TEQZONE

2021-2022

Institute Vision

To be a Global Leader in imparting Quality Technical Education to produce Competent, Technically Innovative Engineers imbibed with Research Aptitude, Entrepreneurship and Social Responsibility.

Institute Mission

1.To nurture the Students with Fundamental Engineering Knowledge enriched with Technical Skills.

2.To create Conducive Environment to nurture Innovation and Interdisciplinary Research.

3.To develop Professionals through Innovative Pedagogy focusing on Individual Growth, Discipline, Integrity, Ethics and Social Responsibility.

4.To foster Industry-Institution Partnerships Leading to Skill Development and Entrepreneurship.

DEPARTMENT VISION

To be a center for academic Excellence in Computer Science and engineering Education, Research and Consultancy

Contributing Effectively to meet industrial and social needs

DEPARTMENT MISSION

i. To Impart quality technical education with global standards.

ii. To Provide a platform for harnessing Industry oriented technical skills with inter – disciplinary research awareness.

iii. To Promote entrepreneurship and leadership qualities imbibed with professional ethics

ABOUT DEPART MENT

The Department of Computer Science and Engineering offers 4 year Degree which is established in the year 2007 with intake of 60 seats in CSE. It is approved by AICTE and Affiliated to JNTUA, Anantapur. In 2011 post graduate programe (M.Tech) in Computer Science & Engineering is introduced with an intake 18 seats. An additional intake of 6 seats was incorporated in 2013, total intake of M.tech program reaches to 24 seats. The course is flexible and has been structured to meet the evolving needs of the IT industry. Since the Management of this college includes the highly educated persons, it understands the value of the latest applications. employees or to turn as employers by taking up

Program Educational Objectives (PEO)

PEO1: Graduates of the Program will have Strong fundamental knowledge in Computer Science & Engineering, technical competency and problem-solving skills to develop innovative solutions.

PEO2: Graduates of the Program will have Necessary domain knowledge and successful professional career in IT and allied fields of Computer Science & Engineering.

PEO3: Graduates of the Program will have Ability to pursue higher education and Entrepreneurship.

PEO4: Graduates of the Program will haveNecessary skills for lifelong learning, teamwork and research to cater for real time needs of industry and society.

Programme Specific Outcomes (PSOs)

PSO1: Apply Software Engineering Principles and Practices to provide software solutions.

PSO2: Design and Develop Network and Mobile based applications.

PSO3: Design innovative algorithms and develop effective code for business applications.

ACKNOWLEDGEMENT

We extend our sincere thanks to ....

Honorable   Chairman

Dr. K.V. Subba Reddy

Secretary &correspondent

Smt. S. VijayaLakshmamma

Principal

Dr. L. Thimmaiah

HOD

Dr. C.Md Gulzar

All our staff members for their humble

Co- operation and involvement in their creation of bytes,

For the year 2021-2022

Message from the Chair man

Its been a real pleasure to know that the Department of CSE is hosting their first ever National Level Technical Symposium “TEQZONE”, AND I’ am glad to hear that it is being organized wholly for the students with guidance of the staff members. Such combined effort is always encouraged and bring out good results.

The Department of computer Scince and Engineering has always conducting activities which helps in Development of students into leaders, I hope TEQZONE2021 is a huge success and adds a new star in the history of the department

With Regards

Dr. K .V. Subba Reddy,

Founder – Chairman,

Dr. K.V. Subba reddy Institute of Technology,

kurnool- 518218,

Message from the Correspondent

I feel very proud that the Department of CSE is Organizing a national level technical symposium “TEQZONE” on 2021.

The 21st century is advancing rapidly by multipronged scientific inventions and discoveries in that the Computer Science and Engineering is playing the vital role in all scientific developments. The has Com that without Computer Science Engineering nothing is going to move I this universe. In this perspective the contribution the development of society by this department is vital in all sphere of life.

I heartily wish the staff and students of the department in their endeavor to bring in a house magazine which will otherwise contribute to the highest learning of this magnificent engineering.

With Regards

Secretary &correspondent

Smt. S. VijayaLakshmamma,

Dr. K.V. Subba reddy Institute of Technology,

kurnool- 518218,

Message from the Principal

In the ever changing field of technical education, technology is moving at a very fast pace. What was break through yesterday is obsolete today. This has made it improve that future technocrats must be familiar not only with technical skills but also With the technology of tomorrow . I hope young engineers passing from this instigation will create difference in Indian and global scenario.

I expect my Students to be sincere in their work . They should have never give up attitude and unquenchable thirst of know ledge. I am sure that this magazine will provide platform to students to sharpen their skills.

With Regards

Dr . L. Thimmaiah,

Principal

Dr. K.V. Subba Reddy Institute of Technology,

Kurnool- 518218,

Message from the HOD

I wish that this seminar provides an opportunistic forum and vibrant platform for the engineers to share their original research work and practical development experiences and emerging issues.

With Regards

Dr. C. Md Gulzar,

CSE-HOD

Dr. K.V. Subba Reddy Institute of Technology,

Kurnool- 518218,

ABOUT COLLEGE

This institution was established in the year 2007 by Dr. K.V . Subba Reddy, Chairman, Dr. K.V . Subba Reddy ,Chairman, Group of institutions and his wife Smt. S. Vijaya Lakshmamma correspondent K.V. Subba Reddy group of institutions with an altruistic motive of providing deserved technical education to the students with humble education background . Dr. K V SRIT is located at Dupadu Village , On highway NH-44 to words Kurnool to Bangalore, in a sprawling area spreading over 40 acres admist lush green fields the scenic landscape and the serene environment is absolutely conductive for academic pursuits . The institute which is 9km away from Kurnool city can be reached by bus or auto The institute offers 5 UG Programs in CSE, ECE, EEE, ME and CE and five PG Programs in MBA, MTech (ECE), MTech(EEE) MTech (CE) MTech (CSE) , The Institution Has registered considerable growth in terms of infrastructure with untiring efforts of management , the departments are accommodated with highly qualified and experienced faculty members. The institute is marching a head by imparting quality technical education with an objective of producing young engineers and managers endowed with dynamic skills and prudence to meet their future chalanges . For more details visit WWW.drkvsrit.in.

Student Articles

Neuro Chip

Neurochip based on Light-Addressable Potentiometric Sensor(LAPS), whose sensing elements are excitable cells, can monitor electrophysiological properties of cultured neuron networks with cellular signals well analyzed. Here we are highlighting a kind of neurochip with rat pheochromocytoma (PC12) cells hybrid with LAPS and a method of de-noising signals based on wavelet transform. Cells were cultured on LAPS for several days to form networks, and we then used LAPS system to detect the extracellular potentials with signals de-noised according to decomposition in the time-frequency space. The signal was decomposed into various scales, and coefficients were processed based on the properties of each layer. At last, signal was reconstructed based on the new coefficients. The results show that after de-noising, baseline drift is removed and signal-to-noise ratio is increased. It suggests that the neurochip of PC12 cells coupled to LAPS is stable and suitable for long-term and non-invasive measurement of cell electrophysiological properties with wavelet transform, taking advantage of its time-frequency localization analysis to reduce noise

Introduction:

Until recently, neurobiologists have used computers for simulation, data collection, and data analysis, but not to interact directly with nerve tissue in live, behaving animals. Although digital computers and nerve tissue both use voltage waveforms to transmit and process information, engineers and neurobiologists have yet to cohesively link the electronic signalling of digital computers with the electronic signalling of nerve tissue in freely behaving animals.

Recent advances in micro-electro-mechanical systems (MEMS), CMOS electronics, and embedded computer systems will finally let us link computer circuitry to neural cells in live animals and, in particular, to re-identifiable cells with specific, known neural functions. The key components of such a brain-computer system include neural probes, analog electronics, and a miniature microcomputer. Researchers developing neural probes such as sub- micron MEMS probes, micro clamps, microprobe arrays, and similar structures can now penetrate and make electrical contact with nerve cells with out causing significant or long-term damage to probes or cells.

Researchers developing analog electronics such as low-power amplifiers and analog-to-digital converters can now integrate these devices with micro- controllers on a single low-power CMOS die. Further, researchers developing embedded computer systems can now incorporate all the core circuitry of a modern computer on a single silicon chip that can run on miniscule power from a tiny watch battery. In short, engineers have all the pieces they need to build truly autonomous implantable computer systems.

Until now, high signal-to-noise recording as well as digital processing of real-time neuronal signals has been possible only in constrained laboratory experiments. By combining MEMS probes with analog electronics and modern CMOS computing into self-contained, implantable microsystems, implantable computers will free neuroscientists from the lab bench.

INTEGRATING SILICON and NEUROBIOLOGY

Neurons and neuronal networks decide, remember, modulate, and control an animals every sensation, thought, movement, and act. The intimate details of this network, including the dynamic properties of individual neurons and neuron populations, give a nervous system the power to control a wide array of behavioural functions.

The goal of understanding these details motivates many workers in modern neurobiology. To make significant progress, these neurobiologists need methods for recording the activity of single neurons or neuron assemblies, for long timescales, at high fidelity, in animals that can interact freely with their sensory world and express normal behavioral responses.Conventional techniques

Neurobiologists examine the activities of brain cells tied to sensory inputs, integrative processes, and motor outputs to understand the neural basis of animal behavior and intelligence. They also probe the components of neuronal control circuitry to understand the plasticity and dynamics of control. They want to know more about neuronal dynamics and networks, about synaptic interactions between neurons, and about the inextricable links between environmental stimuli and neuronal signalling, behavior, and control.

To explore the details of this biological circuitry, neurobiologists use two classes of electrodes to record and stimulate electrical signals in tissue

intracellular micropipettes to impale or patch- clamp single cells for interrogation of the cells internal workings, and

Extracellular wires or micro machined probes for interrogating multisite patterns of extra- cellular neural signalling or electrical activity in muscles.

Neurobiologists use amplifiers and signal generators to stimulate and record to and from neurons through these electrodes, and signal-processing systems to analyse the results. They have used these techniques for decades to accumulate a wealth of understanding about the nervous system. Unfortunately, to date, most of these experiments have been performed on slices of brain tissue or on restrained and immobilized animals, primarily because the electronic instruments required to run the experiments occupy the better part of a lab bench.

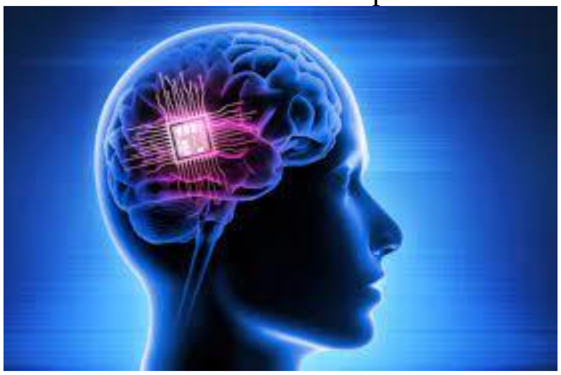
This situation leaves neurobiologists with a nagging question: Are they measuring the animals nor mal brain signals or something far different? Further, neurobiologists want to understand how animal brains respond and react to environmental stimuli. The only way to truly answer these questions is to measure a brains neural signalling while the animal roams freely in its natural environment.

SALIENT OBJECTIVES

The solution to these problems lies in making the test equipment so small that a scientist can implant it into or onto the animal, using materials and implantation techniques that hurt neither computer nor animal. Recent developments in MEMS, semi-conductor electronics, embedded systems, bio compatible materials, and electronic packaging finally allow neuroscientists and engineers to begin packaging entire neurobiology experiments into hardware and firmware that occupy less space than a human fingernail.Researchers call these bioembedded systems neurochips. Scientists from the University of Washing-ton, Caltech, and Case Western Reserve University have teamed to build these miniaturized implantable experimental setups to explore the neural basis of behavior.

This research effort has developed or is in the process of developing the following:

Miniaturized silicon MEMS probes for

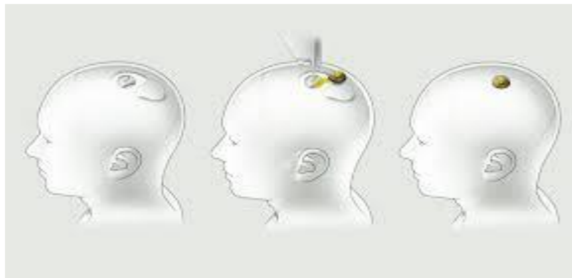


recording from the insides of nerve cells;

biocompatible coatings that protect these probes from protein fouling;
a stand-alone implantable microcomputer that records from and stimulates neurons, sensory pathways, or motor control pathways in an intact animal, using intracellular probes, extra- cellular probes, or wire electrodes;
neurophysiological preparations and techniques for implanting microchips and wire electrodes or MEMS probes into or onto animals in a way that does not damage the probes or tissue;
firmware that performs real-time biology experiments with implanted computers, using analytical models of the underlying biology; and
software to study and interpret the experimental results, eventually leading to reverse- engineered studies of animal behavior.
As the Neuroscience Application Examples sidebar shows, the first neurochip experiments use sea slugs and moths in artificial environments, but broad interest has already arisen for using implantable computers in many other animals.

DESIGNER NEUROCHIPS

Like their bench top experimental counterparts, neurochips use amplifiers to boost low-voltage biological signals, analog-to-digital converters (ADCs) to digitize these signals, microcomputers



CONCLUSION:
The invention of Neuro chip implant technology is boon for patients with neurological diseases its revolution in
the field of engineering and neuro science. Brain chip technology which involves communication based on neural activity of brain. The results are spectacularly wonderful and unbelievable. The advantage of brain chips with nano technology will allow researchers for smaller and superior chips making brain chips technology less burdens some and more reliable option for people. More effective for restoring limbs function of patients. Rehabilitations for patients. Finally, it has amazing endless advantages.

K. SAMSON PAUL
ASSISTANT PROFESSOR
CSE DEPARMENT

The Eye gaze System

The Eye gaze System is a communication and control system for people with physical disabilities. The Eye gaze System is a direct-select vision-controlled communication and control system. By looking at control keys displayed on a screen, a person can synthesize speech, control his environment (lights, appliances, etc.), operate a telephone, type, operate the computer mouse and browse the internet. Eyegaze Systems are being used to write books, attend school and enhance the quality of life of people with disabilities all over the world. Eyegaze Systems are being used in homes, care facilities, hospitals, offices, and schools.

Sophisticated image-processing software in the Eyegaze System continually analyses the video image of the eye and determines where the user is looking on the screen. Eyegaze communication is a potential porthole into current cognitive processes and communication through the direction of eyes which is faster than any other mode of human communication.

Suggested Read:

Blue Eyes Technology
Blue Brain
Introduction

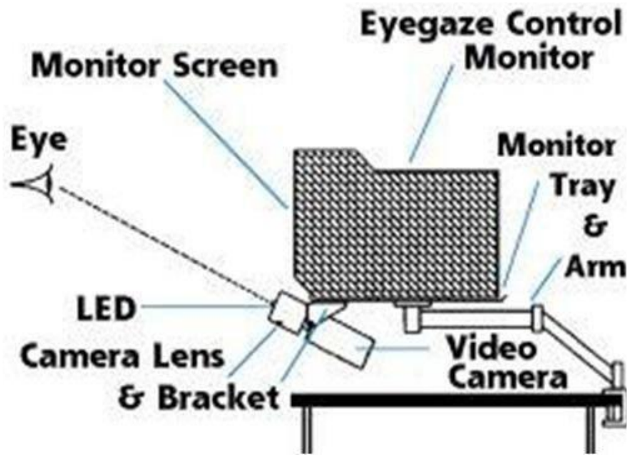
Imagine yourself being an intelligent, motivated, and working person in the fiercely competitive market of information technology, but just one problem you can't use your hands. Or you can't speak. How do you do your job? How do you stay employed? You can, because of a very good gift from computer Industry: The Eyegaze, a communication & control system you run with your eyes. It was developed in Fairfax, Virginia, by LC Technologies, Inc.

The Eyegaze System is a boon for the people with physical disabilities. It helps them to connect with the real world and other people. It provides an easy interface to operate, interact, and to perform computations. This system is mainly developed for those who lack the use of their hands or voice. Only requirements to operate the Eyegaze are control of at least one eye with good vision & ability to keep head fairly still.

A person belonging to any age group can use this system. Mostly people suffering from diseases such as cerebral palsy, spinal cord injuries, brain injuries, Amyotrophic Lateral Sclerosis, multiple sclerosis, brainstem strokes, muscular dystrophy etc use Eyegaze systems.

Working:

The following video explains how an eyegaze system works. It shows how a person with physical disabilities can operate the system.As a user sits in front of the Eyegaze monitor, a specialized video camera mounted below the monitor observes one of the user's eyes. The user operates the Eyegaze System by looking at rectangular keys that are displayed on the control screen. To "press" an Eyegaze key, the user looks at the key for a specified period of time. The gaze duration required to visually activate a key, typically a fraction of a second, is adjustable. An array of menu keys and exit keys allow the user to navigate through the Eyegaze programs independently.



Working of the Eyegaze System
Sophisticated image-processing software in the Eyegaze System's computer continually analyzes the video image of the eye and determines where the user is looking on the screen. Nothing is attached to the user's head or body.

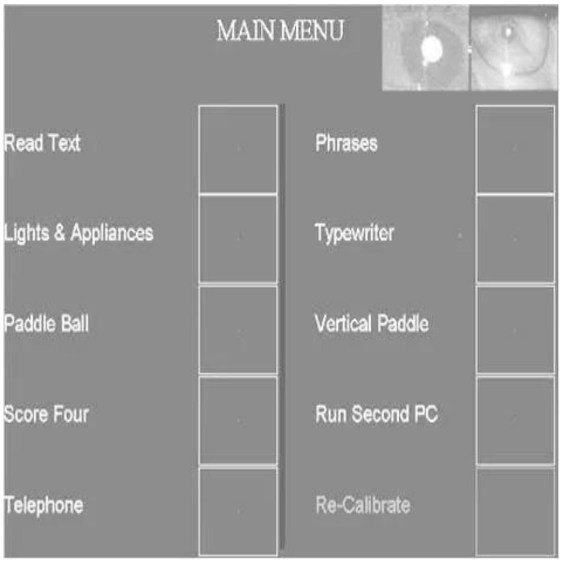
In detail the procedure can be described as follows:

The Eyegaze System uses the pupil-center/corneal-reflection method to determine where the user is looking on the screen. An infrared-sensitive video camera, mounted beneath the System's monitor, takes 60 pictures per second of the user's eye. A low power, infrared light emitting diode (LED), mounted in the center of the camera's lens illuminates the eye. The LED reflects a small bit of light off the surface of the eye's cornea. The light also shines through the pupil and reflects off of the retina, the back surface of the eye, and causes the pupil to appear white. The bright-pupil effect enhances the camera's image of the pupil and makes it easier for the image processing functions to locate the center of the pupil. The computer calculates the person's gazepoint, i.e., the coordinates of where, he is looking on the screen, based on the relative positions of the pupil center and corneal reflection within the video image of the eye. Typically the Eyegaze System predicts the gazepoint with an average accuracy of a quarter inch or better.

Prior to operating the eye-tracking applications, the Eyegaze System must learn several physiological properties of a user's eye in order to be able to project his gazepoint accurately. The system learns these properties by performing a calibration procedure. The user calibrates the system by fixing his gaze on a small yellow circle displayed on the screen and following it as it moves around the screen. The calibration procedure usually takes about 15 seconds, and the user does not need to recalibrate if he moves away from the Eyegaze System and returns later.

Menus of the Eyegaze System: The main menu:

The Main Menu appears on the screen as soon as the user completes a 15-second calibration procedure. The Main Menu presents a list of available Eyegaze programs as shown in the below figure.



The user calls up the desired program by looking at the Eyegaze key next to his program choice.

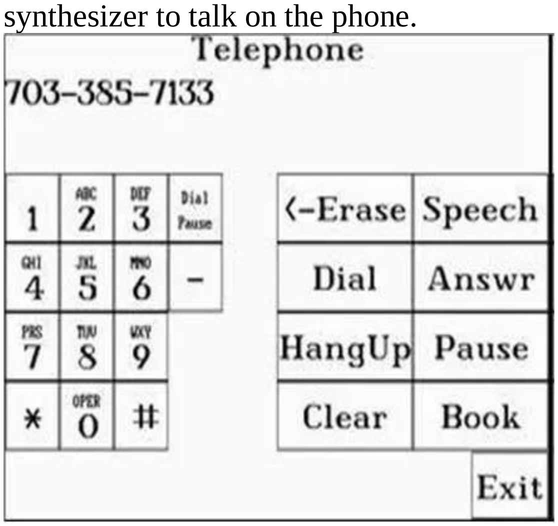
VI. Menu Options:

The Phrase Program:

Phrases include Hello, goodbye, how are you? where have you been, what are you doing, talk to me, I am not well etc. Along with the speech synthesizer, provides quick communications for non-verbal users. Looking at a key causes a preprogrammed message to be spoken. The Phrases program stores up to 126 messages, which can be composed and easily changed to suit the user.

The telephone program:

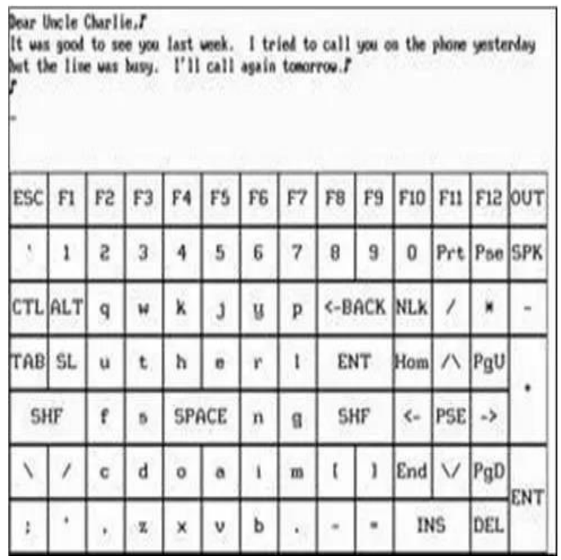
The telephone program allows the user to place and receive calls. Frequently used numbers are stored in a telephone "book". Non-verbal users may access the speech synthesizer to talk on the phone.



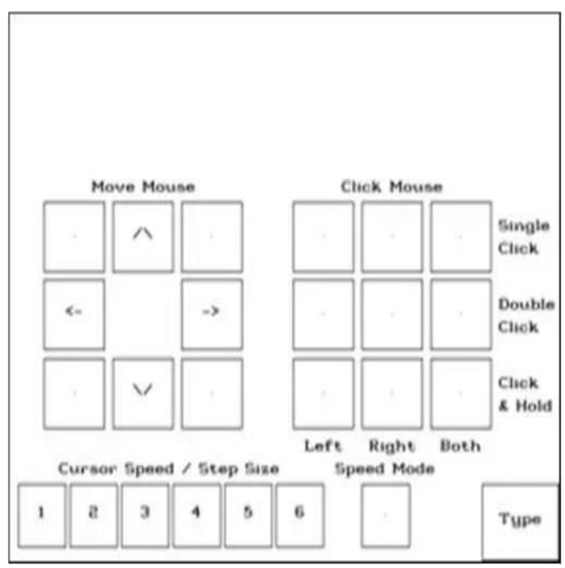
Telephone Menu

Run Second PC:

The Run Second PC program permits the Eyegaze Communication System to act as a peripheral keyboard and Mouse interface to a Windows computer. The user can run any off-the-shelf software he chooses on the second computer. He can access the Internet, and send an email by looking at keyboard and mouse control screens on the Eyegaze monitor. The programs being run are displayed on the second computer's monitor. Typed text appears simultaneously on the Eyegaze and second PC's screens.



Keyboard controlled screen



Mouse Controlled Screen

Mouse controlled screen For children, Two new Eyegaze programs have been added to the Eyegaze System. Both run with the Second PC option. Eye Switch is a big, basic On-screen switch to run “cause & effect” software programs on a Second PC. Simple Mouse is an easy mouse control program to provide simplified access to educational software on a Second PC.

The Lights & appliances Program:

The Lights & appliances Program which includes computer-controlled switching equipment provides Eyegaze control of lights and appliances anywhere in the home or office. No special house wiring is necessary. The user turns appliances on and off by looking at a bank of switches displayed on the screen.

Paddle games & Score Four:

These are the Visually controlled Games.

Read Text Program:

The Read Text Program allows the user to select text for display and to “turn pages” with his eyes. Any ASCII format text can be loaded for the user to access. Books on floppy disk are available from Services for the Blind.

Television:

Television programs can be displayed directly on the desktop Eyegaze System screen. On-screen volume and channel controls provide independent operation. (Not available on the Portable Eyegaze System.)

Different Eyegaze systems available:

Environment required for Eyegaze System:

Because eye-tracking is done using infrared light.Eyegaze system must take care of light sources in the room in order to ensure the best accuracy. The Eyegaze System must be operated in an environment where there is limited to ambient infrared light. Common sources of infrared light are sunlight and incandescent light bulbs. The System makes its predictions based on the assumption that the only source of infrared light shining on the user’s eye is coming from the center of the camera. Therefore, stray sources of infrared may degrade the accuracy or prevent Eyegaze operation altogether. The System works best away from windows, and in a room lit with fluorescent or mercury-vapor lights, which are low in infrared.

Uses of an Eyegaze System:

A. The Basic Eyegaze Can:

Easier to adjust the settings for all kinds of users. (Calibration)

TYPE with one of four keyboards, then print or speak. (Typewriter)
TURN pages on the computer screen by looking at ,up or ,down. (Read Text)
PLAY games, two "Paddle" games, plus Solitaire and Slot Machine.
TEACH new users with simplified screens. (Teach Screens)
B. With Options The Eyegaze Can:
BE at TWO SITES! The portable computer has a handle to hand-carry between two sites. Two sets of other components and cables for access to Eyegaze System at school, work or home. Dimensions 9″x5'txl7'1, weight approximately 16 lbs. (Transportable Computer)
BE A KEYBOARD to a second computer to run any keyboard-controlled software, by means of the T-TAM connector. (Second Computer Mode)
SPEAK 100 ,canned phrases through a speech synthesizer, with a single glance of the eye. Phrases can be changed by caregiver or user. (Phrases)
CONTROL appliances anywhere in the home or office from one Eyegaze screen. No special wiring. (Lights and Appliances)
DIAL and answer a speaker phone from one screen. Phone Bookstores 16 frequently used numbers. (Telephone)

Conclusion:

Today, the human eye-gaze can be recorded by relatively unremarkable techniques. This thesis argues that it is possible to use the eye-gaze of a computer user in the interface to aid the control of the application. Care must be taken, though, that eye-gaze tracking data is used in a sensible way, since the nature of human eye-movements is a combination of several voluntary and involuntary cognitive processes.

Today is the era of high technology and information exchange world. Everyone is in need of sending or downloading a huge amount of data. Further being connected on the go and all the time is what people want today. Broadband and wireless connectivity in homes and offices is what being used by users that keep them wire free and make the accessibility easy and fast. Further to this providing a robust, fast and reliable connectivity network to the people on the go in vehicles and even aircraft is a challenge. In this paper we explore such a technology that talks about connectivity in aviation and aircrafts i.e. Airborne Internet. The idea is to take all the facilities and implementation of the ground networks and provide a high speed network connecting aircraft and ground.

Shaik Naheda (19FH1A0514)
II-II (CSE)

System in Package (SiP) Assembly and Reliability

This paper presents assembly challenges and reliability evaluation of 2.5D (aka, System in Package [SiP]) in fine pitch ball grid array (FPGA). The SiP test vehicles were configured with centrally located integrated circuits (IC) surrounded by eight chip scale packages (CSPs). The ICs and CSPs with either tin-lead (SnPb) or SAC305 balls were assembled onto a fine pitch ball grid array (FPGA) interposer for subsequent assembly into a hybrid configuration. Mix assembly becomes a challenging task and required to be characterized by X-ray for solder-joint quality and by Shadow Moiré analysis for warpage characterization. Acceptable assemblies were then subjected to thermal cycling between -40°C and 125°C for reliability evaluation and failure mechanisms assessment. The paper presents details of design, characterization by X-ray and Moiré, as well as reliability behavior of the SiP due to thermal cycling exposures. Failure analyses results also presented covering evaluation by optical, scanning electron microscopy (SEM), X-sectioning, and dye-and-pry methods.

Stack packaging—more than Moore's Law (MtM)—has now been widely implemented for use to increase the capabilities of commercial electronics because of increasing cost and limitation of die fabrication with finer features . Moore's Law, stating that the number of transistors on a given chip will double every two years (or even shorter, 18 months), has been substantiated by package implementations throughout the past several decades. The exponential growth for die density has allowed computers and electronic communication devices to become cheaper and more powerful simultaneously. However, the die density growth has slowed significantly. Recently, Intel's chief technologist stated that “Moore's Law is about integration for lower cost-per-function, and it continues —but we don't get to pick the technology that enables it anymore.” This is alluding to new materials, devices, and packaging methods.

A system in package, or SiP, is a way of bundling two or more ICs inside a single package. This is in contrast to a system on chip, or SoC, where the functions on those chips are integrated onto the same die.

SiP has been around since the 1980s in the form of multi-chip modules. Rather than put chips on a printed circuit board, they can be combined into the same package to lower cost or to shorten distances that electrical signals have to travel. Connections historically have been through wire bonds.

While SiP saw limited adoption in its earliest forms, there has been much work done on improving this concept recently with 2.5D and 3D-ICs, as well as package-on-package and flip-chips. There are several key drivers for these changes:

1. Analog IP doesn’t shrink as easily as digital circuits from one process node to the next, making it extremely time-consuming and costly to move IC designs from one process node to the next in accordance to Moore’s Law. Being able to shrink just the digital portions and keep analog at older process geometries is increasingly attractive, but it also requires some sophisticated communication between dies.

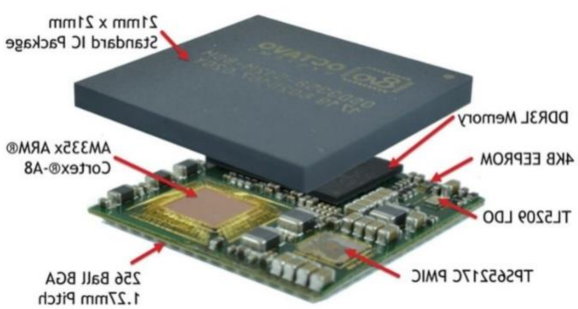
2. Shrinking features and adding more functionality onto semiconductors requires longer and thinner wires, which increases the time it takes for signals to move around a chip. By packaging different chips together, connected through an interposer or

through-silicon via, those signals can be speeded up using shorter wire distances and wider conduits.

3. The need to extend battery life in mobile devices will require ways of reducing the amount of power needed to drive signals. Reducing the distances that signals have to travel, particularly in and out of memory, and increasing the width of the conduits, have a direct effect on the amount of energy expended to drive signals.

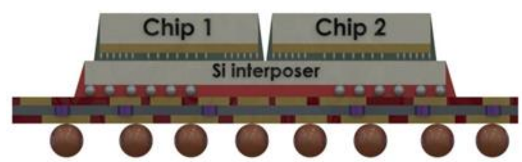
Introduction to System in Package (SiP)

System in Package (SiP) is a method used for bundling multiple integrated circuits (ICs) and passive components into a single package, under which they all work together. This contrasts to a System on Chip (SoC), whereas the functions on those chips are integrated into the same die.



Silicon dies containing different circuits based on various process nodes (CMOS, SiGe, BiCMOS) may be stacked vertically or side by side on a substrate. The package consists of an internal wiring that connects all the dies together into a functional system. Wire bonding or bumping technologies are typically used in system in package solutions.

A System in Package is similar to a System-on-a-Chip, but it is less tightly integrated, and it is not made using a single semiconductor die. A common SiP solution may make use of multiple packaging technologies, such as flip chip, wire bonding, wafer-level packaging, etc.
The variable number of integrated circuits and other components enclosed in system in package is in theory unlimited, therefore, engineers can essentially and integrate an entire system into a single package.



Benefits of System in Package

The main difference between SiPs and SoCs is that the SoC incorporates every single component needed on the same die, whereas the SiP approach takes heterogeneous components and connects them into one or more chip carrier packages.
For example, an SoC would integrate the CPU, GPU, memory interfaces, HDD and USB connectivity, RAM/ROM and/or their controllers on a single silicon, which then gets packaged into a single chip. In contrast, an equivalent SiP would take the separate dies from different process nodes (CMOS, SiGe, High Power), connect and combine them into a single package onto a single substrate (PCB). With this in mind, it is easy to see that SiPs have a lower degree of

integration when compared to similar SoCs, and, as a result, adoption of SiPs has been slowMore recently though, advancements made in 2.5D and 3D ICs, flip chip technology, and package on package technology have shone a new light on the possibilities offered by using a SiP.

There are a couple of major elements that drive this current trend of replacing SoCs with SiPs:

Analog blocks don't benefit from lower process integration. Because of this and due to the increased complexity of trying to keep the analog blocks on sperate process technology (BCD,BiCMOS, SiGe) this makes SiPs as more attractive option for shrinking system size.

External devices such as antenna, MEMS sensors, passive component (for example: large inductors) cannot fit into an SoC. Therefore, engineers need to use SiP technology in provide their customer with a complete solution.

Delivering of modules instead of chips is a trend that started due to wireless applications (such as Bluetooth module) to help customers reach to market quickly without the need to design from scratch. Instead they use a SiP module that consists of an entire system.

Apart from the factors mentioned above, SiPs offer even more advantages as follows:

Miniaturisation – One highly impactful element of semiconductor manufacturing is the ability to constantly miniaturise them. This fact is increasingly important in the new era of IoT devices and gadgets. But when only a couple of components can be shrunk down in a system, things get increasingly difficult to maintain. Here SiP shines, as it can offer better die integration and closer passive integration. In this way, SiP methodology can reduce the overall size of a given system by as much as 65%.

Cost reduction – Usually accompanying miniaturisation, cost reductions are a welcome side effect, though limited in certain cases of SiPs. The cost savings begin showing up when economies of scale are applied for high volume components, but they are not limited to that. Other factors that can influence the cost are assembly costs, PCB design costs, and the discrete BOM (Bill Of Materials) overhead, which can all be greatly affected depending on the system.

Simplification – SiP methodology allows silicon designers to work with more abstract building blocks, giving them the advantage of higher turn-over rates and an overall smaller design cycle. In addition, the BOM gets simplified as well, thus reducing the need for testing already proven blocks.

Yield and manufacturability – Being a constantly evolving concept, manufacturability and yield can be substantially improved if SiP expertise is used efficiently, from mold compound selection, substrate selection, and thermo-mechanical modelling.

Reliability – Due to the fact that SiP are very similar to a PCB system using discrete components, such as ICs or passive devices, they have at least the same expected failure probability. The extra reliability comes from the packaging involved, which can strengthen the system and provide a longer usable lifetime for the device. One example is the use of molding to encapsulate the system, thus protecting solder joints from physical stresses.

Antenna integration – in many wireless applications (Bluetooth, WiFi) an antenna is required. In s System in Package solution, an antenna can be integrated into the package with very short distance to the RF IC – ensuring higher performance of the wireless solution.

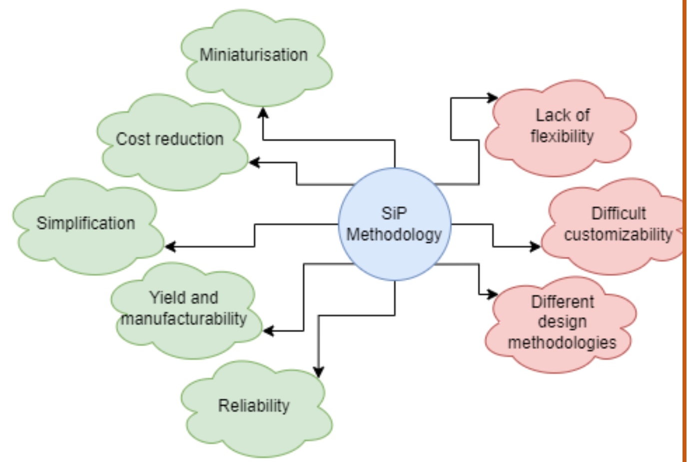
For a complete view though, we have to acknowledge that SiPs can have some drawbacks, as well. Here are some major disadvantages that need to be taken into consideration before picking SiP as the design philosophy:

Lack of flexibility – Owing to the fact that SiPs are systems, not components, they are application-dependent and are more application-specific than a comparable SoC. As such, the economies of scale associated with the production of high-volume SoCs is not found in the case of SiPs. This also translates into another problem: how to apply high-volume production techniques to low-volume components for SiPs?

Difficult customizability – Even though SiPs are made from discrete components which can be changed very quickly to accommodate changes at the design level, the same thing cannot be said about the major backbone components of SiPs, such as the substrate or interconnect systems. These are usually very expensive and time consuming to redesign for a new revision. The ideal case is to have the flexibility of SiP with the economies of scale of an SoC.

Different design methodology – Seeing as SiP design rules imply a focus on the integration part more and the combining of different components rather than focusing on one new monolithic component, this implies changes in the role of component design as well. With this in mind, components need to be developed with a SiP-ready mindset rather than standalone components, like it is in the case of SoCs.

weather conditions and to be cheaply exchanged in the case of failure.



Conclusion

But what does the ultimate SiP look like? In theory, it should be a standalone component with zero connections to the outside. It is a custom component that perfectly suits the job it was meant to do, all the while requiring no external physical connections for communications or power. It should be able to generate or harvest its own power, function autonomously, and communicate wirelessly with an information system. Also, it should be relatively cheap and resistant to the elements, allowing it to function in most

With demand for more and more simplification and system-level integration, the components of today will become the SiP-ready components of tomorrow, while the SiPs of today will become Sub-System in Packages (SSiPs). SiP-ready components and SSiPs will then be integrated into larger SiPs as system integration drives SiP technology ever closer to the final goal: the ultimate SiP.

A.Fasi Ahmed (19FH1A0530)

II-II (CSE)

Neural Interfacing Net

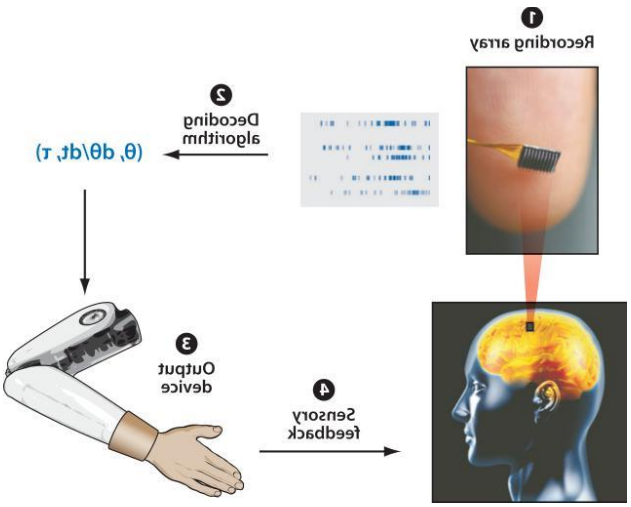
Bushra Tahseen (Assistant Professor)

The ultimate goal of neural interface research is to create links between the nervous system and the outside world either by stimulating or by recording from neural tissue to treat or assist people with sensory, motor, or other disabilities of neural function. Although electrical stimulation systems have already reached widespread clinical application, neural interfaces that record neural signals to decipher movement intentions are only now beginning to develop into clinically viable systems to help paralyzed people. We begin by reviewing state-of-the-art research and early-stage clinical recording systems and focus on systems that record single-unit action potentials. We then address the potential for neural interface research to enhance basic scientific understanding of brain function by offering unique insights in neural coding and representation, plasticity, brain-behavior relations, and the neurobiology of disease. Finally, we discuss technical and scientific challenges faced by these systems before they are widely adopted by severely motor-disabled patients.

Keywords: brain-machine interface, neural prosthesis, multielectrode array, decoding, motor cortex

Introduction

Research to develop systems that can help restore sensory function, communication, and control to impaired humans is coalescing into a new branch of experimental neuroscience, variously named brain-machine interfaces (BMIs), brain-computer interfaces (BCIs), neural prostheses, or neural interface systems (NISs). This emergence is evidenced by the dramatic increase in the number of publications and presentations related to NISs in neuroscientific journals and conferences. NISs have captured the broader public imagination by providing the possibility of freeing ourselves from the limitations of our bodies by forming a direct interaction between the brain and the outside world. More importantly, NIS research offers the possibility of helping people with severe sensory and motor disabilities better interact with their world, thereby improving their quality of life. However, an important question that has often been raised by neuroscientists is whether this emerging area of research and technology can also provide fundamental scientific knowledge about nervous system function, especially in humans. Does NIS research legitimately constitute a scientific discipline within the neurosciences, or does it belong within a subfield of biomedical engineering such as neural engineering, which is focused mainly on producing useful technology? In this review, we begin with recent clinically relevant advances in NIS research, dealing mainly with neuromotor prosthesis studies that tie together basic and translational research using single neuron recordings. We then critically evaluate neuroscientific contributions that this emerging field is providing. We finish with our view of the future challenges in NIS research and its ability to advance neuroscience. Although we briefly discuss recent, promising developments in noninvasive, electroencephalogram (EEG)-based NISs, our emphasis in this review is invasive systems that rely on extracellular microelectrode recordings of action potentials (spikes) from neuronal populations.



CLINICAL APPLICATIONS

NIS research using multineuron recording sensors has now been translated from preclinical proof of concept to early-stage human clinical trials (Hochberg et al. 2006, Kennedy & Bakay 1998). The motivation for these trials is to create a device that can be used by individuals with movement impairment to regain control, communication, and independence. This advance also provides a new opportunity for long-term neurophysiological investigation in human cortex at the level of single and multiple neurons and local field potentials (LFPs), which has previously never been possible.

NISs are being created to help the large number of people who have limited movement abilities owing to damage or disease of the motor system. A number of disorders disconnect an otherwise healthy cerebral motor system from the muscles, leading to various degrees of paralysis but with retention of the ability to plan and imagine making movements. These conditions include trauma, such as spinal cord injury, which renders ~100,000 Americans tetraplegic; strokes, which interrupt descending motor pathways, with the most devastating being a pontine stroke, which can disconnect all descending control to produce a locked-in state; and degenerative disorders such as amyotrophic lateral sclerosis (ALS, or Lou Gehrig's disease), in which alpha motor neurons (and likely cerebral neurons) progressively die. Cerebral palsy, muscular dystrophy, and limb amputation may also lead to the inability to execute voluntary actions. In each case, muscle control by the brain is lost, while cerebral mechanisms to generate movement intentions could remain relatively intact (Enzinger et al. 2008, Shoham et al. 2001). Thus, an NIS may be a means to directly deliver motor commands from the brain to assistive technologies, bypassing the biological lesion to restore control and independence to those with paralysis. Assistive technologies are aids to function; they can include any device from a simple switch, a computer cursor, a robot, or an artificial limb. A neural command with sufficiently rich and stable information could be used to operate any of these devices. Neural signals could also be used to recouple the brain to the muscles through functional electrical stimulation (FES). An FES system converts command signals into stimulation trains, which the FES system uses to activate muscles (Peckham et al. 2002). With a neural command source, an FES system could allow movement intentions to produce arm movements once again, although the complexity of artificially coordinating the myriad of arm muscles used for normal human arm movements is daunting.

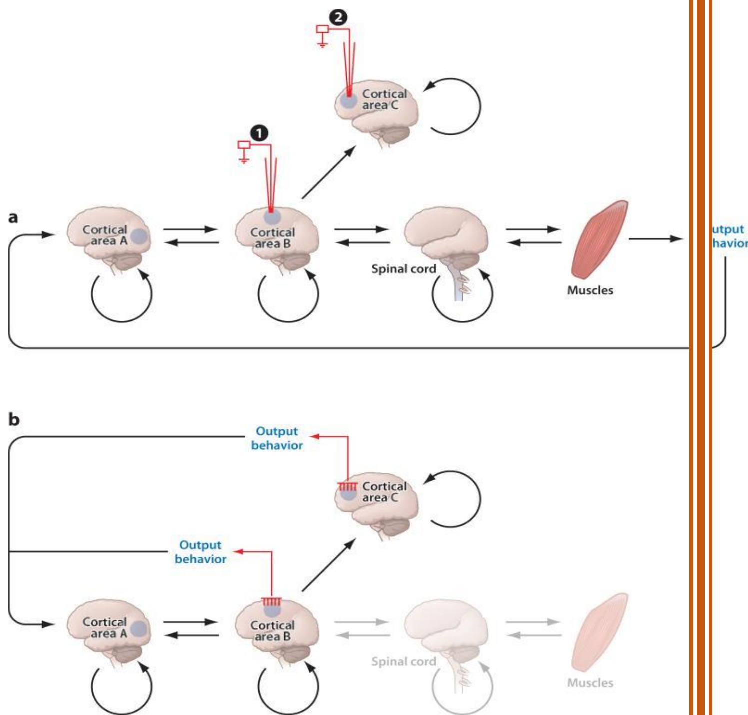
Like their preclinical counterparts, the clinical NIS must have a sensor for recording volitional signals, a decoding algorithm, an effector, and some form of feedback. Here, we emphasize those recently tested systems that are based on intracortical signals to derive commands because they establish a new link between human and nonhuman primate behavioral neurophysiology experiments. They provide insights into human neural processes not available from surface field potentials, which is the other main control signal source being tested for NISs (Birbaumer 2006). Kennedy (Kennedy et al. 2000, 2004; Kennedy & Bakay 1998) developed the first spike-based approach for NISs using a sensor of individually implanted microwires encased in glass cones so that neurites would grow into the cone and establish long-lasting connections to the nervous system. Using a few channels, humans with tetraplegia from stroke or degenerative disease showed that they could activate spiking or LFPs from cortical neurons to move a cursor.

An ongoing pilot study of the first human chronically implanted multielectrode array-based NIS has made several advances in recording, decoding, and demonstrating potential use of a pilot NIS system. This system, termed BrainGate, is based on spiking signals recorded from a 4 × 4 mm array of 100 Si microelectrodes in a fixed 10-by-10 arrangement placed within the motor cortex arm area. Studies to date utilizing four patients with tetraplegia have demonstrated participants' ability to produce two-dimensional cursor control that can be used to operate a computer and control a robot arm to perform simple grip and transport actions (Hochberg et al. 2006). These studies demonstrated that both spiking and LFPs remain in motor cortex and can be volitionally modulated in the absence of movement, years after spinal cord injury (Hochberg et al. 2006) or stroke (Kim et al. 2007b). Patterns of activity appear to be similar to those observed in intact monkeys when movement is actually performed. This demonstration, that MI displays similar activity when movement is imagined and performed, raises fundamental questions about the nature of neural activity in MI and provides a key finding necessary for any further development of spike-based NISs.

Control achieved by human participants using continuous control commands derived from linear decoders was quite similar to that achieved with the same algorithms in preclinical studies using able-bodied monkeys, discussed above (Carmena et al. 2003, Serruya et al. 2002, Taylor et al. 2002, Velliste et al. 2008). Improvements in the decoders using Kalman filters showed not only the ability to make smooth point-to-point movements, but also the ability to stop cursor motion and select targets by clicking on the basis of decoding an intended hand squeeze (Kim et al. 2007b). Using this improvement, a participant in three test sessions was able to point and click to one of eight screen targets, never selecting the wrong target and rarely (<4%) failing to make correct target selections. However, to achieve this success, movements were slow, taking 6.4 s, on average, to move from the middle of the screen to a target at the screen's edge and click on it. These initial findings suggest that practical NISs for humans with paralysis are feasible and that this field is on a path to improving independence, control, and in the case of locked-in persons, communication, which is otherwise severely limited.

DISTRIBUTED REPRESENTATIONS

Results from NIS studies have provided further support for highly distributed arm movement representations in the frontal and parietal cortices and have extended this knowledge to the human motor cortex. Despite clear evidence for functional specialization of movement planning and performance in motor, premotor, and parietal cortical areas (Andersen & Buneo 2002, Buneo & Andersen 2006, Luppino & Rizzolatti 2000), it has become evident from NIS experiments that large networks of neurons are active to various degrees even during simple movements. For example, neural interface studies have directly compared decoding performance from simultaneously recorded neuronal populations in various cortical areas including the ipsi- and contralateral primary motor (MI), dorsal premotor (PMd), supplementary motor (SMA), primary somatosensory (SI), and posterior parietal cortices (Carmena et al. 2003, Hatsopoulos et al. 2004, Wessberg et al. 2000). Investigators observed significant differences in decoding performance across different cortical areas that could help determine which area to implant for optimal NIS performance, but what is particularly surprising is the fact that all tested areas exhibited a certain degree of accurate arm-movement decoding performance. These results strongly support the view that ordinary forms of voluntary limb motor control recruit large numbers of neurons in distributed areas encompassing many regions of the frontal and parietal cortices.



Brain-Body Uncoupling

In a closed-loop NIS paradigm, it remains a mystery as to how a population of recorded neurons can be co-opted to control an artificial device without moving the limb, which was, under normal circumstances, moved by the activation of the same population. Several studies have documented the fact that monkeys that are exposed to an NIS paradigm will eventually stop moving or minimally move their own limbs when guiding the artificial device through cortical control (Carmena et al. 2003, Lebedev et al. 2005, Serruya et al. 2002, Taylor et al. 2002, Velliste et al. 2008). In all these cases, tiny movements or subthreshold activation of motor neurons could not be ruled out. However, what is impressive is that the original gross action that was used for control was substituted for another behavior, despite the involvement of a similar pattern of MI activity. Whether this change in behavior is a result of short-term plasticity, a newly learned motor pattern, or active inhibition of downstream cortico-spinal circuits remains untested. A lucid explanation of this phenomenon would have far-reaching implications for mechanisms underlying adaptation to novel control situations.

Mirror-Like Responses in MI

An effort to solve a problem inherent to NISs for motor-disabled patients led to advances in understanding fundamental response properties of neurons in motor cortex. Building a decoding mapping between neural ensemble activity and motor output requires collecting data in which neural activity and motor behavior are concurrently recorded, which is not possible for persons who are paralyzed. We recently discovered that passive visual observation of a familiar task can elicit responses in the primary motor cortex that closely resemble those observed when the animal actually performs the task (Tkach et al. 2007). Indeed, decoding filters were built for paralyzed persons while they observed computer-controlled motion of a cursor (Hochberg et al. 2006). However, unlike in our animal studies, the human participants were asked to imagine they were producing the cursor motion. Our recent discovery of mirror-like single neuron responses in the primary motor cortex was directly motivated by a desire to elicit motor cortical activity to build a neural interface mapping between neural activity and observed motion without explicit movement.

Recording in Chronically Injured Human Patients

Finally, clinical NISs have provided the opportunity to engage in cellular physiology in persons with injury and degenerative diseases. They have shown that neural spiking and LFP activity survive years after damage including transection of layer V pyramidal cell axons in the cord or the pons (Hochberg et al. 2006, Kennedy & Bakay 1998). Moreover, these studies have shown that tetraplegic persons can volitionally modulate MI activity in the absence of any ability to move. This result is surprising because a variety of animal and indirect human studies suggest that the motor cortex can reorganize rapidly in response to injury (Dancause et al. 2005, Donoghue et al. 1990, Giraux et al. 2001, Nudo 2006, Sanes et al. 1990), which apparently has not occurred in similar form in those studied so far. Thus, the results of these human studies have raised a number of issues related to the function of MI and the nature of cortical plasticity, including whether different mechanisms operate in humans and in other species or whether the types of injury or disease result in different types of functional responses.

FUTURE CHALLENGES AND OPPORTUNITIES

Technical Challenges

We believe important technical issues must be addressed as NISs become useful technologies for disabled patients. First, no multielectrode recording arrays have currently been fully verified to stably and reliably record action potentials from multiple single units for extended periods of time (i.e., over many years). Reliable chronic recording has been an area of considerable concern, although both cone electrodes (Kennedy et al. 1992a,b) and micro-electrode arrays can record for many months in monkeys (Suner et al. 2005) and humans (Kim et al. 2007b). We have sometimes encountered loss of recordings associated with complex connectors and faulty insulating materials in chronically implanted electrode arrays. Ongoing testing of advanced and improved versions of these sensors will be required to achieve long-term viability of implants.

A second important technical challenge for a long-term human NIS is the creation of a fully implantable system that can provide high-bandwidth information. A fully implantable sensor is necessary to eliminate cabling, which limits mobility, as well as the need for percutaneous connectors, which can present an ongoing infection concern. In addition, implantable systems have the advantage that they are hidden from view, improving the cosmetic appeal of such systems. Creation of high-channel count, high-bandwidth implantable systems, which are required for spiking signals, is complex particularly because initial signal processing must now be completed inside the body. Active electronics of this complexity are difficult to seal fully, can induce excess heat, and require power and wireless communication. Despite these formidable challenges, several groups are now developing these systems (Kim et al. 2007a, Patterson et al. 2004, Rizk et al. 2007, Song et al. 2005).

CONCLUSION

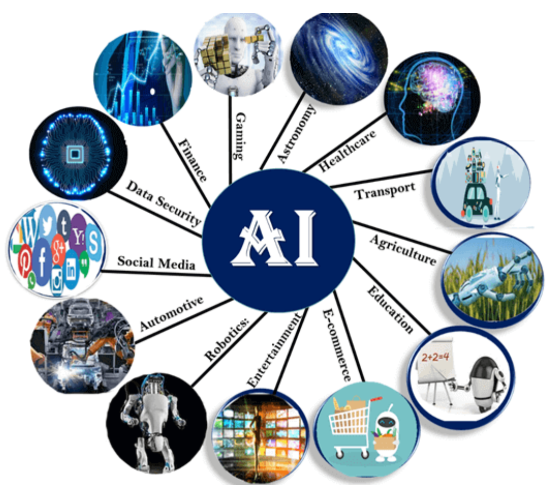
The creation of the NIS paradigm has been motivated by a desire to create devices to treat and recover functioning in patients with severe sensory and motor disabilities. Output NISs are now at the cusp of moving from research proofs of concept and pilot human clinical trials to useful devices as input NISs already have. We have demonstrated that this paradigm has also offered a unique framework for studying basic scientific problems in coding, representation, and plasticity in neuronal ensembles. As current and future challenges are addressed to create useful systems for patients, this field may further expand our networks

Ruksar Sultana (18FH1A0513)
IV-I (CSE DepT)

Application of Artificial Networks

Artificial Intelligence has various applications in today's society. It is becoming essential for today's time because it can solve complex problems with an efficient way in multiple industries, such as Healthcare, entertainment, finance, education, etc. AI is making our daily life more comfortable and fast.

Following are some sectors which have the application of Artificial Intelligence:



1. AI in Astronomy

Artificial Intelligence can be very useful to solve complex universe problems. AI technology can be helpful for understanding the universe such as how it works, origin, etc.

2. AI in Healthcare

In the last, five to ten years, AI becoming more advantageous for the healthcare industry and going to have a significant impact on this industry.

Healthcare Industries are applying AI to make a better and faster diagnosis than humans. AI can help doctors with diagnoses and can inform when patients are worsening so that medical help can reach to the patient before hospitalization.

3. AI in Gaming

AI can be used for gaming purpose. The AI machines can play strategic games like chess, where the machine needs to think of a large number of possible places.

4. AI in Finance

AI and finance industries are the best matches for each other. The finance industry is implementing automation, chatbot, adaptive intelligence, algorithm trading, and machine learning into financial processes.

5. AI in Data Security

The security of data is crucial for every company and cyber-attacks are growing very rapidly in the digital world. AI can be used to make your data more safe and secure. Some examples such as AEG bot, AI2 Platform,are used to determine software bug and cyber-attacks in a better way.

6. AI in Social Media

Social Media sites such as Facebook, Twitter, and Snapchat contain billions of user profiles, which need to be stored and managed in a very efficient way. AI can organize and manage massive amounts of data. AI can analyze lots of data to identify the latest trends, hashtag, and requirement of different users.

7. AI in Travel & Transport

AI is becoming highly demanding for travel industries. AI is capable of doing various travel related works such as from making travel arrangement to suggesting the hotels, flights, and best routes to the customers. Travel industries are using AI-powered chatbots which can make human-like interaction with customers for better and fast response.

8. AI in Automotive Industry

Some Automotive industries are using AI to provide virtual assistant to their user for better performance. Such as Tesla has introduced TeslaBot, an intelligent virtual assistant.

Various Industries are currently working for developing self-driven cars which can make your journey more safe and secure.

9. AI in Robotics:

Artificial Intelligence has a remarkable role in Robotics. Usually, general robots are programmed such that they can perform some repetitive task, but with the help of AI, we can create intelligent robots which can perform tasks with their own experiences without pre-programmed.

Humanoid Robots are best examples for AI in robotics, recently the intelligent Humanoid robot named as Erica and Sophia has been developed which can talk and behave like humans.

10. AI in Entertainment

We are currently using some AI based applications in our daily life with some entertainment services such as Netflix or Amazon. With the help of ML/AI algorithms, these services show the recommendations for programs or shows.

11. AI in Agriculture

Agriculture is an area which requires various resources, labor, money, and time for best result. Now a day's agriculture is becoming digital, and AI is emerging in this field. Agriculture is applying AI as agriculture robotics, solid and crop monitoring, predictive analysis. AI in agriculture can be very helpful for farmers.

12. AI in E-commerce

AI is providing a competitive edge to the e-commerce industry, and it is becoming more demanding in the e-commerce business. AI is helping shoppers to discover associated products with recommended size, color, or even brand.

13. AI in education:

AI can automate grading so that the tutor can have more time to teach. AI chatbot can communicate with students as a teaching assistant.

AI in the future can be work as a personal virtual tutor for students, which will be accessible easily at any time and any place.

Search Algorithms in Artificial Intelligence

Search algorithms are one of the most important areas of Artificial Intelligence. This topic will explain all about the search algorithms in AI.

Problem-solving agents:

In Artificial Intelligence, Search techniques are universal problem-solving methods. Rational agents or Problem-solving agents in AI mostly used these search strategies or algorithms to solve a specific problem and provide the best result. Problem-solving agents are the goal-based agents and use atomic representation. In this topic, we will learn various problem-solving search algorithms.

Search Algorithm Terminologies:

Search: Searchingis a step by step procedure to solve a search-problem in a given search space. A search problem can have three main factors:

Search Space: Search space represents a set of possible solutions, which a system may have.

Start State: It is a state from where agent begins the search.

Goal test: It is a function which observe the current state and returns whether the goal state is achieved or not.

Search tree: A tree representation of search problem is called Search tree. The root of the search tree is the root node which is corresponding to the initial state.

Actions: It gives the description of all the available actions to the agent.

Transition model: A description of what each action do, can be represented as a transition model.

Path Cost: It is a function which assigns a numeric cost to each path.

Solution: It is an action sequence which leads from the start node to the goal node.

Optimal Solution: If a solution has the lowest cost among all solutions.
Properties of Search Algorithms:
Following are the four essential properties of search algorithms to compare the efficiency of these algorithms:

Completeness: A search algorithm is said to be complete if it guarantees to return a solution if at least any solution exists for any random input.
Play Video

Optimality: If a solution found for an algorithm is guaranteed to be the best solution (lowest path cost) among all other solutions, then such a solution for is said to be an optimal solution.

Time Complexity: Time complexity is a measure of time for an algorithm to complete its task.

Space Complexity: It is the maximum storage space required at any point during the search, as the complexity of the problem.

Types of search algorithms
Based on the search problems we can classify the search algorithms into uninformed (Blind search) search and informed search (Heuristic search) algorithms.

Search Algorithms in Artificial Intelligence
Uninformed/Blind Search:
The uninformed search does not contain any domain knowledge such as closeness, the location of the goal. It operates in a brute-force way as it only includes information about how to traverse the tree and how to identify leaf and goal nodes. Uninformed search applies a way in which search tree is searched without any information about the search space like initial state operators and test for the goal, so it is also called blind search.It examines each node of the tree until it achieves the goal node.

It can be divided into five main types:

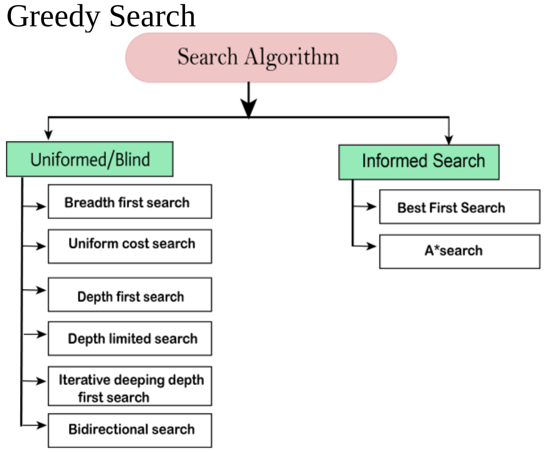
Breadth-first search
Uniform cost search
Depth-first search
Iterative deepening depth-first search
Bidirectional Search
Informed Search
Informed search algorithms use domain knowledge. In an informed search, problem information is available which can guide the search. Informed search strategies can find a solution more efficiently than an uninformed search strategy. Informed search is also called a Heuristic search.

A heuristic is a way which might not always be guaranteed for best solutions but guaranteed to find a good solution in reasonable time.

Informed search can solve much complex problem which could not be solved in another way.

An example of informed search algorithms is a traveling salesman problem.

Greedy Search



Hill Climbing Algorithm in Artificial

Intelligence

Hill climbing algorithm is a local search algorithm which continuously moves in the direction of increasing elevation/value to find the peak of the mountain or best solution to the problem. It terminates when it reaches a peak value where no neighbor has a higher value.

Hill climbing algorithm is a technique which is used for optimizing the mathematical problems. One of the widely discussed examples of Hill climbing algorithm is Traveling-salesman Problem in which we need to minimize the distance traveled by the salesman.

It is also called greedy local search as it only looks to its good immediate neighbor state and not beyond that.

A node of hill climbing algorithm has two components which are state and value.

Hill Climbing is mostly used when a good heuristic is available.

In this algorithm, we don't need to maintain and handle the search tree or graph as it only keeps a single current state.

Features of Hill Climbing:

Following are some main features of Hill Climbing Algorithm:

Generate and Test variant: Hill Climbing is the variant of Generate and Test method. The Generate and Test method produce feedback which helps to decide which direction to move in the search space.

Greedy approach: Hill-climbing algorithm search moves in the direction which optimizes the cost.

No backtracking: It does not backtrack the search space, as it does not remember the previous states.

State-space Diagram for Hill Climbing:

The state-space landscape is a graphical representation of the hill-climbing algorithm which is showing a graph between various states of algorithm and Objective function/Cost.

On Y-axis we have taken the function which can be an objective function or cost function, and state-space on the x-axis. If the function on Y-axis is cost then, the goal of search is to find the global minimum and local minimum. If the function of Y-axis is Objective function, then the goal of the search is to find the global maximum and local maximum.

Hill Climbing Algorithm in AI

Different regions in the state space landscape:

Local Maximum: Local maximum is a state which is better than its neighbor states, but there is also another state which is higher than it.

Play Video

Global Maximum: Global maximum is the best possible state of state space landscape. It has the highest value of objective function.

Current state: It is a state in a landscape diagram where an agent is currently present.

Flat local maximum: It is a flat space in the landscape where all the neighbor states of current states have the same value.

Shoulder: It is a plateau region which has an uphill edge.

Types of Hill Climbing Algorithm:

Simple hill Climbing:

Steepest-Ascent hill-climbing:

Stochastic hill Climbing:

1. Simple Hill Climbing:

Simple hill climbing is the simplest way to implement a hill climbing algorithm. It only evaluates the neighbor node state at a time and selects the first one which optimizes current cost and set it as a current state. It only checks it's one successor state, and if it finds better than the current state, then move else be in the same state. This algorithm has the following features:

Less time consuming

Less optimal solution and the solution is not guaranteed

Algorithm for Simple Hill Climbing:

Step 1: Evaluate the initial state, if it is goal state then return success and Stop.

Step 2: Loop Until a solution is found or there is no new operator left to apply.

Step 3: Select and apply an operator to the current state.

Step 4: Check new state:

If it is goal state, then return success and quit.

Else if it is better than the current state then assign new state as a current state.

Else if not better than the current state, then return to step2.

Step 5: Exit.

2. Steepest-Ascent hill climbing:

The steepest-Ascent algorithm is a variation of simple hill climbing algorithm. This algorithm examines all the neighboring nodes of the current state and selects one neighbor node which is closest to the goal state. This algorithm consumes more time as it searches for multiple neighbors

Algorithm for Steepest-Ascent hill climbing:

Step 1: Evaluate the initial state, if it is goal state then return success and stop, else make current state as initial state.

Step 2: Loop until a solution is found or the current state does not change.

Let SUCC be a state such that any successor of the current state will be better than it.

For each operator that applies to the current state:

Apply the new operator and generate a new state.

Evaluate the new state.

If it is goal state, then return it and quit, else compare it to the SUCC.

If it is better than SUCC, then set new state as SUCC.

If the SUCC is better than the current state, then set current state to SUCC.

Step 5: Exit.

3. Stochastic hill climbing:

Stochastic hill climbing does not examine for all its neighbor before moving. Rather, this search algorithm selects one neighbor node at random and decides whether to choose it as a current state or examine another state.

Problems in Hill Climbing Algorithm:

1. Local Maximum: A local maximum is a peak state in the landscape which is better than each of its neighboring states, but there is another state also present which is higher than the local maximum.

Solution: Backtracking technique can be a solution of the local maximum in state space landscape. Create a list of the promising path so that the algorithm can backtrack the search space and explore other paths as well.

Hill Climbing Algorithm in AI

2. Plateau: A plateau is the flat area of the search space in which all the neighbor states of the current state contains the same value, because of this algorithm does not find any best direction to move. A hill-climbing search might be lost in the plateau area.

Solution: The solution for the plateau is to take big steps or very little steps while searching, to solve the problem. Randomly select a state which is far away from the current state so it is possible that the algorithm could find non-plateau region.

Hill Climbing Algorithm in AI

3. Ridges: A ridge is a special form of the local maximum. It has an area which is higher than its surrounding areas, but itself

has a slope, and cannot be reached in a single move.

Solution: With the use of bidirectional search, or by moving in different directions, we can improve this problem.

What is an Expert System?

An expert system is a computer program that is designed to solve complex problems and to provide decision-making ability like a human expert. It performs this by extracting knowledge from its knowledge base using the reasoning and inference rules according to the user queries.

The expert system is a part of AI, and the first ES was developed in the year 1970, which was the first successful approach of artificial intelligence. It solves the most complex issue as an expert by extracting the knowledge stored in its knowledge base. The system helps in decision making for compsex problems using both facts and heuristics like a human expert. It is called so because it contains the expert knowledge of a specific domain and can solve any complex problem of that particular domain. These systems are designed for a specific domain, such as medicine, science, etc.

The performance of an expert system is based on the expert's knowledge stored in its knowledge base. The more knowledge stored in the KB, the more that system improves its performance. One of the common examples of an ES is a suggestion of spelling errors while typing in the Google search box.

Below is the block diagram that represents the working of an expert system:

Play Video

Expert Systems in AI

Note: It is important to remember that an expert system is not used to replace the human experts; instead, it is used to assist the human in making a complex decision. These systems do not have human capabilities of thinking and work on the basis of the knowledge base of the particular domain.

Below are some popular examples of the Expert System:

DENDRAL: It was an artificial intelligence project that was made as a chemical analysis expert system. It was used in organic chemistry to detect unknown organic molecules with the help of their mass spectra and knowledge base of chemistry.

MYCIN: It was one of the earliest backward chaining expert systems that was designed to find the bacteria causing infections like bacteraemia and meningitis. It was also used for the recommendation of antibiotics and the diagnosis of blood clotting diseases.

PXDES: It is an expert system that is used to determine the type and level of lung cancer. To determine the disease, it takes a picture from the upper body, which looks like the shadow. This shadow identifies the type and degree of harm.

CaDeT: The CaDet expert system is a diagnostic support system that can detect cancer at early stages.

Characteristics of Expert System

High Performance: The expert system provides high performance for solving any type of complex problem of a specific domain with high efficiency and accuracy.

Understandable: It responds in a way that can be easily understandable by the user. It can take input in human language and provides the output in the same way.

Reliable: It is much reliable for generating an efficient and accurate output.

Highly responsive: ES provides the result for any complex query within a very short period of time.

Components of Expert System

An expert system mainly consists of three components:

User Interface
Inference Engine
Knowledge Base
Expert Systems in AI

1. User Interface

With the help of a user interface, the expert system interacts with the user, takes queries as an input in a readable format, and passes it to the inference engine. After getting the response from the inference engine, it displays the output to the user. In other words, it is an interface that helps a non-expert user to communicate with the expert system to find a solution.

2. Inference Engine(Rules of Engine)

The inference engine is known as the brain of the expert system as it is the main processing unit of the system. It applies inference rules to the knowledge base to derive a conclusion or deduce new information. It helps in deriving an error-free solution of queries asked by the user.

With the help of an inference engine, the system extracts the knowledge from the knowledge base.

There are two types of inference engine:

Deterministic Inference engine: The conclusions drawn from this type of inference engine are assumed to be true. It is based on facts and rules.

Probabilistic Inference engine: This type of inference engine contains uncertainty in conclusions, and based on the probability.

Inference engine uses the below modes to derive the solutions:

Forward Chaining: It starts from the known facts and rules, and applies the inference rules to add their conclusion to the known facts.

Backward Chaining: It is a backward reasoning method that starts from the goal and works backward to prove the known facts.

3. Knowledge Base

The knowledgebase is a type of storage that stores knowledge acquired from the different experts of the particular domain. It is considered as big storage of knowledge. The more the knowledge base, the more precise will be the Expert System.

It is similar to a database that contains information and rules of a particular domain or subject.

One can also view the knowledge base as collections of objects and their attributes. Such as a Lion is an object and its attributes are it is a mammal, it is not a domestic animal, etc.

Components of Knowledge Base

Factual Knowledge: The knowledge which is based on facts and accepted by knowledge engineers comes under factual knowledge.

Heuristic Knowledge: This knowledge is based on practice, the ability to guess, evaluation, and experiences.

Knowledge Representation: It is used to formalize the knowledge stored in the knowledge base using the If-else rules.

Knowledge Acquisitions: It is the process of extracting, organizing, and structuring the domain knowledge, specifying the rules to acquire the knowledge from various experts, and store that knowledge into the knowledge base.

Development of Expert System

Here, we will explain the working of an expert system by taking an example of MYCIN ES. Below are some steps to build an MYCIN:

Firstly, ES should be fed with expert knowledge. In the case of MYCIN, human experts specialized in the medical field of bacterial infection, provide information about the causes, symptoms, and other knowledge in that domain.

The KB of the MYCIN is updated successfully. In order to test it, the doctor provides a new problem to it. The problem is to identify the presence of the bacteria by inputting the details of a patient, including the symptoms, current condition, and medical history.

The ES will need a questionnaire to be filled by the patient to know the general information about the patient, such as gender, age, etc.

Now the system has collected all the information, so it will find the solution for the problem by applying if-then rules using the inference engine and using the facts stored within the KB.

In the end, it will provide a response to the patient by using the user interface.

Participants in the development of Expert System

There are three primary participants in the building of Expert System:

Expert: The success of an ES much depends on the knowledge provided by human experts. These experts are those persons who are specialized in that specific domain.

Knowledge Engineer: Knowledge engineer is the person who gathers the knowledge from the domain experts and then codifies that knowledge to the system according to the formalism.

End-User: This is a particular person or a group of people who may not be experts, and working on the expert system needs the solution or advice for his queries, which are complex.

Why Expert System?

Expert Systems in AI

Before using any technology, we must have an idea about why to use that technology and hence the same for the ES. Although we have human experts in every field, then what is the need to develop a computer-based system. So below are the points that are describing the need of the ES:

No memory Limitations: It can store as much data as required and can memorize it at the time of its application. But for human experts, there are some limitations to memorize all things at every time.

High Efficiency: If the knowledge base is updated with the correct knowledge, then it provides a highly efficient output, which may not be possible for a human.

Expertise in a domain: There are lots of human experts in each domain, and they all have different skills, different experiences, and different skills, so it is not easy to get a final output for the query. But if we put the knowledge gained from human experts into the expert system, then it provides an efficient output by mixing all the facts and knowledge

Not affected by emotions: These systems are not affected by human emotions such as fatigue, anger, depression, anxiety, etc.. Hence the performance remains constant.

High security: These systems provide high security to resolve any query.

Considers all the facts: To respond to any query, it checks and considers all the available facts and provides the result accordingly. But it is possible that a human expert may not consider some facts due to any reason.

Regular updates improve the performance: If there is an issue in the result provided by the expert systems, we can improve the performance of the system by updating the knowledge base.

Capabilities of the Expert System

Below are some capabilities of an Expert System:

Advising: It is capable of advising the human being for the query of any domain from the particular ES.
Provide decision-making capabilities: It provides the capability of decision making in any domain, such as for making any financial decision, decisions in medical science, etc.
Demonstrate a device: It is capable of demonstrating any new products such as its features, specifications, how to use that product, etc.
Problem-solving: It has problem-solving capabilities.
Explaining a problem: It is also capable of providing a detailed description of an input problem.
Interpreting the input: It is capable of interpreting the input given by the user.
Predicting results: It can be used for the prediction of a result.
Diagnosis: An ES designed for the medical field is capable of diagnosing a disease without using multiple components as it already contains various inbuilt medical tools.

Advantages of Expert System

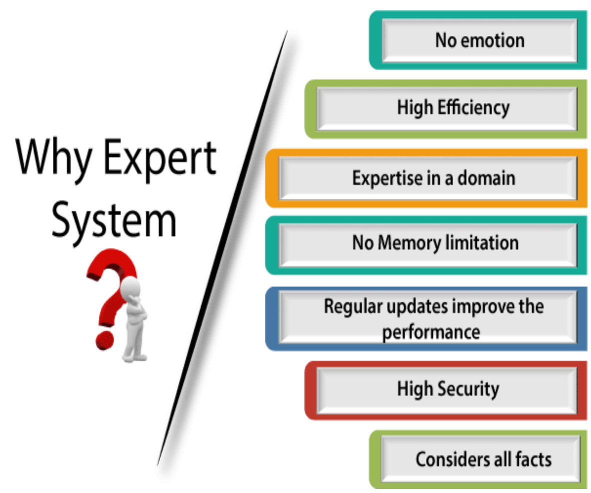
These systems are highly reproducible.
They can be used for risky places where the human presence is not safe.
Error possibilities are less if the KB contains correct knowledge.
The performance of these systems remains steady as it is not affected by emotions, tension, or fatigue.
They provide a very high speed to respond to a particular query.

Limitations of Expert System

The response of the expert system may get wrong if the knowledge base contains the wrong information.
Like a human being, it cannot produce a creative output for different scenarios.
Its maintenance and development costs are very high.
Knowledge acquisition for designing is much difficult.
For each domain, we require a specific ES, which is one of the big limitations.
It cannot learn from itself and hence requires manual updates.

Applications of Expert System

In designing and manufacturing domain
It can be broadly used for designing and manufacturing physical devices such as camera lenses and automobiles.
In the knowledge domain
These systems are primarily used for publishing the relevant knowledge to the users. The two popular ES used for this domain is an advisor and a tax advisor.
In the finance domain
In the finance industries, it is used to detect any type of possible fraud, suspicious activity, and advise bankers that if they should provide loans for business or not.
In the diagnosis and troubleshooting of devices
In medical diagnosis, the ES system is used, and it was the first area where these systems were used.
Planning and Scheduling
The expert systems can also be used for planning and scheduling some particular tasks for achieving the goal of that task.



Machine Learning provides basic and

advanced concepts of machine learning. Our machine learning tutorial is designed for students and working professionals.

Machine learning is a growing technology which enables computers to learn automatically from past data. Machine learning uses various algorithms for building mathematical models and making predictions using historical data or information. Currently, it is being used for various tasks such as image recognition, speech recognition, email filtering, Facebook auto-tagging, recommender system, and many more.

This machine learning tutorial gives you an introduction to machine learning along with the wide range of machine learning techniques such as Supervised, Unsupervised, and Reinforcement learning. You will learn about regression and classification models, clustering methods, hidden Markov models, and various sequential models.

Conclusion:

The reasoning is the mental process of deriving logical conclusion and making predictions from available knowledge, facts, and beliefs. Or we can say, "Reasoning is a way to infer facts from existing data." It is a general process of thinking rationally, to find valid conclusions. In artificial intelligence, the reasoning is essential so that the machine can also think rationally as a human brain, and can perform like a human.

Bala Saraswathi (18FH1A0528)
IV-I (CSE)

STUDENTS ART GALLERY

ART BY
ESHA RANI (18FH1A0501) III-I SEM

ART BY
19FH1A0514 SHAIK NAHADA (II-I SEM)