

Vision System of Blue Eyes

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Abstract-

Human cognition and survival of animals depends on highly developed sensory abilities to perceive, integrate, and interpret visual, auditory, and touch information. Without a doubt, computers would be much more powerful if they had even a small fraction of the perceptual ability of animals or humans. Adding such perceptual abilities to computers would enable computers and humans to work together more as partners. Blue Eyes uses sensing technology to identify a user's actions and to extract key information. This information is then 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. If we add these perceptual abilities of human to computers would enable computers to work together with human beings[4]. The "BLUE EYES" technology aims at creating computational machines that have perceptual and sensory ability like those of human beings. This paper aims at specifying the viewing system of blue eyes. Also mentioned are the applications of the blue eyes technology.

Keywords- Blue-eyes, DAU, CSI, GSA, MDS, Magic-pointing

I. INTRODUCTION

Blue in this term stands for Bluetooth, which enables reliable wireless communication and the Eyes because the eye movement enables us to obtain a lot of interesting and important information. The basic idea behind this technology is to give computer human power. 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 sensing 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[4].

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.

From the physiological data , an emotional state may be determined which would then be related to the task the user is currently doing on the 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. 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.

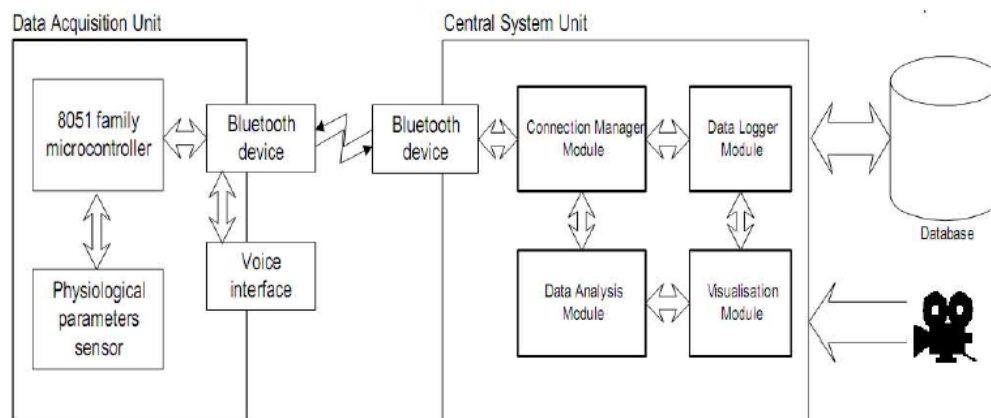
The remainder of the paper is organized as follows: Section II describes the major system overview of blue eyes system, III related research work on it Section IV focuses on vision system. Section V relates our discussion on applications of this emerging technology. Section VI Concludes the paper Section VII Future works are drawn in the final section.

II SYSTEM OVERVIEW

"BLUE EYES" system provides technical means for monitoring and recording the operator's basic physiological parameters. The most important parameter is saccadic activity¹, which enables the system to monitor the status of the operator's visual attention along with head acceleration, which accompanies large displacement of the 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 lethysmographic 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 operators 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. This 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 different people can use a single mobile device[8][9].

The overall System diagram is as follows:-



III. RELATED WORKS

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[4]. An adaptive, smart computer system has been driving our efforts to detect a person's emotional state. 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[5]. 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. Because of the incredible amount of time spent touching an input device, we will explore the possibility of detecting emotion through touch.

FACIAL EXPRESSION: Based on facial expression work, a correlation between a person's emotional state and a person's physiological can be measured. 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. Six participants were trained to exhibit the facial expressions 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 discriminant 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 the 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 prediction of emotion. We also hypothesize the GSA can be measured by change in movement in the computer mouse.

MAGIC-POINTING: This work explores a new direction in utilizing eye gaze for computer input. Gaze tracking has long been considered as an alternative or potentially superior pointing method for computer input. We believe that many fundamental limitations exist with traditional gaze pointing. In particular, it is unnatural to overload a perceptual channel such as vision with a motor control task. We therefore propose an alternative approach, dubbed MAGIC (Manual and Gaze Input Cascaded) pointing. With such an approach, pointing appears to the user to be a manual task, used for fine manipulation and selection. However, a large portion of the cursor movement is eliminated by warping the cursor to the eye gaze area, which encompasses the target. Two specific MAGIC pointing techniques, one conservative and one liberal, were designed, analyzed, and implemented with an eye tracker we developed. They were then tested in a pilot study. This early stage exploration showed that the MAGIC pointing techniques might offer many advantages, including reduced physical effort and fatigue as compared to traditional manual pointing, greater accuracy and naturalness than traditional gaze pointing, and possibly faster speed than manual pointing. The pros and cons of the two techniques are discussed in light of both performance data and subjective reports.

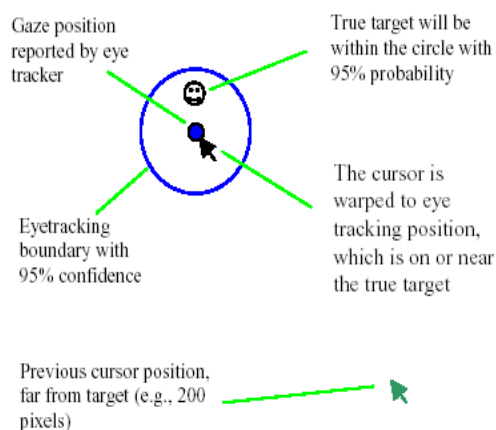


Figure 1. The liberal MAGIC pointing technique: cursor is placed in the vicinity of a target that the user fixates on.

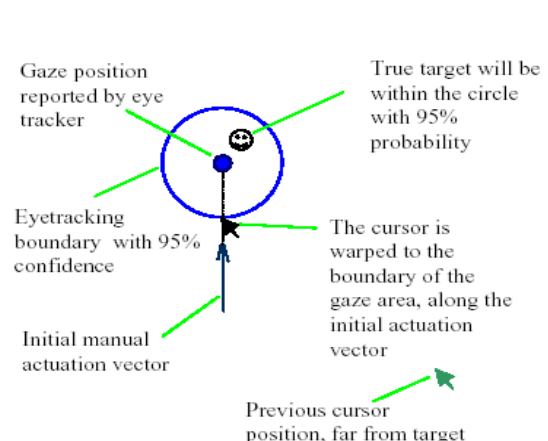


Figure 2. The conservative MAGIC pointing technique with "intelligent offset"

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 special language for creating software.

IV. VISION SYSTEM

The system uses IBM Blue Eyes infrared lighting cameras[1]. These cameras are used as sensors for our eye tracking algorithm and the tracked eyes are used in conjunction to estimate the user's head pose and eye gaze direction (see Figure 1). Each eye tracker utilizes a simple dynamics model of eye movements along with Kalman filters and appearance models to track the eyes robustly in real-time and under widely varying lighting conditions. The tracked head pose is used to estimate a user's eye gaze to measure whether a user is looking at a previously defined region of interest that the prototype applications use to further interact with the user.

Multicamera IR based eye tracking

Several pre-calibrated cameras to estimate a user's head pose are used. For each camera, we use the tracked eye locations to estimate mouth corners. These two mouth corners and eye positions are then used as low level features between all cameras to estimate the user's 3D head pose. A combination of stereo triangulation, noise reduction via interpolation is used, and a camera switching metric to use the best subsets of cameras for better tracking as a user is moving their head in the tracking volume[1]. Multiple cameras provide both a large tracking volume as well as 3D head pose information. However, as a user moves in the tracking volume, it is possible that their eyes are no longer visible from some cameras[7].

Dealing with infrared saturation

The tracker was initially designed to work in indoor office environments with fluorescent lighting and limited daylight. The presence of almost omni directional infrared lighting complicates the tracking because there are many additional sources of infrared light besides the LEDs on the camera. Indeed, in an indoor residential setting, infrared light

is picked up by the cameras as it is present everywhere during the day. In the eye tracking sub-system, principal component analysis (PCA) was used to construct appearance models for the eyes [6]. However, PCA weighs all components of the feature vectors equally and cannot account for different noise contributions in different variables. The principal components cannot capture all variation in eyes and non-eyes lit differently throughout the day and from different windows[2]. Multiple classes could be created, but it is unclear how to assign the training data to different classes or what the classes themselves should be to represent varying lighting. Fisher's linear discriminant has previously been used to compensate for varying light conditions for improved facial recognition [1].

Head pose and software application integration

We integrate the head pose and eye gaze estimates from the vision system as a noninvasive user interface for the HCI applications by treating the vision system as a server. The vision system can be queried by applications to find out how many eyes are in the scene, what the estimated head pose is and whether there is any overlap between application defined regions of interest and the user's head position[2]. Treating the vision system as a service abstracts the technical details of the tracking and allows HCI researchers to focus on using the data provided by our system to support user interactions more effectively[6].

V. APPLICATIONS OF BLUE EYES

1. Engineers at IBM's office: smart tags" Research Center in San Jose, CA, report that a number of large retailers have implemented surveillance systems that record and interpret customer movements, using software from Almaden's BlueEyes research project. BlueEyes is developing ways for computers to anticipate users' wants by gathering video data on eye movement and facial expression. Your gaze might rest on a Web site heading, for example, and that would prompt your computer to find similar links and to call them up in a new window. But the first practical use for the research turns out to be snooping on shoppers. BlueEyes software makes sense of what the cameras see to answer key questions for retailers, including, How many shoppers ignored a promotion? How many stopped? How long did they stay? Did their faces register boredom or delight? How many reached for the item and put it in their shopping carts? BlueEyes works by tracking pupil, eyebrow and mouth movement. When monitoring pupils, the system uses a camera and two infrared light sources placed inside the product display. One light source is aligned with the camera's focus; the other is slightly off axis. When the eye looks into the camera-aligned light, the pupil appears bright to the sensor, and the software registers the customer's attention. This is way it captures the person's income and buying preferences. Blue Eyes is actively been incorporated in some of the leading retail outlets.

2. Another application would be in the automobile industry. By simply touching a computer input device such as a mouse, the computer system is designed to be able to determine a person's emotional state for cars, it could be useful to help with critical decisions like: "I know you want to get into the fast lane, but I'm afraid I can't do that. Your too upset right now" and therefore assist in driving safely.

3. Current interfaces between computers and humans can present information vividly, but have no sense of whether that information is ever viewed or understood. In contrast, new real-time computer vision techniques for perceiving people allows us to create "Face-responsive Displays" and "Perceptive Environments", which can sense and respond to users that are viewing them. Using stereo-vision techniques, we are able to detect, track, and identify users robustly and in real time. This information can make spoken language interface more robust, by selecting the acoustic information from a visually-localized source. Environments can become aware of how many people are present, what activity is occurring, and therefore what display or messaging modalities are most appropriate to use in the current situation. The results of our research will allow the interface between computers and human users to become more natural and intuitive[10][11].

4. We could see its use in video games where, it could give individual challenges to customers playing video games. Typically targeting commercial business. The integration of children's toys, technologies and computers is enabling new play experiences that were not commercially feasible until recently. The Intel Play QX3 Computer Microscope, the Me2Cam with Fun Fair, and the Computer Sound Morpher are commercially available smart toy products developed by the Intel Smart Toy Lab in . One theme that is common across these PC-connected toys is that users interact with them using a combination of visual, audible and tactile input & output modalities. The presentation will provide an overview of the interaction design of these products and pose some unique challenges faced by designers and engineers of such experiences targeted at novice computer users, namely young children.

5. The familiar and useful come from things we recognize. Many of our favorite things' appearance communicate their use; they show the change in their value through patina. As technologists we are now poised to imagine a world where computing objects communicate with us in-situ; where we are. We use our looks, feelings, and actions to give the computer the experience it needs to work with us. Keyboards and mice will not continue to dominate computer user interfaces. Keyboard input will be replaced in large measure by systems that know what we want and require less explicit communication. Sensors are gaining fidelity and ubiquity to record presence and actions; sensors will notice when we

enter a space, sit down, lie down, pump iron, etc. Pervasive infrastructure is recording it. This talk will cover projects from the Context Aware Computing Group at MIT Media Lab.

VI. CONCLUSION

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 ability of our system to track user head pose over multiple cameras in indoor settings is demonstrated. Several users may be able to perform the tracking under varying lighting conditions very robustly. In addition, present a framework is presented to seamlessly integrate vision-based system with application prototypes to make higher-level inferences about user behavior.

FUTURE WORKS

The feedback from the user studies could be used to modify the granularity of head pose data provided by the tracking system. A proper planning can be thought of to investigate how effective the gaze data has been in facilitating family communications and what new social implications arise from these kinds of perceptual systems. Several more experiments can be conducted with several other application prototypes to explore new avenues for using perceptual interfaces based on vision-based system.

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