A

Seminar report

on

Blue Eyes

Submitted in partial fulfillment of the requirement for the award of degree of Computer Science

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SUBMITTED TO:

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Preface

I have made this report file on the topic **Blue Eyes** ,I have tried my best to elucidate all the relevant detail to the topic to be included in the report. While in the beginning I have tried to give a general view about this topic.

My efforts and wholehearted co-corporation of each and everyone has ended on a successful note. I express my sincere gratitude to …………..who assisting me throughout the prepration of this topic. I thank him for providing me the reinforcement, confidence and most importantly the track for the topic whenever I needed it.

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INTRODUCTION

Ever think your computer might one day pester you with messages of love or take up arms in a fit of rage over your insensitivity?

If researchers at IBM's Almaden Research Center here are to be believed, we could then soon see computers that actually know you hate them, or in turn appreciate them for a job well done.

Their initiative to make this happen: the *Blue Eyes* research project currently being implemented by the center's user systems ergonomic research group (User). *Blue Eyes* seeks attentive computation by integrating perceptual abilities to computers wherein non-obtrusive sensing technology, such as video cameras and microphones, are used to identify and observe your actions.

As you walk by the computer screen, for example, the camera would immediately "sense" your presence and automatically turn on room lights, the television, or radio while popping up your favorite Internet website on the display.

Part of this project is not only teaching computers how to sense or perceive user action. They are also being programmed to know how users feel--depressed, ecstatic, bored, amused, or anxious--and make a corresponding response. Computers can, on their own, play a funny Flash animation feature to entertain its "master" if it notices a sad look on his or her face.

Voice or sound capabilities can also be integrated, with the computer "talking" to his user about the task at hand or simply acknowledging a command with a respectful, "yes, sir."

In these cases, the computer extracts key information, such as where the user is looking, what he or she is saying or gesturing or how the subject's emotions are evident with a grip on the pointing device.

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These cues are analyzed to determine the user's physical, emotional, or informational state, which can be used to increase productivity. This is done by performing expected actions or by providing expected information.

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 users' 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.

For a long time emotions have been kept out of the deliberate tools of science; scientists have expressed emotion, but no tools could sense and respond to their affective information. This paper highlights research aimed at giving computers the ability to comfortably sense, recognize and respond to the human communication of emotion, especially affective states such as frustration, confusion, interest, distress, anger and joy. Two main themes of sensing—self–report and concurrent expression—are described, together with examples of systems that give users new ways to communicate emotions to computers and, through computers, to other people. In addition to building systems that try to elicit and detect frustration, system has been developed that responds to user frustration in a way that appears to help alleviate it. This paper highlights applications of this research to interface design, wearable computing, entertainment and education and briefly presents some potential ethical concerns and how they might be addressed.

Not all computers need to "pay attention" to emotions or to have the capability to emulate emotion. Some machines are useful as rigid tools, and it is fine to keep them that way. However, there are situations in which human—computer interaction could be improved by having he

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computer adapt to the user, and in which communication about when, where, how and how important it is to adapt involves the use of emotional information.

N Findings of Reeves and Nass at Stanford University suggest that the interaction between human and machine is largely natural and social, indicating that factors important in *human*— *human* interaction are also important in *human*—*computer* interaction. In *human*—*human* interaction, it has been argued that skills of so—called "emotional intelligence" are more important than are traditional mathematical and verbal skills of intelligence. These skills include the ability to recognize the emotions of another and to respond appropriately to these emotions. Whether or not these particular skills are more important than certain other skills will depend on the situation and goals of the used, but what is clear is that these skills are important in *human*—*human* interaction, and when they are missing, interaction is more likely to be perceived as frustrating and not very intelligent.

Current computer input devices, particularly the common ones such as keyboards and mice, are limiting in capabilities. Interfaces should not be limited merely to the screen, which forms the intermediary between the user and the results of the computer processes. Rather, the subsidiary devices should also be brought into the equation. In a sense, computer interfaces could be seen as a 'peer', or as one who responds activity to user input, as a reflection and a response lf the user's feeling and emotions, to better understand the true intensions of the user.

There are three key aspects that is important in representing the 'emotions' that a computer is believed to posses: automatic signals, facial expressions and behavioral manifestations. When observing human communication, studies have shown that apart from facial expressions, gestures, touch and other signs of the body language play a vita role in the communication of feelings and emotion. However one failing of the desktop PC is its inability to simulate the effect of touch. Humans are experts at interpreting facial expressions and tones of voice and making accurate interferences about others' internal states from these clues. Controversy rages over anthromorphism: should we leverage this expertise in the service of computer interface design, since attributing human characteristic to machines often means setting unrealistic and unfulfillable expectations about the machine's capabilities? Show a human face;

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expect human capabilities that far outstrip the machines? Yet the fact remains that faces have been used effectively in media to represent a wide variety of internal states. And with careful design, we regard emotional expression via face and sound as a potentially effective means of communicating a wide array of information to computer users. As system become more capable of emotional communication with users, we see systems needing more and more sophisticated emotionally— expressive capability.

Sensors, tactile or otherwise, are an integral part of an effective computing system because they provide information about the wearer's physical state or behavior. They can gather data in a continuous way without having to interrupt the user. The emphasis here is on describing physiological sensors; however, there are many kinds of new sensors currently under development that might be useful in recognizing affective cues. (Tactile) Sensors to receive human felling as input have been progressively developing over the last few decades. Since the human brain functions communicates its emotions as electrical signals, sensitive equipment and apparatus are able to pick up these weak signals. Here, we provide a concise list of the current technology available that could be further developed as input devices for obtaining user emotional information.

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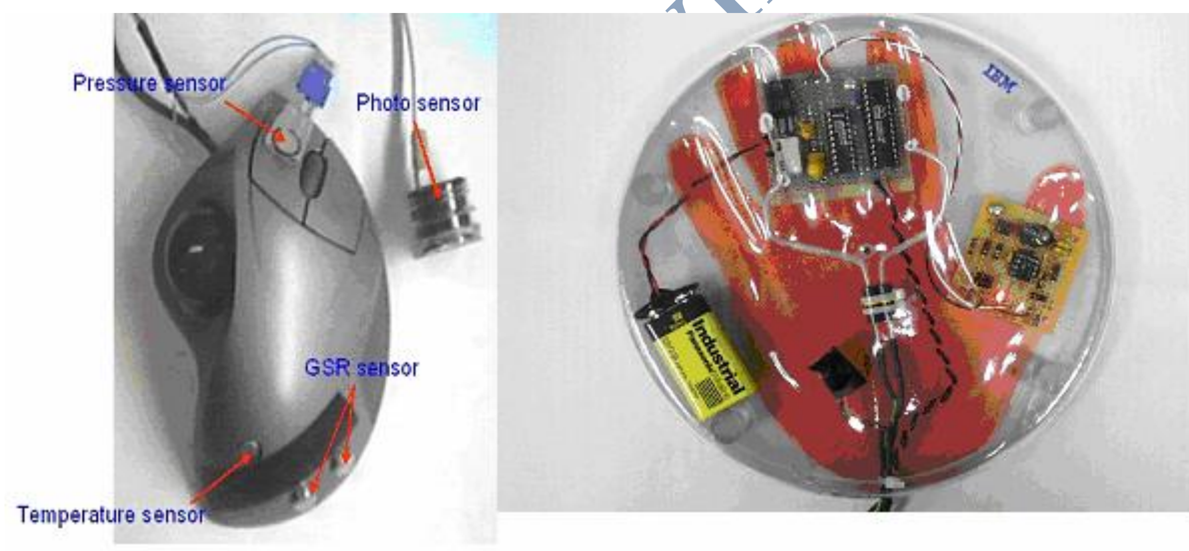
TYPES OF EMOTIONAL SENSORS

FOR HAND

EMOTION MOUSE



Emotional mouse implemented on a real mouse. Emotion mouse developed at IBM Research Lab 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

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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

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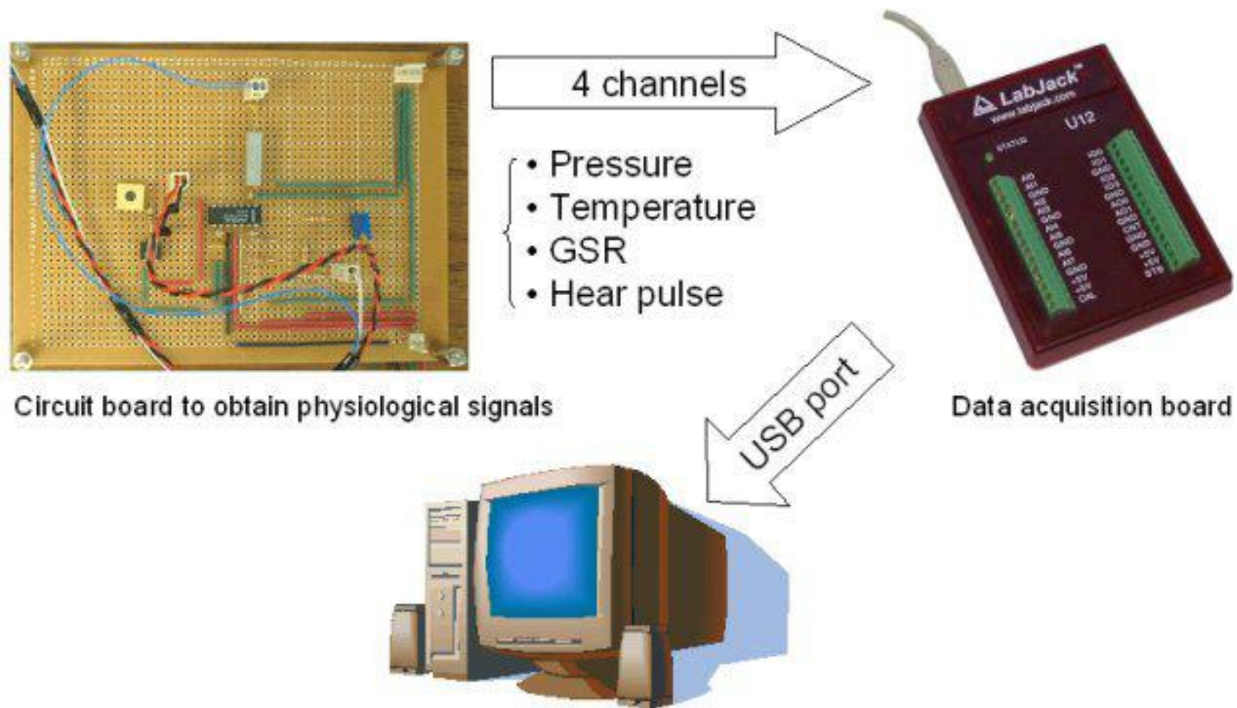
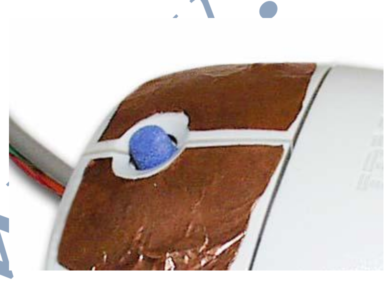


System configuration for emotional mouse

SENTIC MOUSE



The Sentic Mouse is an experiment inspired by the work of Peter J. Lang, Ward Winton, Lois Putnam, Robert Kraus and Dr. Manfred Clynes, that provides a first step toward designing a tool to measure a subject's *emotional valence* response. Emotional valence may be described as a person's emotional assessment of stimuli, from positive (associated with pleasure, liking and

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attraction) to negative (associated with displeasure, dislike and avoidance or revulsions). The goal of the experiment is to begin to apply quantifying values to emotions and ultimately to build a predictive model for emotion theory.

Peter J. Lang and others showed subjects a series of pictures and asked them to self-rate their emotional response. Ward Winton, Lois Putnam, and Robert Krauss measured heart rate and skin conductance while subjects viewed emotionally evocative stimuli. Dr. Manfred Clynes conducted a series of sentic experiments, gathering data from the vertical and horizontal components of finger pressure. Each of these experiments attempted to quantify emotions and map them into a predictive model of emotion theory. Under the auspices of the Affective Computing research group, these three models were applied to the interaction between humans and computers. Using a computer to provide the affective stimulus to the human subject, an experiment was conducted which combined all three emotion studies.

An ordinary computer mouse was augmented with a pressure sensor to collect sentic data as in Dr. Clynes experiments. Simultaneously as the subjects viewed Lang's affective picture database, IAPS, we monitored the various other bio sensors they were connected to, including GSR and EKG, as precidented by the research of Winton, Putnam, and Krauss.

The three measured results: sentic data, heart rate, and self-assessment, were then readily compared against each other as well as against the theoretically predicted results to assess the subject's emotional valence for each slide. The results, which are in the preliminary stages of analysis, suggest that valence information can be captured by the sentic mouse.

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WORKING OF EMOTIONAL MOUSE

Sensors in the mouse sense the physiological attributes, which are 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. A vector in N dimensions, representative of subject user's emotions, is output or subsequent subject users whose emotions are sought to be known, with the baseline being the reference in the N—dimensional space of the vector.

One goal of human computer interaction (HCI) is to make an adaptive, smart computer system. This type of project could possibly include gesture reorganization, etc. another non—invasive way to obtain information about a person is through touch. People use their computers to obtain, store and manipulate data. In order to start creating smart computers, the computer must start gaining information about the user.

Our proposed method for gaining user information through touch is via a computer input device, the mouse. From the physiological data obtained from the user, an emotional state may be determined which would then be related to the task the user is currently doing on computer. Over a period of time, a user model will be built in order to gain a sense of the user's personality. The scope of the project is to have the computer adapt to the user in order to create a better working environment where the user is more productive. The first step towards realizing this goal is described here:-

FOR EYES

EXPRESSION GLASSES

The Expression Glasses are a wearable device that allows any viewer to see a graphical display of a subset of the wearer's facial expressions. Currently, the glasses are capable of learning an individual's patterns and discriminating between confusion and interest expressions.

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Through two small pieces of piezoelectric film imbedded in the frames, the muscle movement in the corrugators and frontalis (eyebrow) muscles is measured and translated to a full-color visual display. The display allows a viewer to visualize confusion expressions of the wearer of the glasses by watching changes in a moving bargraph (red for confusion, green for interest).

There are many reasons why the wearer or his audience may want to have access to expressed emotions. For Human-to-Self purposes, this might include practice session feedback for certain professions (such as counseling), where individuals are trained specifically to refrain from expressing negativity. For Human-to-Human communication, a device like this would be helpful in allowing a video lecturer access to the confusion or interest level of her students in a remote location, providing a "barometer" of collective emotional expression. Since current technology tends to inhibit access to individual facial expressions when lecturing via videoconferencing, use of a device like the glasses gives students an opportunity to communicate information about their experience to the instructor. Additionally, the anonymous nature of the glasses allows individual students to express their emotions without necessarily being forced to identify themselves.

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EMOTIONS & 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 y Dryer & Horoqitz, 1997 has shown that people with personalities that are similar or complement each other collaborate well. Dryer (1999) has 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. By matching a person's emotional state and the context of the expressed emotion, over a period of time the person's personality is being exhibited. Therefore, by giving the computer a longitudinal understanding of the emotional state of its user, the computer could adapt a working style which fits with its user's personality. The result of this collaboration could increase productivity for the user.

One way of gaining information from a user non— intrusively, is by video. Cameras have been used to detect a person's emotional state (Johnson, 1999). We have explored gaining information through touch. One obvious place to put sensors is on the mouse. Through observing normal computer usage (creating and editing documents and surfing the web), people spend approximately 1/3 of their total computer time touching their input device, we will explore the possibility of detecting emotion through touch.

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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. Six participants were trained to exhibit the facial expression of the six basic emotions. While each participant exhibited these expressions, the physiological changes associated with affect were assessed. 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. This analysis suggested that the physiological similarities and dissimilarities of the six emotional states fit within a four dimensional model. For the ***second*** analysis, a discriminated function analysis was used to determine the mathematic functions that would distinguish the six emotional states. This analysis suggested that all four physiological variables made significant, non—redundant contributions to the functions that distinguish the six states. Moreover, these analyses indicate that these four physiological measures are sufficient to determine reliably a person's specific emotional state.

Because of our need to incorporate these measurements into a small, non—intrusive form, we will explore taking these measurements from the hand. The amount of conductivity of the skin is best taken from fingers. However, the other measures may not be as obvious or robust. We hypothesize that changes in the temperature of the finger are reliable for the production of emotion. We also hypothesize the GSA can be measured by change in movement in the computer mouse.

EXPERIMENTAL DESIGN

An experiment was designed to test the above hypotheses. The four physiological readings measured were heart rate, temperature, GSR and somatic movement. The heart rate was measured through a commercially available chest strap sensor. The temperature was measured with a thermocouple attached to a digital multimeter (DMM). The GSR was also measured with a DMM. The somatic movement was measured by recording the computer mouse movements.

METHOD

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Six people participated in this study (3 male, 3 female). The experiment was within subject design and order of presentation was counter-balanced across participants.

PROCEDURE

Participants were asked to sit in front of the computer and hold the temperature and GSR sensors in their left hand hold the mouse with their right hand and wore the chest sensor. The resting (baseline) measurements were recorded for five minutes and then the participant was instructed to act out one emotion for five minutes. The emotions consisted of: anger, fear, sadness, disgust, happiness and surprise. The only instruction for acting out the emotion was to show the emotion in their facial expressions.

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. We first calculated the mean score for each of the baseline and test sessions. 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 remaining data are described in Table 1.

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Table 1: Difference Scores.

		Anger	Disgust	Fear	Happiness	Sadness	Surprise
GSA	Mean	-0.66	-1.15	-2.02	.22	0.14	-.1.28
	Std. Dev.	1.87	1.02	0.23	1.60	2.44	1.16
GSR	Mean	-41209	-53206	-61160	-38999	-417990	-41242
	Std. Dev.	63934	8949	47297	46650	586309	24824
Pulse	Mean	2.56	2.07	3.28	2.40	4.83	2.84
	Std. Dev.	1.41	2.73	2.10	2.33	2.91	3.18
Temp	Mean	1.36	1.79	3.76	1.79	2.89	3.26
	Std. Dev.	3.75	2.66	3.81	3.72	4.99	0.90

In order to determine whether our measures of physiology could discriminate among the six different emotions, the data were analyzed with a discriminant function analysis. The four physiological difference scores were the discriminating variables and the six emotions were the discriminated groups. The variables were entered into the equation simultaneously, and four canonical discriminant functions were calculated. A Wilks' Lambda test of these four functions was marginally statistically significant; for lambda = .192, chi-square (20) = 29.748, p < .075. The functions are shown in Table 2

Table 2: Standardized Discriminant Function Coefficients.

	Function			
	1	2	3	4
GSA	0.593	-0.926	0.674	0.033
GSR	-0.664	0.957	0.350	0.583
Pulse	1.006	0.484	0.026	0.846
Temp.	1.277	0.405	0.423	-0.293

The unstandardized canonical discriminant functions evaluated at group means are shown in Table 3. Function 1 is defined by sadness and fear at one end and anger and surprise at the other. Function 2 has fear and disgust at one end and sadness at the other. Function 3 has happiness at one end and surprise at the other. Function 4 has disgust and anger at one end and surprise at the other. Table 3:

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Table 3: Functions at Group Centroids.

EMOTION	Function			
	1	2	3	4
anger	-1.166	-0.052	-0.108	0.137
fear	1.360	1.704	-0.046	-0.093
sadness	2.168	-0.546	-0.096	-0.006
disgust	-0.048	0.340	0.079	0.184
happiness	-0.428	-0.184	0.269	-0.075
surprise	-1.674	-0.111	-0.247	-0.189

To determine the effectiveness of these functions, we used them to predict the group membership for each set of physiological data. As shown in Table 4, two-thirds of the cases were successfully classified

Table 4: Classification Results.

		Predicted Group Membership						Total
	EMOTION	Anger	Fear	sadness	disgust	happine	surprise	
Original	anger	2	0	0	0	2	1	5
	fear	0	2	0	0	0	0	2
	sadness	0	0	4	0	1	0	5
	disgust	0	1	0	1	1	0	3
	happiness	1	0	0	0	5	0	6
	surprise	0	0	0	0	1	2	3

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. Now that we have proven the method, the next step is to improve the hardware. Instead of using cumbersome multimeters to gather information about the user, it will be better to use smaller and less intrusive units. We plan to improve our infrared pulse detector which can be placed inside the body of the mouse. Also, a framework for the user modeling needs to be developed in order to correctly handle all of the information after it has been gathered. There are other possible applications for

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the Emotion technology other than just increased productivity for a desktop computer user. Other domains such as entertainment, health and the communications and the automobile industry could find this technology useful for other purposes.

CONCLUSION OF EXPERIMENT

The results show the theory behind the Emotion mouse's 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 the statistical analysis of calibration signals generated by users having emotion that are measured or otherwise known at calibration time.

Next step is to improve the hardware. Instead of using cumbersome multimeters, it will be better to use smaller and less intrusive units. The infrared pulse detector can be improved to place it inside the mouse. Also, a framework for the user modeling needs to be developed in order to correctly handle all of the information after it has been gathered.

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BLUE EYES–HUMAN OPERATOR MONITORING SYSTEM

This is a project, developed by Poznan University, which is based on Blue Eyes *technology*. Blue Eyes system provides technical means for monitoring and recording human-operator's physiological condition.

The key features of the system are:

- Visual attention monitoring (eye motility analysis)
- Physiological condition monitoring (pulse rate, blood oxygenation)
- Operator's position detection (standing, lying)
- Wireless data acquisition using Bluetooth technology
- real-time user-defined alarm triggering
- Physiological data, operator's voice and overall view of the control room recording
- recorded data playback

The system consists of a *portable measuring unit* and a *central analytical system.* The mobile device is integrated with Bluetooth module providing wireless interface between the operator-worn sensors 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 that different people can use a single sensor device.

Blue Eyes system can be applied in every working environment requiring permanent operator's attention:

- At power plant control rooms
- At captain bridges
- At flight control centers
- Professional drivers

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INTRODUCTION OF THE SYSTEM

Human error is still one of the most frequent causes of catastrophes and ecological disasters. The main reason is that the monitoring systems concern only the state of the processes whereas human contribution to the overall performance of the system is left unsupervised. Since the control instruments are automated to a large extent, a human – operator becomes a passive observer of the supervised system, which results in weariness and vigilance drop. Thus, he may not notice important changes of indications causing financial or ecological consequences and a threat to human life. It therefore is crucial to assure that the operator's conscious brain is involved in an active system supervising over the whole work time period.

It is possible to measure indirectly the level of the operator's conscious brain involvement using eye motility analysis. Although there are capable sensors available on the market, a complex solution enabling transformation, analysis and reasoning based on measured signals still does not exist. In large control rooms, wiring the operator to the central system is a serious limitation of his mobility and disables his operation. Utilization of wireless technology becomes essential.

Blue Eyes - the system is intended to be the complex solution for monitoring and recording the operator's conscious brain involvement as well as his physiological condition. This required designing a Personal Area Network linking all the operators and the supervising system. As the operator using his sight and hearing senses the state of the controlled system, the supervising system will look after his physiological condition.

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SYSTEM OVERVIEW

Blue Eyes system provides technical means for monitoring and recording the operator's basic physiological parameters. The most important parameter is saccadic activity[1], which enables the system to monitor the status of the operator's visual attention along with head acceleration, which accompanies large displacement of visual axis (saccades larger than 15 degrees). Complex industrial environment can create a danger of exposing the operator to toxic substances, which can affect his cardiac, circulatory and pulmonary systems. Thus, on the grounds of plethysmographic signal taken from the forehead skin surface, the system computes heart beat rate and blood oxygenation.

The Blue Eyes system checks above parameters against abnormal (e.g. a low level of blood oxygenation or a high pulse rate) or undesirable (e.g. a longer period of lowered visual attention) values and triggers user-defined alarms when necessary. Quite often in an emergency situation operator speak to themselves expressing their surprise or stating verbally the problem. Therefore, the operator's voice, physiological parameters and an overall view of the operating room are recorded. This helps to reconstruct the course of operators' work and provides data for long-term analysis.

Blue Eyes 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 different people can use a single mobile device (called hereafter DAU – Data Acquisition Unit). The overall system diagram is shown in Figure 1. The tasks of the mobile Data Acquisition Unit are to maintain Bluetooth connections, to get information from the sensor and sending it over the wireless connection, to deliver the alarm messages sent from the Central System Unit to the operator and handle personalized ID cards. Central System Unit maintains the other side of the Bluetooth connection, buffers incoming sensor data, performs on-line data analysis, records the conclusions for further exploration and provides visualization interface.

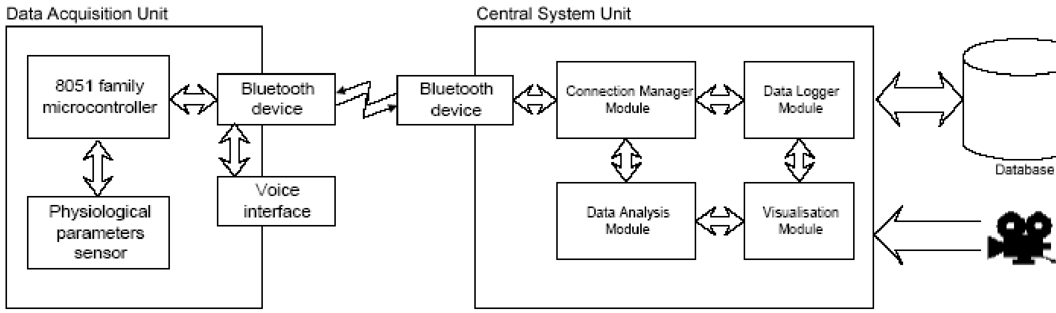

Figure 1. Overall system diagram

The task of the mobile Data Acquisition Unit are to maintain Bluetooth connection, to get information from the sensor and sending it over the wireless connection ,to deliver the alarm messages sent from the Central System Unit to the operator and handle personalized ID cards. Central System Unit maintains the other side of the Bluetooth connection, buffers incoming sensor data, performs on-line data analysis, records the conclusion for further exploration and provides visualization interface.

DATA ACQUISITION UNIT (DAU)

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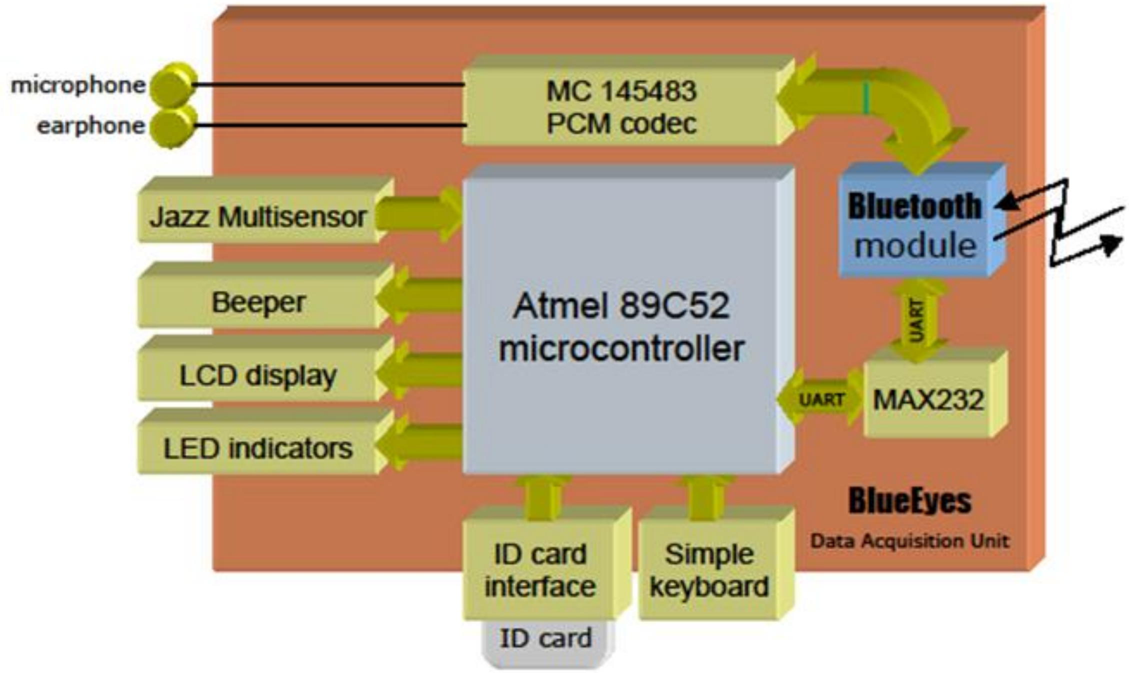

Data Acquisition Unit is a mobile part of the Blue Eyes system. Its main task is to fetch the physiological data from the sensor and to send it to the central system to be processed. To accomplish the task the device must manage wireless Bluetooth connections (connection establishment, authentication 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

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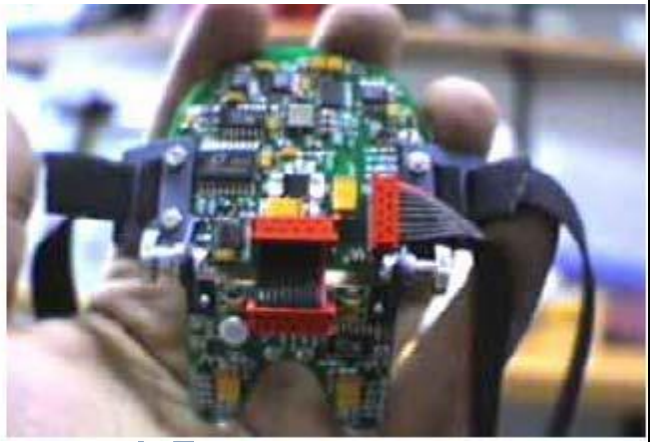
- Jazz Multisensor interface
- beeper and LED indicators
- 6 AA batteries and voltage level monitor

JAZZ MULTISENSOR



To provide the Data Acquisition Unit with necessary physiological data *JAZZ Multisensor* is used. It supplies Raw digital data regarding eye position, the level of blood oxygenation, acceleration along horizontal and vertical axes and ambient light intensity.

Eye movement is measured using direct infrared oculographic transducers. The eye movement is sampled at 1 kHz, the other parameters at 250 Hz. The sensor sends approximately 5,2kB of data per second.

OTHER COMPONENTS

We have chosen Atmel 8952 microcontroller to be the core of the Data Acquisition Unit since it is a well-established industrial standard and provides necessary functionality (i.e. High speed serial port) at a low price.

Since the Bluetooth module we received supports synchronous voice data transmission we decided to use hardware *PCM codec* to transmit operator's voice and central system sound feedback. The codec that we have employed reduces the microcontroller's tasks and lessens the amount of data being sent over the UART. Additionally, the Bluetooth module performs voice data compression, which results in smaller bandwidth utilization and better sound quality.

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Communication between the Bluetooth module and the microcontroller is carried on using standard UART interface. *MAX232 Level Shifter* does the RS232↔ TTL voltage level conversion. The speed of UART is set to 115200 bps in order to assure that the entire sensor data is delivered in time to the central system (sensor data along with Bluetooth related control data take up approx.70% of bandwidth).

The *LCD Display* gives more information of incoming events and helps the operator to enter PIN code. The *LED indicators* show the results in built-in self-test, power level and the state of wireless connection.

The *simple keyboard* is used to react to incoming events (e.g. to silence the alarm sound) and to enter PIN code while performing authorization procedure.

ID card interface helps connect the operator's personal identification card to the DAU. After inserting the card authorization procedure starts. Each ID card is programmed to contain: operator's unique identifier, device access PIN code the operator enters on inserting his ID card and system access PIN code that is used on connection authentication. The operator's unique identifier enables the supervising system to distinguish different operators.

CENTRAL SYSTEM UNIT (CSU)

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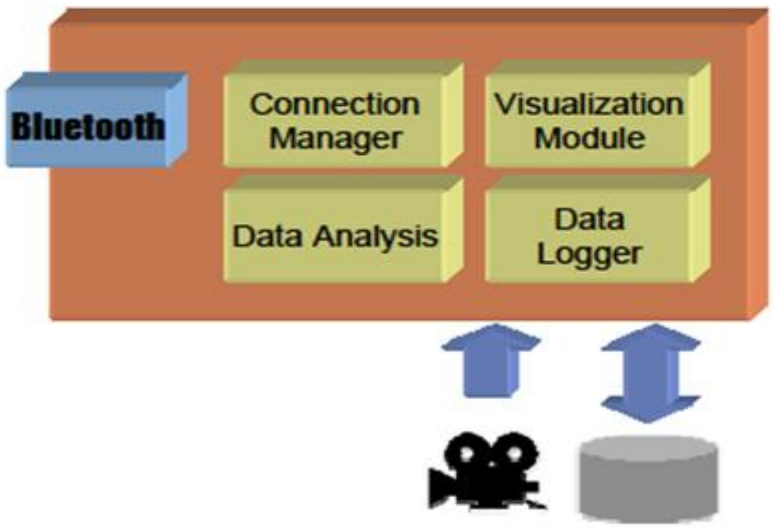

CSU software is located on the delivered Computer/System; in case of larger resource demands the processing can be distributed among a number of nodes. In this section we describe the four main CSU modules: Connection Manager, Data Analysis, Data Logger and Visualization. The modules exchange data using specially designed single-producer multi consumer buffered thread-safe queues. Any number of consumer modules 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 consumer.

CONNECTION MANAGER

Connection Manager's main task is to perform low-level Bluetooth communication using Host. Controller Interface commands. It is designed to cooperate with all available Bluetooth devices in order to support roaming. Additionally, Connection Manager authorizes operators, manages their sessions, demultiplexes and buffers raw physiological data.

The *Connection Manager* handles:

- Communication with the CSU hardware
- Searching for new devices in the covered range
- Establishing Bluetooth connections

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- Connection authentication
- Incoming data buffering
- Sending alerts

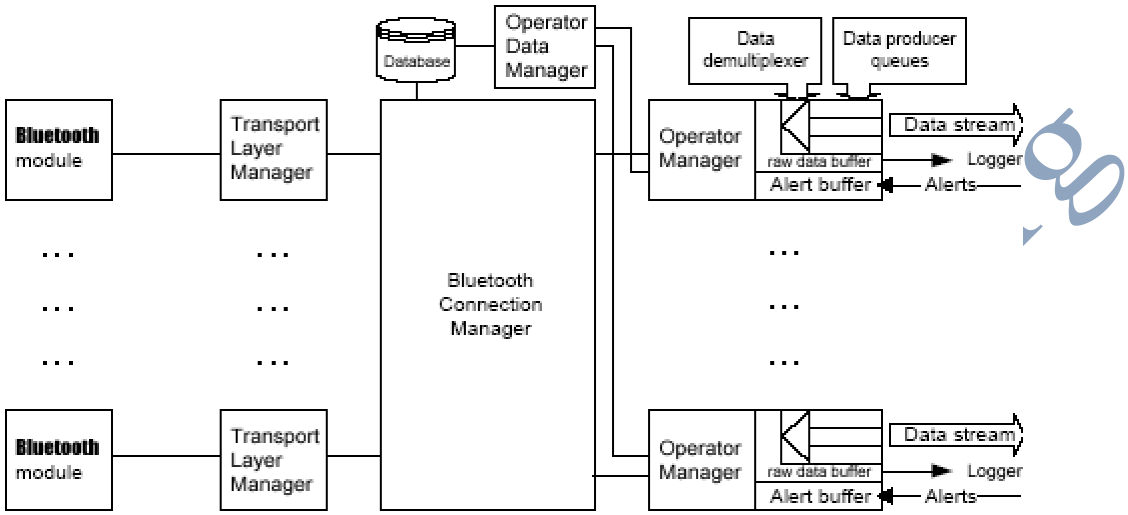

Figure shows Connection Manager Architecture

Transport Layer Manager hides the details regarding actual Bluetooth physical transport interface.

Bluetooth Connection Manager is responsible for establishing and maintaining connections using all available Bluetooth devices. It periodically inquires new devices in an operating range and checks whether they are registered in the system database. Only with those devices the Connection Manager will communicate. After establishing a connection an authentication procedure occurs. The authentication process is performed using system PIN code fetched from the database. Once the connection has been authenticated the mobile unit sends a data frame containing the operator's identifier. Finally, the Connection Manager adds a SCO link (voice connection) and runs a new dedicated Operator Manager, which will manage the new operator's session. Additionally, the Connection Manager maps the operator's identifiers into the Bluetooth connections, so that when the operators roam around the covered area a connection with an appropriate Bluetooth device is established and the data stream is redirected accordingly.

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The data of each supervised operator is buffered separately in the dedicated Operator Manager. At the startup it communicates with the Operator Data Manager in order to get more detailed personal data. The most important Operator Manager's task is to buffer the incoming raw data and to split it into separate data streams related to each of the measured parameters. The raw data is sent to a Logger Module, the split data streams are available for the other system modules through producer-consumer queues. Furthermore, the Operator Manager provides an interface for sending alert messages to the related operator.

Operator Data Manager provides an interface to the operator database enabling the other modules to read or write personal data and system access information.

DATA ANALYSIS MODULE

The 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.

DATA LOGGER MODULE

The module provides support for storing the monitored data in order to enable the supervisor to reconstruct and analyze the course of the operator's duty. The module registers as a consumer of the data to be stored in the database. Each working operator's data is recorded by a separate instance of the Data Logger. Apart from the raw or processed physiological data, alerts and operator's voice are stored. The raw data is supplied by the related Operator Manager module, whereas the Data Analysis module delivers the processed data. The voice data is delivered by a Voice Data Acquisition module. The module registers as an operator's voice data consumer and optionally processes the sound to be stored (i.e. reduces noise or removes the fragments when the operator does not speak). The Logger's task is to add appropriate time stamps to enable the system to reconstruct the voice.

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Additionally, there is a dedicated video data logger, which records the data supplied by the Video Data Acquisition module (in the prototype we use JPEG compression). The module is designed to handle one or more cameras using Video for Windows standard.

VISUALIZATION MODULE

It 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.

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SUMMARY

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.

Blue Eyes system has been developed because of the need for a real-time monitoring system for a human operator. The approach is innovative since it helps supervise the operator not the process, as it is in presently available solutions.

The system will help avoid potential threats resulting from human errors, such as weariness, oversight, tiredness or temporal indisposition. It is possible still to improve the system. The use of a miniature CMOS camera integrated into the eye movement sensor will enable the system to calculate the point of gaze and observe what the operator is actually looking at. Introducing voice recognition algorithm will facilitate the communication between the operator and the central system and simplify authorization process.

Despite considering only the operators working in control rooms, the system may well be applied to everyday life situations. Assuming the operator is a driver and the supervised process is car driving it is possible to build a simpler embedded online system, which will only monitor conscious brain involvement and warn when necessary. As in this case the logging module is redundant, and the Bluetooth technology is becoming more and more popular, the commercial implementation of such a system would be relatively inexpensive.

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FUTURE AHEAD

At IBM's lab researchers are tackling the lofty goal of designing smarter devices. Following the movement of your eyes, the "gaze—tracking" technology uses MAGIC (Manual Acquisition with Gaze-Initiated Cursor) to control your mouse. With MAGIC, the cursor follows your eyes as you look around the screen. When your eyes spot on an object, you click the mouse to select it.

Why not free up your hand and let your eyes do all the work? Researchers tried that and found that the hand is quicker than the eye, or at least more accurate, says Morris, the research center director. Also, current versions of the gaze tracking technology only come within an inch or so of its target.

One limitation of today's input devices is that we have to tell them what we want. When you lay your hand on the *Emotion Mouse***,** it will measure how you are feeling and react accordingly.

Aside from pointing devices, researchers at Almaden are studying emotion technology for use in automobiles, video games, remote controls and telephones. But it may be a decade before this type of technology is readily available.

Blue Eyes uses non—obtrusive sensing technology, such as video cameras and microphones, to identify and observe a user's actions and to extract key information, such as where the user is looking and what the user is saying verbally and gesturely.
These cues are analyzed to determine the user's physical, emotional or informational state, which in turn can be used to help make the user more productive by performing expected actions or by providing expected information. For example, a *blue eyes* enabled television would become active when the user makes eye contact, at which points the user could tell the television to "turn on CNN". The television would respond to the user's request by changing the channel to CNN. If the television then ***sees*** the user frown and complain, it would explain that it didn't understand the request and ask for clarification in which you could explain you meant CNN Headline News.

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Blue Eyes technology can be implemented in computer training or education programs, enabling computers to observe students' emotional state and just as any good instructor, adjust information delivery accordingly, in the future, ordinary household devices— will do their jobs when wee look at them and speak at them. Future applications of *Blue Eyes* technology are limitless — from designing cars and developing presentations, to interactive entertainment and advertising.

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REFERENCES

1. www.philologos.com
2. www.techreviwe.com
3. www.almaden.im.com
4. www.research.im.com
5. www.metropolismag.com
6. www.visuallee.com
7. www.howstuffworks.com
8. www.entecollege.com

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