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The Mind Reading Technology

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ABSTRACT: In this paper, we describe a human-computer interface (HCI) system that includes an enabler for controlling gadgets based on signal analysis of brain activities transmitted from the enabler to the gadgets. The enabler is insertable in a user's ear and includes a recorder that records brain signals. A processing unit of the system, which is inserted in a gadget, commands the gadget based on decoding the recorded brain signals. The proposed device and system could facilitate a mind reading analysis to control the gadget from electroencephalography signals in the user's brain. Though computers can solve extraordinary 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 hus scheme, the electroencephalograph, a device used by medical researchers to pick up electrical current from various parst of the brain. The relationship between observable head and facial displays and the corresponding hidden mental states over time is modelled using K-Nearest Neighbor (KNN).

KEYWORDS: Mind Reading, Human Computer Interface, Mental State Analysis, Electroencephalograph, Futuristic Headband, K-Nearest Neighbor

I. INTRODUCTION

HCI has been primarily implemented by monitoring direct manipulation of devices such as mice, keyboards, pens, touch surfaces, etc. However, as digital information becomes more integrated into everyday life, situations arise where it may be inconvenient to use hands to directly manipulate a gadget. For example, a driver might find it useful to interact with a vehicle navigation system without removing hands from the steering wheel. Further, a person in a meeting may wish to invisibly interact with a communication device.

[1].Accordingly, in the past few years there have been significant activities in the field of hands-free human-machine interface It is predicted that the future of HCI is moving toward compact and convenient hands-free devices.

[2].Notably, in a recent report, IBM has predicted that at least in the next five years, mind-reading technologies for controlling gadgets would be available in the communication market. In theIBM report it is predicted that "if you just need to think about calling someone, it happens…or you can control the cursor on a computer screen just by thinking about where you want to move it." Accordingly, there is a need to make such enablers that could capture, analyze, process, and transfer the brain signals, and command a gadget based on the instructions that a user has in mind. This paper discusses an enabler that is insertable in a user's ear to record an electroencephalography in the brain as brain signals while the user imagines various commands for controlling a gadget. The ear could provide a relatively inconspicuous location. Indeed, ear is known as a site where brain wave activity is detectable.

[3].Certain areas of the ear, such as the area of the ear canal have proven to be better locations for detecting brain wave activity. Particularly, the area of the upper part of the ear, called the triangular fossa has high brain wave activity, especially near the skull. It is considered that the thinness of the skull at this area could facilitate higher reading of the brain wave activities. The proposed enabler of this paper could transmit, for example wirelessly, the brain signals to a processing unit inserted in the gadget. The processing unit decodes the received brain signals by a pattern recognition technique. Based on the decoded brain signals, the processing unit could control applications that are installed in the gadget. The details of the device and system that could facilitate such brain-machine interface are discussed in this paper. This paper addresses the current technologies in mind-reading systems, the deficiencies and limits of the existing technologies, along with possible solutions to have a practical device for brain-computer interaction, and the future plans to achieve such cutting-edge technology.

The objective of this study is to introduce the mind reading computer system in various approaches as well as different theoretical models;

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particularly, how the computational framework works along with its methods. This study also aims to explore and discuss how in the future, the existence and the ease of use of mind reading computer can be beneficial to humans in various aspects. To achieve that, this study will collect and analyse information regarding affective computing specifically in mind reading computer topic from secondary data sources, which are the existedscholar journals, articles, news and media. It will then be compared and reviewed.

This will help to gather ideas and insights to better understand the topic and establish recommendation for future research as well as recognise its limitations. Hence, this case study will be considered as an exploratory research and it willconcentrate more on the impacts of existed models of mind reading computer to the individuals as end-users of this system. Taking everything into account, this case study aims to answer the questions of what would be the future of mind reading computer and how it can be applied to many disciplines.

II. LITERATURE SURVEY

To date, there have been a lot of ongoing information systems projects in enhancing HCI. According to the study of mind reading computer was first conducted because researchers and scientists believed that understanding human's emotions is one of the essential elements in human-computer interaction (HCI) that needs to be improved.

[4].This concern also arose due to the fact that human tend to interact with computer machines naturally. In everyday life, people express their mental states, which include emotions, thoughts and feelings. These mental states are expressed through their facial expressions, verbal communications as well as their gestures. Consequently, more and more attention is given to this particular topic.

[5.Examined that there have been a number of studies done in recognising human's affective states over the last few decades. The study investigated the idea that people's underlying mental states can actually contribute to the quality of their performances and actions. This fact helps researchers and scientists establishing the background for the development of the mind reading computer. Despite this, he believed that the main focus in today's research is how human's mental states can play a big role when humans are interacting with computers.

[6].also agreed that there are a large number of affective computing studies around the world conducted to improve many areas in human-computer interaction (HCI).

The studies mainly focused on the development of computer systems program that in the future, will be able to communicate, understand, and respond to users' emotions. Furthermore, it is also important to notice that over the last few decades, the important roles of emotion in HCI have attracted many scientists' and researchers' attentions as they believed that many of the findings in this area have reshaped scientific understanding of human's mental states.

[7].Argued that future research should focus on how to program computer machines to express and understand emotions in an appropriate way. Since then, the developments of mind reading computer models have been rapidly evolving in the past couple of years. He stated that computational model, futuristic headband, mind-controlled wheelchair, and emotional-social intelligence system are one of the developed models of this computer system. As mentioned before, the mind reading computer wasfirst studied and developed in the early 1970s by the United States government as well as many research institutions; He also believed that they were the first to experiment mind reading computer with Electroencephalograph (EEG) connected to the computers. Khan also explained the method that participants were asked to control and move a dot in a computer screen by using thought, and remarkably, the system was 60% right. However, this experiment was undisclosed by the US government and developed secretly for a while. Nevertheless, the first experiment has proved that the mind reading computers are able to recognise and respond to human minds.

As stated before, there are various models of mind reading computers that have been developed in this era namely the computational model. Computational model is one of the computers' abilities to interpret human's mental states from their facial expressions and gestures. This model was first introduced by researchers from the University of Cambridge using the Nevenvision software. Khan believed that this software allows users to identify 24 feature points on the face.

It will then recognise the hidden underlying mental states of the person by combining this feature with K-Nearest Neighbor. Moreover, findings by adding that this computational model works by using video cameras to capture the facial signals which then will be analysed in real time. To get a better understanding of this model, it will be further explored later in this paper. Khan then further discussed that another model of mind reading

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computer is the futuristic headband, which measuresthe brain activity of the person by using the fNIRS technology. The fNIRS stands for functional near-infrared spectroscopy; this technology involves measuring the volume and oxygen of the blood. This has attracted many researchers' attentions regarding its functionality. The idea of this model and believed that the headband will measure metabolic activities that a person's brain in reacting. To further investigate this model, an experiment was conducted; participants were asked to do some tasks and at the end, they had to rate the difficulty of the tasks. With respect to this, it is proved that the predictions of participants' answers that made by the fNIRS were 83% correct compare to the real answers.

What is mind reading computer?

Mind reading computer may be defined as the machine that speculates the human mental states. The understanding of a human's thoughts is one of the most difficult tasks. No one exactly knows what a person would do in the upcoming second by executing his present thoughts or what would a person thought about any other human or what would a person desires and many more. But a mind reading computer could give the answer of allthese questions.

It was developed by a team of Cambridge university, taking an inspiration from the Psychology, vision of computer and Machine Learning. Prior knowledge of how the particular mental states are expressed through the face in real time is required. Software from Nevenvision identifies 24 feature points on human face and tracks them in the real time. Movement, Shape and Color are then analyzed to identify the gestures like smile etc.

[8].Furthermore, many researchers and scientists believed that this next model of mind reading computer has opened the gate for people who are disabled or paralysed to have more freedom and independence. This model is the mind-controlled wheelchair, which allows the user to control his/her wheelchair just by thinking. Mindcontrolled wheelchair was developed in Japan by the University of Electro-Communications. They argued that this can be accomplished by mapping the brainwaves which will assign command to the wheelchair; the wheelchair will then work accordingly to the command. Again, this system uses combination of numbers of software, which includes the Electroencephalograph (EEG).

Fig. 2.1The mind-controlled Wheel Chair [9]

Obviously, those models that have been mentioned above are not the only models of mind reading computer that can be used to help human's activities. There are many more models and applications of mind reading computer that will benefit humans in many aspects in the near future. Additionally, Khan believed that people will be able to make use of mind reading computer in interacting with games and car and the development of the e-Learning systems.

A Computational Model of Mind Reading

The goal is to enhance the human-computer interaction through compassionate responses, to improve the productivity of the user and to enable the applications to initiate interactions with and on behalf of the user, without waiting for an input from that user.

Why mind reading?

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. How would that change our use of technology and our lives? We are working with a major car manufacturer to implement this system in cars to detect driver mental states such as drowsiness, distraction and anger.

[10].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.Imagine a future where we are surrounded with mobile phones, cars and online services that can read our minds and react to our moods. How would that change our use of technology and our lives?

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Mind-reading can also support on-line shopping and learning systems.

The need of Mind Reading Computer is due to following reasons

• Input to computer with an incredible speed
• To support learning systems and on-line shopping.
• To control the animation of cartoon like avatars.
• To detect driver mental states such as anger, drowsiness,distraction.
• To monitor and Suggests improvement in human humanInteraction.

Brain Chip

It is an independent processor linked to the neurocomputer built to house an artificial intelligence. The artificial intelligence program has access to the sensory data and information in the neurocomputer, and can "read" surface thoughts of the owner. Having a (or several) as advisor/secretary/partner is becoming more and more common, although most people really on an external artificial intelligence system and a wireless neural connection. It is not uncommon for users to get a motoric shunt to give the artificial intelligencethe ability to control the body. Chips with monitoring artificial intelligence are sometimes used for or behavior correction in Landfall.

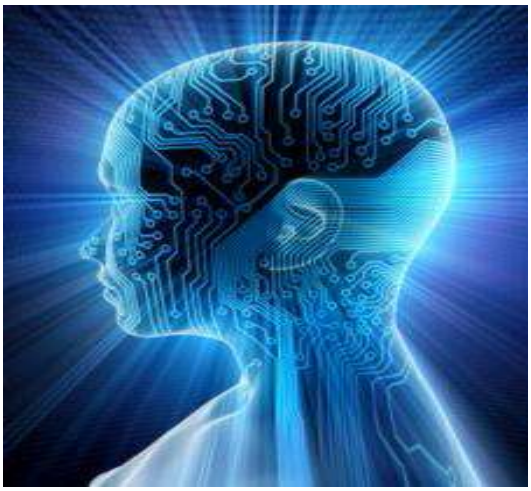

Fig. 2.2 Brain chip [11]

Scientists successfully implant chips that control Brain allowing thoughts, memory and behavior to be transferred from one brain to another brain. In a scene right out of a George Orwell novel, a team of scientists working in the fields of "neural engineering" and "Biomimetic MicroElectronic Systems" have successfully created a chip that controls the brain and can be used as a storage device for long-term memories. In studies the scientists have been able to record, download and transfer memories into other hosts with the same chip implanted. The advancement in technology brings the world one step closer to a globalpolice state and the reality of absolute mind control.

Current status of technology

Traditional human-computer interfaces are limited since they require a human to physically interact with a device, such as pressing a button by a finger. In one of the most recent attempts to address this problem, speech processing devices have been considered for voice activation. However, voice activation technology suffers from many use-related limitations, including poor operation in noisy environments, inappropriateness in public places, difficulty of use by those with speech and hearing problems, and issues to capture and recognize different and not previously stored patterns of accents and languages. Further, attempts have been made to use head and eye movement schemes to move a cursor around on a computer screen. Such methods are limited in functionality and require additional measures to provide a reliable control interface

[12].It is noted that the direction of HCI is moving toward hands-free brain-computer interfacewith a fast pace. Among promising technologies in this field, Nokia Corporation (hereinafter "Nokia") recently has proposed a system for providing a hierarchical approach to command-control tasks using a brain-computer interface. This system includes a hierarchical multi-level decision tree structure that applies internal nodes and leaf nodes, in which the decision tree structure represents a task. The system performs navigating, using information derived from detected mental states of a user, through levels of the decision tree structure to reach a leaf node for achieving the task. The navigating includes selecting, using the information derived from the detected mental states of the user, between attribute values associated with the internal nodes of the decision tree structure to communicate with a device, including a name dialing or a command/control task. However, Nokia's device suffers from the complexity of the system, which requires a noticeable space that could not be accommodated in a compact unit to be carried by the user or inserted in the gadget. Further, in Nokia's system there is a possibility of a limited understanding of the user's brain and its electrical activities, since the accuracy of a mind signal

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detection could be degraded as the number of mind states increases.

Future plans and limitations

This paper discusses an enabler for controlling a gadget based on signal analysis of brain activities transmitted from the enabler to the gadget in a system, which could overcome the issues set forth above in the conventional devices. Therefore, it is an advantage of the system disclosed in this paper to provide an improved human-computer interface system, having many of the same capabilities as conventional input devices, but which is hands-free and does not require hand operated electromechanical controls, or microphone-based speech processing methods, and is easy to insert to provide comfort for a user of the enabler to enable easily controlling gadgets such as mobile phones, personal digital assistant devices, media players, etc. With the proposed enabler and system of this paper, these gadgets can be controlled without a need for an additional hardware, particularly without additional electrodes outside the enabler.

The enabler includes a recorder that is insertable in an outer ear area of the user.

[13].The recorder records electroencephalography signals generated in the brain. The recorded signals are transferred to a processing unit inserted in the gadget for converting the signals to command applications in the gadget.

A recorder that is inserted in the enabler records the brain signals. The recorder has an electrode that is located at the entrance of the ear, and could be mounted with an earplug. Signals can be amplified and digitized for transmitting from the enabler. The enabler wirelessly transmits the recorded brain signals to the processing unit that includes a decoder. A transmitting device installed in the enabler produces a radio frequency signal corresponding to voltages sensed by the recorder and transmits the radio frequency signal by radio frequency telemetry through a transmitting antenna. The transmitting device could include the transmitting antenna, a transmitter, an amplifying device, a controller, and a power supply unit, such as a battery. The amplifying device could include an input amplifier and a bandpass filter. The amplifying device receives an electrode signal from the recorder.

The electrode signal is a response to changes in the brain electrical activities of the user. The input amplifier could provide an initial gain to the electrode signal, and the bandpass filter could provide an additional gain to the electrode signal resulting in an output signal with an overall gain of much higher than the electrode signal. The controller is electrically connected to the bandpass filter. The output signal from the bandpass filter is inputted to the controller. The controller provides signal conditioning to the output signal to provide telemetry transmission. Such signal conditioning includes analog to digital conversion. The controller also controls the transmitter channel frequency thereby controlling the frequency of the radio frequency signal to be transmitted.

A receiving device in the processing unit, through a receiving antenna, receives the radio frequency signal generated and transmitted by the transmitting device. The receiving device produces a data output corresponding to the received radio frequency signal. The receiving device could include any radio frequency receiving means with a plurality of channels. A desired channel is selected via processor control of the frequency of an oscillator. The receiving device could employ a frequency shift keyed demodulation format. The receiving could also include a microcontroller incorporated to program the oscillator. The receiving device outputs data and error correction bits to the microcontroller which removes errorcorrection bits and outputs corrected data as the data output to an operator interface. The data output corresponds to the radio frequency signal received by the receiving device. The receiving device outputs the data output to the operator interface. The operator interface could include software which allows automatic synchronization of the stimulus with the data output.

The decoder decodes the data output using a common algorithm such as pattern classifier. By evaluating frequencies in a wide range from theta to gamma brain signals recorded by the recorder, complex cognitive signals are decodable and are used for controlling the gadget. The processing unit converts the decoded signals to command signals for running an application inserted in the gadget. The above-mentioned pattern classifier can utilize conventional algorithms that apply classifier-directed pattern recognition techniques to identify and measure specific changes in each input signal and derive an index of the relative strength of the change. In one method, a rule-based hierarchical database structure, describes the relevant features within each signal and a weighting function for each feature.

A self-learning heuristic algorithm governs the use and reweighting criteria for each feature, maintains the database of the feature indexes, and regulates feedback from a Feedback Control Interface. The output vectors are sent

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through cascades of classifiers, which select the most appropriate combination of the features necessary to generate a control signal to match an application in the gadget.

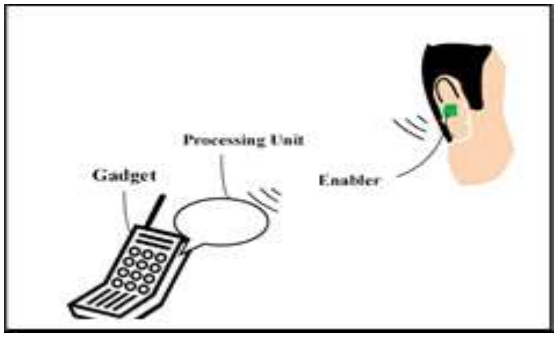

Fig.2.3 Mind-reading enabler communicating with a processing unit of a gadget

How does it work?

Electroencephalograph (EEG) a device used by the medical researchers to pick up electrical currents from the various parts of the brain.Functional near-infrared spectroscopy (fNIRS) Technology whichmeasures the volume and an oxygen level of the blood around the subject's brain. Futuristic headband that sends light into the tissues of the head where it is absorbed by the active, blood-filled tissues and then it measures how much light was not absorbed. NASA has developed the computer program which can read silently spoken words by analysing the nerve signals in our throats and mouth. Just the slightest movement in the Voice box and tongue is enough to work. Initially scientists trained the software program to recognize the six words-including go, left, 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% of the time.

Futuristic Headband

The user wears a futuristic headband that sends the light in that spectrum into the tissues of the head where it is absorbed by active, blood-filled tissues. The headband after that measures how much light was not absorbed, letting the computer gauge the metabolic demands that the brain is making.

The results are then compared to an MRI, but can be collected with lightweight, non-invasive equipment. When user wears the fNIRS sensor then an experimental subjects were asked to count the number of squares on a rotating onscreen cube and to perform some other tasks that are necessary. The subjects were then asked to rate the complexity of the tasks, andtheir ratings agreed with the work intensity detected by the fNIRS system up to 83 percent of the time.

Fig.2.4Various Models of the futuristic headband [14]

Applications

Mind Controlled Wheelchair

The mind controlled wheelchair was developed by the University of Electro-Communications in Japan. With the power of mind you can move the wheelchair. It can be done by mapping the brain waves when you think about moving forward or backward, left, right and then assigns required actions to a wheelchair command of actually moving forward or backward, left, right.

Mind Controlled Wheelchair could be useful for people who are paralyzed, and are not able to control their body parts. The main parts of this wheel chair system include an electrical wheelchair, a laptop pc, an Arduino, an interface circuit, an EEG headset, and a set of ready-made and custom software. The EEG headset, which connects wirelessly to laptop and then allows the operator to simply think "forward" or "left" or "right" to cause the wheelchair to move. The Performance is directly related to practice by the user, better 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 therefore the joystick of the wheelchair. When the Arduino receives a command from the pc, it makes the circuit to "fool" the wheelchair into thinking that the operator or the human has moved the joystick.

Brain to Vehicle Communication

Autonomous driving has been portrayed as a really hands-off, computer-led concept. Most manufacturers use pictures of individuals reading the newspaper or scrolling through their phone, in cabins with no wheel or pedals, whenever a

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replacement self - driving concept is released. You may have heard of Vehicle-to-Vehicle or V2V technology, but Nissan calls this new technology Brain-to-Vehicle or B2V technology. It's a driving system that interprets signals from the driver's brain to "make the drive even more exciting and enjoyable". Future vehicles will be both self-driving (autonomous) and manual. Car makers and tech companies from Ford to Google have made huge progress in making fully automated cars a reality - but there are still hurdles to beat. Changing and unpredictable weather can interfere with the car's ability to identify or track moving objects and GPS and AI vision systems can struggle in remote or inaccessible areas. Nissan thinks so called brain-to-vehicle technology will mean a driver's reaction times are sped up, making driving safer and easier.

As cars with more autonomous capability make their thanks to the road, Nissan is seeking to capture the eye of these people that aren't able toabandoning of their steering wheels. Nissan Brain-to-Vehicle technology provides the world's first system for real-time detection and analysis of brain activity concerning driving. It includes activity in advance of intentional movement (eg. steering), known as movement-related cortical potential (MRCP), and activity that reveals the variance between what the driver expects and what they are experiencing (eg. car moving too fast for comfort), known as error-related potentials (ErrP). The brainwave activity is measured employing a skullcap worn by the driving force and analyzed and interpreted for immediate implementation by on-board autonomous systems. EEG cap gathers raw data from the driver's brain; the car's artificial intelligence interprets it. The headset contains numerous electrodes that press on the brink of the person's scalp. The prototype cap uses electroencephalography (EEG) to decode thoughts while driving. By anticipating intended movement, systems can engage (turning the wheel or slowing the car) 0.2 to 0.5 seconds faster than the standard human response time, improving reaction times while being largely imperceptible for the driver. The signals produced in the driver's frontal motor cortex are detected using a sensor-equipped EEG headset (futuristic cap). They are then sent to the smart vehicle for processing. By combining that data with the knowledge detected by its own sensors, the car can react to things at hand. "If you're coming to a red light and preparing to brake, the car will assist you by starting to brake 200–500 milliseconds before you're doing. But if you approach a red light and your brain shows no intention of slowing the car down, the car will warn you that the sunshine is red to make sure you've seen it. We all generate different patterns of brain signals, so the vehicle learns from each driver and customize its software.

It stores each driver's regular routes, also as their driving habits and elegance, using this information to more accurately anticipates what each driver might do at any time. The brain-machine interface not only makes driving easier, it also creates a more personalized experience, because thecar will always be in sync with the drive. Even the car's setting can be transparently adapted to the driver's preferences. For instance, if the driving force has adopted a more relaxed driving style, the interface will detect that the chosen sports mode isn't appropriate and switch the car to a more comfortable setting.

Artificial intelligence (AI)

AI Helps Magicians Perform Mind-Reading Tricks. AI technique applies in Lie detection. This is used in Pain detection by fMRI technique. It is very useful in Brain-computer interfaces help of EEG & fMRI

This is useful technique in Pattern analysis and future research-fMRI. In the press: Where the reporters think

this research is headed.

Advantages

- It can be implemented on the wheelchair and the wheelchair can be moved through the mind control. It permits the people who cannot use the normal wheelchairs and other wheelchairs easily due to their disability.
- This will aid the spacewalking astronauts and physically disabled persons.
- This type of system can send instructions to the rover on the other planets and also aid injured astronauts to control devices.
- This can be availed to exchange information on sly, people can avail them on crowded buses without the problem of being overheard.

Disadvantages

- Before implementing the systems the scientist needs to train the systems about all the patterns to predict the result.
- Because of this scientific development, scholars are questioning the theories of criminal justice of the system.

III. METHODOLOGY

The purpose of this case study is to provide in depth analysis of mind reading computer. In order to accomplish that, the study will be based on secondary data sources.

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Information and data regarding this particular subject will be gathered andanalysed from literatures, which include research databases, practitioner database, media report, and other potential sources. To complete this research, it will be also using information from a single interview.

The interview will helps to build better understanding of this complex computer systems project as well as helped to establish the focus of this study. Moreover, the interview also will give a lot of information on where to get more related secondary data sources regarding affective computing and mind reading computer. However, full data and information regarding the development of the project as well as the participants could not be gotten due to privacy reason and data protection. For unit analysis, this study will mainly target and analyse on the individuals as the end-users of this computer system. The reason behind this is because this study aims to investigate how mind reading computer can be accepted by individuals in the future by its ease of use and its benefits to help people improve their quality of life and improve the HCI.

This research will aim to narrow down the scope of this study by targeting and focusing on the discussion of the framework for human's mental states recognition which is the computational model. It will then discuss about its methods (KNN) and applications to life as well as its benefits to the society when it is used.

The principal contribution of this study research is to introduce the novel computer system, which is the mind reading computer. In particular, this study will then go through the process of how this system works. It is also important to notice that the negative sides of mind reading computer are beyond the scope of this case study research.

K-Nearest Neighbor(KNN)Algorithm

K-Nearest Neighbor Algorithm is a stable and efficient method of classification based on examples. KNN are often used for both classification and regression predictive problems. However, it is more widely used in classification problems in the industry. The k-NN algorithm gets its name from the fact that it uses information about an example's k-Nearest Neighbor to classify unlabelled examples. The letter k is a variable term implying that any number of nearest neighbor could be used. After choosing k, the algorithm requires a training dataset made up of examples that have been classified into several categories, as labelled by a nominal variable. Then, for each unlabelled record in the test dataset, KNN identifies k records in the training data that are the "nearest" in similarity. The unlabeled test instance is assigned the class of the majority of the k nearest neighbor.

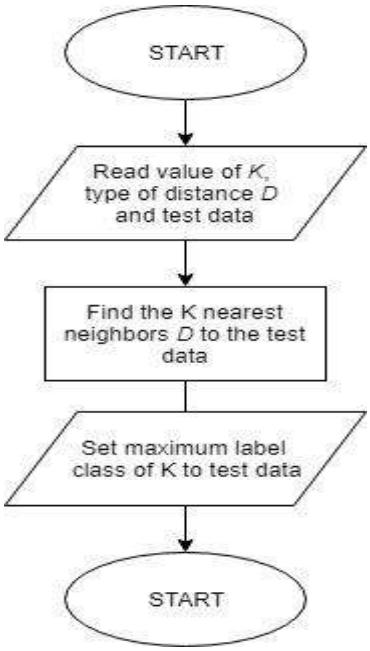

Fig 3.1 Flowchart of KNN algorithm

The KNN Algorithm

1. Load the data
2. Initialize K to your already chosen number of neighbor
3. For each example in the actual data
3.1 Calculate the space between the query example and therefore the current example from the actual data.
3.2 Add the space and therefore the index of the example to an ordered collection
4. Sort the ordered collection of distances or spaces and indices from smallest to largest (in ascending order) by the distances.
5. Pick the primary K entries from the sorted collection
6. Get the labels of the chosen K entries
7. If regression, return the mean of the labels of choosed K entries.
8. If classification, return the mode of the labels choosed K entries.

Choosing the right value for K

To select the K that's right for your data, we run the KNN algorithm several times with different values of K and choose the K that reduces the amount of errors we encounter. While maintaining the algorithm's ability to accurately make predictions when it's given data it hasn't seen before.

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CONCLUSION

In conclusion, based on the discussion presented in this paper, it appears that the trend in the future of the HCI devices and systems is movingtoward providing systems and devices that could efficiently convey the brain signals to command gadgets, while a user is thinking about commanding the gadgets. Recently, among researchers in industry and academia, several attempts have been made to enhance the brain-reading interface technologies. However, as set forth in this paper, each of these devices and systems suffers from deficiencies that refrains the field from achieving maturity. Indeed, it appears that much more research is needed to achieve to a point of commercializing these systems and devices that could be affordable and comfortable for the users.

One of the major obstacles in this journey appears to be in the area of pattern recognition of the mind signals, considering the limited understanding of a user's brain and its electrical activities, since the accuracy of a mind signal detection could be degraded as the number of mind states increases, such as when the user thinks about a series of words to implement a task. In this paper a system was proposed that includes an enabler for controlling gadgets based on signal analysis of brain activities transmitted from the enabler to the gadget. The enabler could be inserted in the user's ear andincludes a recorder that records brain signals. A processing unit of the system commands the device based on decoding the recorded brain signals. The proposed enabler could provide a compact, convenient, and hands-free device to facilitate a brain-machine interface to control the gadget from electroencephalography signals in the user's brain.

One of the frameworks for human's emotions recognition, which is the computational model, was discussed along with its methods and its implementation. The computational model works by extracting data from one's facial expression; to do so, it uses a unique algorithm to get the right extraction. It will then be matched with the dataset through the use of classifiers to recognise the mental state of a person. Finally, it will objectify the data and present the results in a mathematical way

Having said that, it can be concluded that the computational model, is one of the most popular frameworks in recognising one's mental states. This model can then be applied in many practical applications such as the autism syndrome diagnosis system, which can help clinicians in making decision about one's health condition by objectifying the data from human's facial expression extraction. The development of the mind reading computer is very crucial.

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