic activity (Electromyogram, MG)

❖ Prototype



(Fig.7 System Configuration for Emotional Mouse)

❖ Samples Obtained From Emotional Mouse



(Fig.8 Different Signals)

4.1.2 Sentic Mouse

It is a modified computer mouse that includes a directional pressure sensor for aiding in recognition of emotional valence (liking/attraction vs. disliking/avoidance).

(Fig.9 sentic Mouse)

4.2 EYE

4.2.1 Expression Glasses

A wearable device which allows any viewer to visualize the confusion and interest levels of the wearer. Other recent developments in related technology are the attempt to learn the needs of the user just by following the interaction between the user and the computer in order to know what he/she is interested in at any given moment. For example, by remembering the type of websites that the user links to according to the mood and time of the day, the computer could search on related sites and suggest the results the user.

(Fig.10 Expression Glass)

6. ARTIFICIAL INTELLIGENT SPEECH RECOGNITION

It is important to consider the environment in which the speech recognition system has to work. The grammar used by the speaker and accepted by the system, noise level, noise type, position of the microphone, and speed and manner of the user's speech are some factors that may affect the quality of speech recognition .When you dial the telephone number of a big company, you are likely to hear the sonorous voice of a cultured lady who responds to your call with great courtesy saying "Welcome to company X. Please give me the extension number you want". You pronounce the extension number, your name, and the name of person you want to contact. If the called person accepts the call, the connection is given quickly. This is artificial intelligence where an automatic call-handling system is used without employing any telephone operator.

6.1 THE TECHNOLOGY

Artificial intelligence (AI) involves two basic ideas. First, it involves studying the thought processes of human beings. Second, it deals with representing those processes via machines (like computers, robots, etc). AI is behavior of a machine, which, if performed by a human being, would be called intelligent. It makes machines smarter and more useful, and is less expensive than natural intelligence. Natural language processing (NLP) refers to artificial intelligence methods of communicating with a computer in a natural language like English. The main objective of a NLP program is to understand input and initiate action. The input words are scanned and matched against internally stored known words. Identification of a key word causes some action to be taken. In this way, one can communicate with the computer in one's language. No special commands or computer language are required. There is no need to enter programs in a special language for creating software.

6.2 SPEECH RECOGNITION

The user speaks to the computer through a microphone, which, in used; a simple system may contain a minimum of three filters. The more the number of filters used, the higher the probability of accurate recognition. Presently, switched capacitor digital filters are used because these can be custom-built in integrated circuit form. These are smaller and cheaper than active filters using operational amplifiers. The filter output is then fed to the ADC to translate the analogue signal into digital word. The ADC samples the filter outputs many times a second. Each sample represents different amplitude of the signal .Evenly spaced vertical lines represent the amplitude of the audio filter output at the instant of sampling. Each value is then converted to a binary number proportional to the amplitude of the sample. A central processor unit (CPU) controls the input circuits that are fed by the ADCS. A large RAM (random access memory) stores all the digital values in a buffer area. This digital information, representing the spoken word, is now accessed by the CPU to process it further. The normal speech has a frequency range of 200 Hz to 7 kHz. Recognizing a telephone call is more difficult as it has bandwidth limitation of 300 Hz to3.3 kHz.

As explained earlier, the spoken words are processed by the filters and ADCs. The binary representation of each of these words becomes a template or standard, against which the future words are compared. These templates are stored in the memory. Once the storing process is completed, the system can go into its active mode and is capable of identifying spoken words. As each word is spoken, it is converted into binary equivalent and stored in RAM. The computer then starts searching and compares the binary input pattern with the templates. t is to be noted that even if the same speaker talks the same text, there are always slight variations in amplitude or loudness of the signal, pitch, frequency difference, time gap, etc. Due to this reason, there is never a perfect match between the template and binary input word. The pattern matching process therefore uses statistical techniques and is designed to look for the best fit.

The values of binary input words are subtracted from the corresponding values in the templates. If both the values are same, the difference is zero and there is perfect match. If not, the subtraction produces some difference or error. The smaller the error, the better the match. When the best match occurs, the word is identified and displayed on the screen or used in some other manner. The search process takes a considerable amount of time, as the CPU has to make many comparisons before recognition occurs. This necessitates use of very high-speed processors. A large RAM is also required as even though a spoken word may last only a few hundred milliseconds, but the same is translated into many thousands of digital words. It is important to note that alignment of words and templates are to be matched correctly in time, before computing the similarity score. This process, termed as dynamic time warping, recognizes that different speakers pronounce the same words at different speeds as well as elongate different parts of the same word. This is important for the speaker-independent recognizers.

6.3 APPLICATIONS

One of the main benefits of speech recognition system is that it lets user do other works simultaneously. The user can concentrate on observation and manual operations, and still control the machinery by voice input commands. Another major application of speech processing is in military operations. Voice control of weapons is an example. With reliable speech recognition equipment, pilots can give commands and information to the computers by simply speaking into their microphones—they don’t have to use their hands for this purpose. Another good example is a radiologist scanning hundreds of X-rays, ultrasonograms, CT scans and simultaneously dictating conclusions to a speech recognition system connected to word processors. The radiologist can focus his attention on the images rather than writing the text. Voice recognition could also be used on computers for making airline and hotel reservations. A user requires simply to state his needs, to make reservation, cancel a reservation, or make enquiries about schedule.

7. THE SIMPLE USER INTEREST TRACKER (SUITOR)

Computers would have been much more powerful, had they gained perceptual and sensory abilities of the living beings on the earth. What needs to be developed is an intimate relationship between the computer and the humans. And the Simple User Interest Tracker (SUITOR) is a revolutionary approach in this direction.

By observing the Webpage a netizen is browsing, the SUITOR can help by fetching more information at his desktop. By simply noticing where the user's eyes focus on the computer screen, the SUITOR can be more precise in determining his topic of interest. It can even deliver relevant information to a handheld device. The success lies in how much the suitor can be intimate to the user. IBM's BlueEyes research project began with a simple question, according to Myron Flickner, a manager in Almaden's USER group: Can we exploit nonverbal cues to create more effective user interfaces?
One such cue is gaze—the direction in which a person is looking. Flickner and his colleagues have created some new techniques for tracking a person's eyes and have incorporated this gaze-tracking technology into two prototypes. One, called SUITOR (Simple User Interest Tracker), fills a scrolling ticker on a computer screen with information related to the user's current task. SUITOR knows where you are looking, what applications you are running, and what Web pages you may be browsing. "If I'm reading a Web page about IBM, for instance," says Paul Maglio, the Almaden cognitive scientist who invented SUITOR, "the system presents the latest stock price or business news stories that could affect IBM. If I read the headline off the ticker, it pops up the story in a browser window. If I start to read the story, it adds related stories to the ticker. That's the whole idea of an attentive system—one that attends to what you are doing, typing, reading, so that it can attend to your information needs."

8. CONCLUSION

The nineties witnessed quantum leaps interface designing for improved man machine interactions. The BLUE EYES technology ensures a convenient way of simplifying the life by providing more delicate and user friendly facilities in computing devices. Now that we have proven the method, the next step is to improve the hardware. Instead of using cumbersome modules to gather information about the user, it will be better to use smaller and less intrusive units. The day is not far when this technology will push its way into your house hold, making you more lazy. It may even reach your hand held mobile device. Any way this is only a technological forecast.

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