

# Study of blue eye technology



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Blue eye is the technology to make computers sense and understand human behavior and feelings and react in the proper ways. The blue eye technology aims at creating computational machines that have perceptual and sensory ability like those of human beings. It uses non-obtrusive sensing method, employing the 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.

This paper outlines the system over view, design features besides hardware part. The concept of the technology is the system recognizes through its various modules the basic emotions and feelings evinced by the user. This paper brings out the features of this technology, the various methods of giving the inputs to the system, design challenges and the emerging trends. Application of this technology in areas like automobile, surveillance system etc. is also dealt with.

#### THE TERM BLUE EYE:

BLUE in the term stands for Bluetooth, which enables reliable wireless communication.

EYE, because the eye movement enables us to obtain a lot of interesting and important information.

#### BASIC IDEA:

In general, the blue eye technology aims at :

creating interactive computer.

computer acts as partner (and friend) to the user.

realizes his physical or emotional states.

gives computer human power.

provide technical means for monitoring and recording operator physiological conditions

Design smarter devices .

Create devices with emotional intelligence .

Create computational devices with perceptual abilities.

BLUE EYE TECHNOLOGY:

The complex solution for human-operator monitoring:

Visual attention monitoring

Physiological condition

Operator's position detection

Wireless data acquisition using Bluetooth

Real time user defined alarm triggering

Recorded data playback

Gesture recognition,

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Facial recognition,

Eye tracking,

Speech recognition,

Doesn't predict nor interfere with operator's thoughts

Cannot force directly the operator to work

#### SYSTEM OVERVIEW:

Blue eye system provides technical means for monitoring and recording the operator's basic physiological parameters. The most important parameter is saccadic activity ( Saccade is a rapid eye jump to a new location assigned by the conscious attention process), 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 eye 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.

#### DESIGN FEATURES:

It has a personal area network for linking all the operators and the supervising system. It has two major units

DAU (data acquisition unit )

CSU (central system unit )

The basic block diagram is shown below:

#### DATA ACQUISITION UNIT:

The DAU consists of the following components

ATMEL 8952 microcontroller

BLUE TOOTH MODULE – supports synchronous voice data transmission

PCM CODEC -used to transmit operator's voice and central system sound feedback

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UART -communication between bluetooth module and microcontroller  
(115200 bps)

MAX232 -level shifter

ALPHAUNUMERIC LCD display

LED indicators

ID CARD interface

In creating the hardware part of the DAU a development board is built, which enables the operator to mount, connect and test various peripheral devices cooperating with the microcontroller. During the implementation of the DAU a piece of software is needed to establish and test Bluetooth connections. Therefore a tool called BlueDentist is created. The tool provides support for controlling the currently connected Bluetooth device. Its functions are:

local device management (resetting, reading local BD\_ADDR, putting in Inquiry/Page and Inquiry/Page scan modes, reading the list of locally supported features and setting UART speed)

connection management (receiving and displaying Inquiry scan results, establishing ACL links, adding SCO connections, performing link authorization procedure, sending test data packets and disconnecting).

To test the possibilities and

performance of the remaining parts such as computer, camera and

database software, BlueCapture is created. The tool supports capturing video data from various sources (USB web-cam, industrial camera) and storing the data in the MS SQL Server database. Additionally, the application performs sound recording. After filtering and removing insignificant fragments (i. e. silence) the audio data is stored in the database. Finally, the program plays the recorded audiovisual stream. The software is used to measure database system performance and to optimize some of the SQL queries (e. g. replacing of correlated SQL queries with cursor operations).

Also a simple tool for recording Jazz

Multisensor measurements is created. The program reads the data using a parallel port and writes it to a file. To program the operator's personal ID card we use a standard parallel port, as the EPROMs and the port are both TTL-compliant. A simple dialog-based application helps to accomplish the task.

DAU FEATURES:

The data acquisition unit has the following features.

Lightweight

Runs on batteries - low power consumption

Easy to use - does not disturb the operator working

ID cards for operator authorization

Voice transmission using hardware PCM codec

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## CENTRAL SYSTEM UNIT:

The CSU consists of the following components.

CONNECTION MODULE – main task to perform low-level blue tooth communication

DATA ANALYSIS MODULE – performs the analysis of the raw sensor data in order to obtain information about operator's physiological condition

DATA LOGGER MODULE – provides support for storing the monitored data.

VISUALIZATION MODULE – provides user interface for the supervisors

## CSU FEATURES:

The central system unit has the following features.

Access verification

System maintenance

Connection management

Data processing

Visualization

Data recording

## AFFECTIVE COMPUTING



The process of making emotional computers with sensing abilities is known as affective computing.

Steps include:-

Giving sensing abilities

Detecting human emotions

Respond properly

#### ASPECTS OF AFFECTIVE COMPUTING

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, but emotion detection is an important step to an adaptive computer system. An adaptive, smart computer system has been driving efforts to detect a person's emotional state. An important element of incorporating emotion into computing is for productivity for a computer 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.

## INPUTS CONSIDERED

Heart pulse rate

Facial expressions

Eye-brows and mouth lines primarily

Eye movements

As a pointing device

Also to determine the emotion

Voice

## METHODS: 1. AFFECT DETECTION:

One way of gaining information from a user non-intrusively is by video.

Cameras have been used to detect a person's emotional state.

The basic block diagram of the facial expression detection is shown below.

## THEORY ON FACIAL EXPRESSION

Based on a facial expression work, there is a correlation between a person's emotional state and a person's physiological measurements. Paul Ekman, a scientist performed an experiment which 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

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to the six basic emotions. He defined the six basic emotions as anger, fear, sadness, disgust, joy and surprise. Thus from this experiment it was 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.

Thus it can be concluded that “ most of the information is extracted from the position of the eye-brows.”

Detection Geometric facial data extraction Basic emotion-specified facial expression

1 2 3 4 5 6

disgust

fear

joy

surprise

Sadness

anger

2. MAGIC POINTING:

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Magic Pointing stands for

### MANUAL AND GAZE INPUT CASCADED (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. It is believed 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. Therefore an alternative approach of dubbed MAGIC (Manual And Gaze Input Cascaded) pointing is proposed. 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 are

Conservative magic pointing and

Liberal magic pointing.

The pros and cons of the two techniques are discussed in light of both performance data and subjective reports.

### IMPLEMENTATION

The MAGIC pointing program takes data from both the manual input device (of any type, such as a mouse) and the eye tracking system running either

on the same machine or on another machine connected via serial port. Raw data from an eye tracker can not be directly used for gaze-based interaction, due to noise from image processing, eye movement jitters, and samples taken during saccade (ballistic eye movement) periods. Therefore filters are used.

The goal of filter design in general is to make the best compromise between preserving signal bandwidth and eliminating unwanted noise. In the case of eye tracking, eye information relevant to interaction lies in the fixations. The key is to select fixation points with minimal delay.

Samples collected during a saccade are unwanted and should be avoided. In designing the algorithm for picking points of fixation, the

tracking system speed (30 Hz) is considered, and that the MAGIC pointing techniques utilize gaze information only once for each new target, probably immediately after a saccade. The filtering algorithm was designed to pick a fixation with minimum delay by means of selecting two adjacent points over two samples.

Advantages of magic pointing:

The both the liberal and the conservative MAGIC pointing techniques offer the following potential advantages:

Reduction of manual stress and fatigue, since the cross screen long-distance cursor movement is eliminated from manual control.

Practical accuracy level. In comparison to traditional pure gaze pointing whose accuracy is pointing fundamentally limited by the nature of eye movement, the MAGIC pointing techniques let the hand complete the task, so they can be as accurate as any other manual input techniques.

. A more natural mental model for the user. The user does not have to be aware of the role of the eye gaze. To the user, pointing continues to be a manual task, with a cursor conveniently appearing where it needs to be.

Speed. Since the need for large magnitude pointing operations is less than with pure manual cursor control, it is possible that MAGIC pointing will be faster than pure manual pointing.

Improved subjective speed and ease-of-use. Since the manual pointing amplitude is smaller, the user may perceive the MAGIC pointing system to operate faster and more pleasantly than pure manual control, even if it operates at the same speed or more slowly.

Problems related to magic pointing:

In addition to problems with today's eye tracking systems, such as delay, error, and inconvenience, there may also be many potential human factor disadvantages to the MAGIC pointing techniques we have proposed, including the following:

1. With the more liberal MAGIC pointing technique, the cursor warping can be overactive at times, since the cursor moves to the new gaze location whenever the eye gaze moves more than a set distance (e. g., 120 pixels) away from the cursor. This could be particularly distracting when the user is

trying to read. It is possible to introduce additional constraint according to the context. For example, when the user's eye appears to follow a text reading pattern, MAGIC pointing can be automatically suppressed.

2. With the more conservative MAGIC pointing technique, the uncertainty of the exact location at which the cursor might appear may force the user, especially a novice, to adopt a cumbersome strategy: take a touch (use the manual input device to activate the cursor), wait (for the cursor to appear), and move (the cursor to the target manually). Such a strategy may prolong the target acquisition time. The user may have to learn a novel hand-eye coordination pattern to be efficient with this technique. Gaze position reported by eye tracker Eye tracking boundary with 95% confidence True target will be within the circle with 95% probability The cursor is warped to the boundary of the gaze area, along the initial actuation vector Previous cursor position, far from target Initial manual actuation vector

3. With pure manual pointing techniques, the user, knowing the current cursor location, could conceivably perform his motor acts in parallel to visual search. Motor action may start as soon as the user's gaze settles on a target. With MAGIC pointing techniques, the motor action computation (decision) cannot start until the cursor appears. This may negate the time saving gained from the MAGIC pointing technique's reduction of movement amplitude. Clearly, experimental (implementation and empirical) work is needed to validate, refine, or invent alternative MAGIC pointing techniques.

SUITOR

SUITOR stands for " Simple User Interface Tracker". 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

to 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 the user. A cue to exploit nonverbal cues to create more effective

user interfaces is gaze-the direction in which a person is looking. A new

technique for tracking a person's eyes has been created and this gaze-

tracking technology has been incorporated 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 the user is looking, what applications he/she is running, and what Web

pages the user may be browsing.

For example, If a Web page about IBM, is being read for instance and the

system presents the latest stock price or business news stories that could

affect IBM. If the headline off the ticker is read, it pops up the story in a

browser window. If the story is also read then , 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."

#### EMOTION MOUSE:

One goal of human computer interaction (HCI) is to make an adaptive, smart computer system. A non-invasive way to obtain information about a person is through touch. People use their computers to obtain, store and manipulate data using their computer. In order to start creating smart computers, the computer must start gaining information about the user. The 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 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.

. 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. Because of the incredible amount of time spent touching an input device, the possibility of detecting emotion through touch can be explored.

Mouse is embedded with sensors that can sense the physiological attributes like

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Temperature

Body pressure

Pulse rate

Touching style etc.

The computer determines the user's emotional states from these inputs.

#### BLUE EYE – EMOTIONAL MOUSE

sensors in the mouse , sense the physiological attributes which are correlated to emotions using correlation model

-by simply touching the mouse , the computer will be able to determine a person's emotional state.

BLUE EYE enabled TELEVISION – could become active when the user makes an eye contact incorporated.

#### 5. SPEECH RECOGNITION:

It is important to consider the environment in which the speech recognition system has to work. The grammar used by the speaker, 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 . Artificial intelligence comes into place where an automatic call-handling system is used without employing any telephone operator.

#### THE TECHNOLOGY:

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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.

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 amplitudes of the signal . Evenly spaced vertical lines

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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.

The pictures represent the basic schemes of the speech recognition process.

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 to 3.3 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. It 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 is 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.

#### APPLICATIONS OF SPEECH RECOGNITION

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.

## 6. EYE TRACKER:

Eye tracker is a device which tracks the movement of eye. This system is much more compact and reliable. Available commercial systems, rely on a single light source that is positioned either off the camera axis, or on-axis. Illumination from an off-axis source (or ambient illumination) generates a dark pupil image. When the light source is placed on-axis with the camera optical axis, the camera is able to detect the light reflected from the interior of the eye, and the image of the pupil appears bright. This effect is often seen as the red-eye in flash photographs when the flash is close to the camera lens.

The Almaden system of eye tracking uses two near infrared (IR) time multiplexed light sources, composed of two sets of IR LED's, which were synchronized with the camera frame rate. One light source is placed very close to the camera's optical axis and is synchronized with the even frames. Odd frames are synchronized with the second light source, positioned off axis. The two light sources are calibrated to provide approximately

equivalent whole-scene illumination. Pupil detection is realized by means of subtracting the dark pupil image from the bright pupil image. After thresholding the difference, the largest connected component is identified as the pupil. This technique significantly increases the robustness and reliability of the eye tracking system.

The Almaden eye tracker is shown in the figure. The above picture an ON AXIS infrared illuminationThe figure explains the OFF AXIS infrared illumination. APPLICATIONS

#### 1. Surveillance systems:

A large retailers have implemented surveillance systems that record and interpret customer movements, using BlueEye software.

BlueEye 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? Blue Eye 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. BlueEye is actively been incorporated in some of the leading retail outlets.

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## 2. Automobile industry

Blue Eye can be applied 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. You too upset right now" and therefore assist in driving safely.

## 3. Video games

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.

## 4. An alternate to keyboard



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.

##### 5. A better future scenario

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.

## 6. Other applications

Blue eye enabled devices

Devices

POD-Technology used in cars.

PONG- A Robot.

SECURE PAD- An Electronic Badge

Generic control rooms

System can be applied in every working environment requiring permanent operator's attention like

Power station

Captain bridge

Flight control centers

Operating theatres - anesthesiologists

CONCLUSION:

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The nineties witnessed quantum leaps interface designing for improved man machine interactions. The BLUE EYE technology ensures a convenient way of simplifying the life by providing more

delicate and user friendly facilities in computing devices. In the near future, ordinary household devices- such as television , refrigerators , ovens may be able to do their jobs when we look at them and speak to them. Future applications of blue eye technology are limitless. The gap between the electronic and Physical world is greatly reduced. The computers can be run using implicit commands instead of the explicit commands. The day is not far when this technology will push its way

into your house hold, making you more lazy.