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RESEARCH ARTICLE

Mind Reading Computer

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Abstract— ***A computer can, in a very real sense, read human minds. Although the dot's gyrations are directed by a computer, the machine was only carrying out the orders of the test subject. The computer mind-reading technique is far more than a laboratory stunt. Though computers can solve extraordinarily complex problems with incredible speed, the information they digest is fed to them by such slow, cumbersome tools as typewriter keyboards or punched tapes. The key to his scheme: the electroencephalograph, a device used by medical researchers to pick up electrical currents from various parts of the brain. If we could learn to identify brain waves generated by specific thoughts or commands, we might be able to teach the same skill to a computer. The machine might even be able to react to those commands by, say, moving a dot across a TV screen. So far the S.R.I, computer has been taught to recognize seven different commands—up, down, left, right, slow, fast and stop.***

Keywords— ***Facial expression analysis, Mind Reading, Affective Computing, Mental state analysis, Dynamic Bayesian networks***

I. INTRODUCTION

People express their mental states, including emotions, thoughts, and desires, all the time through facial expressions, vocal nuances and gestures. This is true even when they are interacting with machines. Our mental states shape the decisions that we make, govern how we communicate with others, and affect our performance. The ability to attribute mental states to others from their behaviour and to use that knowledge to guide our own actions and predict those of others is known as theory of mind or mind-reading. Existing human-computer interfaces are mind-blind oblivious to the user's mental states and intentions. A computer may wait indefinitely for input from a user who is no longer there, or decide to do irrelevant tasks while a user is frantically working towards an imminent deadline. As a result, existing computer technologies often frustrate the user, have little persuasive power and cannot initiate interactions with the user. Even if they do take the initiative, like the now retired Microsoft Paperclip, they are often misguided and irrelevant, and simply frustrate the user. With the increasing complexity of computer technologies and the ubiquity of mobile and wearable devices, there is a need for machines that are aware of the user's mental state and that adaptively respond to these mental states.

II. HISTORY OF MIND READING COMPUTER

Research on mind-reading has been vigorously pursued by US government agencies and various academic centres since the 1970s, and continues to this day.

Since 1973 DARPA (Defence Advanced Research Projects Agency) has been studying mind-reading with EEG hooked to computers, using scientists at the University of Illinois, UCLA, Stanford Research Institute, Massachusetts Institute of Technology, and the University of Rochester. They developed a system that could determine how a person perceived colours or shapes and were working on methods to detect daydreaming,

fatigue, and other brain states. Although the device had to be calibrated for each person's brain by having them think a series of specific thoughts, the calibration was quick.

In 1974 another very basic mind-reading machine was created by researchers at Stanford Research Institute. It used an EEG (Electroencephalograph) hooked to a computer which allowed a dot to be moved across a computer screen using thought alone. When interpreting people's brainwaves, it was right about 60% of the time. During these tests scientists discovered that brain patterns are like fingerprints, each person has their own. So, each computer would have to be calibrated for a specific person. The "Time Magazine" stated that this experiment looked like some ingenious test of mental telepathy. Seated inside a small isolation booth with wires trailing from the helmet on S.R.I. Researcher Lawrence Pinneo's head, the subject seems deep in concentration. He did not speak or move. Suddenly, a little white dot hovering in the centre of the screen came to life. It swept to the top of the screen, and then it reversed itself and came back down. After a pause, it moved to the right, stopped, moved to the left, momentarily sped up and finally halted — almost as if it were under the control of some external intelligence. In fact, it was. The unusual experiment, conducted at the Stanford Research Institute in Menlo Park, Calif., is a graphic display of one of the newest and most dazzling breakthroughs in cybernetics. It shows that a computer can, in a very real sense, read human minds. Although the dot's gyrations were directed by a computer, the machine was only carrying out the orders of the test subject. He, in turn, did nothing more than think about what the dot's movements should be. Lawrence Pinneo said that the computer mind-reading technique is far more than a laboratory stunt. The key to this scheme is the electroencephalograph, a device used by medical researchers to pick up electrical currents from various parts of the brain. If he could learn to identify brain waves generated by specific thoughts or commands he might be able to teach the same skill to a computer. Pinneo does not worry that mind-reading computers might be abused by Big Brotherly governments or overly zealous police trying to ferret out the innermost thoughts of citizens.

This research conducted in 1974 shows that the capability for computers to respond to human thought was developed decades ago. The subject was classified top secret and continued to be developed secretly by the military and government, but kept well-hidden from public view.

III. COMPUTATIONAL MODEL OF MIND READING

Drawing inspiration from psychology, computer vision and machine learning, the team in the Computer Laboratory at the University of Cambridge has developed mind-reading machines computers that implement a computational model of mind-reading to infer mental states of people from their facial signals. The goal is to enhance human-computer interaction through empathic responses, to improve the productivity of the user and to enable applications to initiate interactions with and on behalf of the user, without waiting for explicit input from that user. There are difficult challenges.

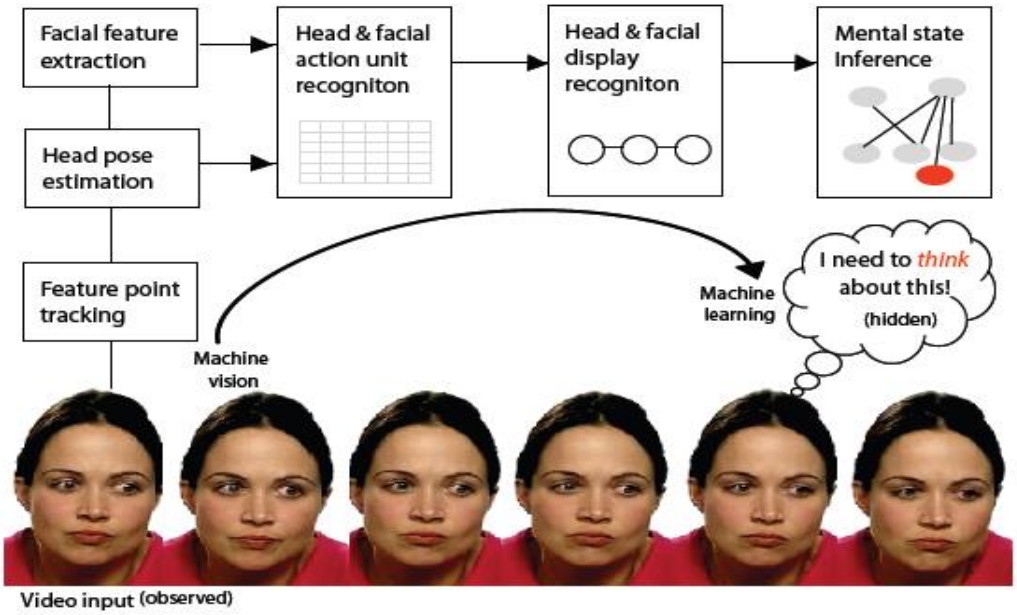

Fig. 1. Processing stages in the mind-reading system

Using a digital video camera, the mind-reading computer system analyzes a person's facial expressions in real time and infers that person's underlying mental state, such as whether he or she is agreeing or disagreeing, interested or bored, thinking or confused. Prior knowledge of how particular mental states are expressed in the face is combined with analysis of facial expressions and head gestures occurring in real time. The model represents these at different granularities, starting with face and head movements and building those in time and

in space to form a clearer model of what mental state is being represented. Software from Nevenvision identifies 24 feature points on the face and tracks them in real time. Movement, shape and color are then analyzed to identify gestures like a smile or eyebrows being raised. Combinations of these occurring over time indicate mental states. For example, a combination of a head nod, with a smile and eyebrows raised might mean interest. The relationship between observable head and facial displays and the corresponding hidden mental states over time is modeled using Dynamic Bayesian Networks.

IV. NEED OF MIND READING COMPUTER

The mind-reading computer system presents information about your mental state as easily as a keyboard and mouse present text and commands. Imagine a future where we are surrounded with mobile phones, cars and online services that can read our minds and react to our moods. Scientists are working with a major car manufacturer to implement this system in cars to detect driver mental states such as drowsiness, distraction and anger. Current projects in Cambridge are considering further inputs such as body posture and gestures to improve the inference. The same models can be used to control the animation of cartoon avatars. Scientists are also looking at the use of mind-reading to support on-line shopping and learning systems. The mind-reading computer system may also be used to monitor and suggest improvements in human-human interaction. The Affective Computing Group at the MIT Media Laboratory is developing an emotional-social intelligence prosthesis that explores new technologies to augment and improve people's social interactions and communication skills.

V. BASIC STEPS TO READ SOMEBODY'S MIND

Brain activity is measured in the visual cortex - the part of the brain that deals with information sent by the eyes - while volunteers looked at different test objects on a computer screen. Looking at the functional magnetic resonance imaging (fMRI) scan results; the scientists were able to predict what had been displayed on the computer screen better than volunteers.

A. Approaches used in Mind reading computer technology

The two approaches which are used as basic for mind reading technology are bio feedback and stimulus and response.

1) *Bio Feed Back:* "Bio feedback is a process that enables an individual to learn how to change physiological activity for the purposes of improving health and performance." Precise instruments measure physiological activity such as brainwaves, heart function, breathing, muscle activity, and skin temperature. These instruments rapidly and accurately 'feedback' information to the user. The presentation of this information often in conjunction with changes in thinking, emotions, and behaviour supports desired physiological changes. Over time, these changes can endure without continued use of an instrument. A subject is connected to an electroencephalograph (EEG) and particular groups of brain signals are monitored. The problem with biofeedback is that the training period can stretch to months, and the results can be very variable between subjects and the tasks they try to perform.

2) *Stimulus and Response:* When a subject is given a certain stimulus, the brain will automatically produce a measurable response so there's no need to train the subject to manipulate specific brain waves.

VI. WORKING OF MIND READING COMPUTER

Fig.2. Futuristic Headband

The mind reading actually involves measuring the volume and oxygen level of the blood around the subject's brain, using technology called functional near-infrared spectroscopy (fNIRS). The user wears a sort of futuristic headband that sends light in that spectrum into the tissues of the head where it is absorbed by active, blood-filled tissues. The headband then measures how much light was not absorbed, letting the computer gauge the metabolic demands that the brain is making. The results are often compared to an MRI, but can be gathered with lightweight, non-invasive equipment.

Wearing the fNIRS sensor, experimental subjects were asked to count the number of squares on a rotating onscreen cube and to perform other tasks. The subjects were then asked to rate the difficulty of the tasks, and their ratings agreed with the work intensity detected by the fNIRS system up to 83 percent of the time.

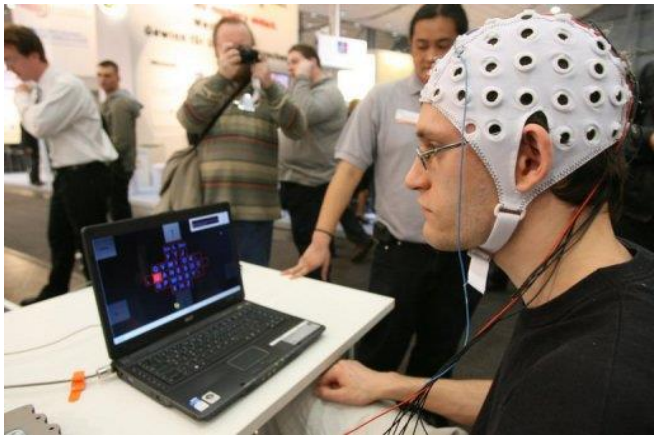

Fig.3. A person wearing futuristic headband

The particular area of the brain where the blood-flow change occurs should provide indications of the brain's metabolic changes and by extension workload, which could be a proxy for emotions like frustration. Measuring mental workload, frustration and distraction is typically limited to qualitatively observing computer users or to administering surveys after completion of a task, potentially missing valuable insight into the users' changing experiences. A computer program which can read silently spoken words by analyzing nerve signals in our mouths and throats has been developed by NASA. Preliminary results show that using button-sized sensors, which attach under the chin and on the side of the Adam's apple, it is possible to pick up and recognize nerve signals and patterns from the tongue and vocal cords that correspond to specific words.

VII. WEB SEARCH USING MIND READING COMPUTER

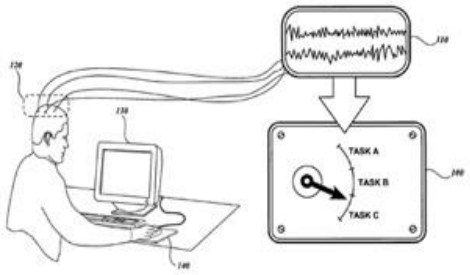

Fig.4. Web search using mind-reading computer

For the first test of the sensors, scientists trained the software program to recognize six words - including "go", "left" and "right" - and 10 numbers. Participants hooked up to the sensors silently said the words to themselves and the software correctly picked up the signals 92 per cent of the time. Then researchers put the letters of the alphabet into a matrix with each column and row labeled with a single-digit number. In that way, each letter was represented by a unique pair of number co-ordinates. These were used to silently spell "NASA" into a web search engine using the program. This proved we could browse the web without touching a keyboard.

VIII. BERLIN HIGH TECH FAIR

A Mind-Reading Computer places by Scientists at Berlin high-tech fair for testing purpose have become a major draw. Huge crowds at the fair gathered round a man sitting at a pinball table, wearing a cap covered in electrodes attached to his head, who controlled the flippers with great proficiency without using hands. "He thinks: left-hand or right-hand and the electrodes monitor the brain waves associated with that thought, send the

information to a computer, which then moves the flippers. But the technology is much more than a fun gadget, it could one day save your life." said Michael Tangermann, from the Berlin Brain Computer Interface.

Fig.5. Man playing pinball using Mind-Reading Computer

IX. MIND CONTROLLED WHEELCHAIR

The mind-controlled wheelchair was developed by the University of Electro-Communications in Japan. This wheelchair can move with the power of mind. This thing works by mapping brain waves when you think about moving left, right, forward or back, and then assigns required actions to a wheelchair command of actually moving left, right, forward or back. This could be useful for people who are paralyzed, and are unable to control parts of their body enough to physically activate the joystick of an electric wheelchair. Many people may be able to use this technology to gain some independence, and to take a break from needing an attendant to push their wheelchair so they can get some fresh air.

The parts of this system include an electric wheelchair, a laptop computer, an Arduino, an interface circuit, an EEG headset, and a collection of ready-made and custom software. The EEG headset, which connects wirelessly to the laptop, allows the operator to simply think "forward" or "left" or "right" to cause the wheelchair to move. Performance is related to practice by the user, proper configuration of the software, and good contact made by the EEG electrodes on the scalp of the operator. The interface circuit connects between the Arduino's digital pins and the joystick of the wheelchair. When the Arduino receives a command from the computer, it causes the circuit to "fool" the wheelchair into thinking that the operator has moved the joystick.

Fig.6. A Man sitting on Mind Controlled Wheelchair

X. IBM'S APPROACH TOWARDS MIND READING COMPUTER

IBM (International Business Machines) says that in coming next 5 years span or by 2016 users will have access to computers which can read human minds (brain) and be able to work according to brain signals. Keyboards and mouse may be the history in coming 5 years, and would be simply used in teaching of evolution of computers. This isn't telepathy, this would be the advancement of technology to get a real-time stream of

thoughts from an individual and put into signals which computer will understand, obey and work accordingly. IBM researcher are using a simple brain-machine interface (BMI) that can detect different kinds of brainwaves and tell a computer to respond a certain way. IBM says it's working on technology for people to use their brains to interface with their everyday devices, like phones and PCs.

XI. APPLICATIONS OF MIND READING COMPUTER

- With the help of Mind Controlled Wheelchair disable person will be able to move their wheelchair with very less effort.
- Mind reading computer helps in space-walking and also helps people who are unable to talk.
- Mind reading computer can send commands to rovers on other planets and help injured astronauts.
- Using mind reading computer's Speech detection system the pilot of a high-speed plane or spacecraft, could simply order by thought alone some vital flight information for an all-purpose cockpit display.
- By virtue of Mind reading computer one can play games without mouse, keyboard or joystick.
- Mind reading computer which are placed inside a robot's body can be used for controlling robots.
- Using Mind reading technology, a car can tell whether the driver is drowsy or not, potentially warning him or her to take a break.
- Scientists are researching ways to monitor motorists' brain waves using mind-reading computer to improve reaction times in a crash. So that in an emergency stop situation, the brain activity kicks in on average around 200 milli-seconds before even an alert driver can hit the brake.
- In future, using Mind reading technology, people will be able to open doors and turn on their televisions with their minds.
- Using Mind reading technology crime detection will be easy, this technology will tell us within a second that whether the suspect is really a criminal or not.
- Web searching is also a very important application of Mind-reading Computer.

XII. CONCLUSION

Tufts University researchers have begun a three-year research project which, if successful, will allow computers to respond to the brain activity of the computer's user. Users wear futuristic-looking headbands to shine light on their foreheads, and then perform a series of increasingly difficult tasks while the device reads what parts of the brain are absorbing the light. That info is then transferred to the computer, and from there the computer can adjust its interface and functions to each individual.

Hence if we get 100% accuracy these computers may find various applications in many fields of electronics where we have very less time to react.

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