EEE ASSOCIATION

TRONICALS

VOLUME 8 | ISSUE 2

COVER STORY

NEUROMORPHIC BRAIN CONTROL INTERFACE

CONTENT

MESSAGE FROM HOD

It gives me immense pleasure to pen the prologue for Tronicals, the bi-annual magazine published by the department of Electrical and Electronics Engineering, NIT Tiruchirappalli. Tronicals brings to light the quintessence of our department and provides the perfect platform for the students and staff to showcase their creative and technical acumen in print. This edition of Tronicals covers a gamut of topics from insightful internship diaries to intriguing articles on cutting-edge research and development.

The EEE Association plays a pivotal role in organizing diverse activities - symposiums, guest lectures, technical contests, quizzes, etc. I wholeheartedly wish them success in all their endeavours and hope they scale greater heights this year.

I'd like to congratulate all the contributors and the editorial team for their unstinted efforts and enthusiasm for the successful launch of this edition. I hope the readers find it informative and enlightening. Happy reading!

Dr. M.P.Selvan, HoD , EEE

MESSAGE FROM FACULTY ADVISOR

On behalf of the EEE Association (EEEA) and Tronicals, I am elated to extend my warm greetings to the EEE family of NITT. It is my pleasure to assume the role of faculty advisor to guide and support the EEEA. The EEE Association plays an integral role in shaping departmental activities to be informative and innovative by conducting various technical workshops, events, guest lectures, and an annual technical symposium, Currents which has garnered enthusiastic participation from students all over India. I take this opportunity to laud the meticulous planning, diligence, and zest of the EEEA Team, and wholeheartedly wish them a successful year ahead.

Tronicals, our in-house technical magazine, portrays a wide assemblage of technical articles on the latest developments in the field of Electrical and Electronics Engineering. This edition also throws light on the coveted internships undertaken by our students in various companies and foreign institutes, hoping to kindle the interests of aspiring students. It also highlights the updates about the activities and accomplishments of the students and distinguished faculty.

This magazine is an earnest attempt to broadcast, inform, inspire and pique the curiosity of the diverse readership. I congratulate the editorial team for their consistent efforts and creativity in curating this magazine and sincerely hope this edition provides a holistic and exciting reading experience.

-Dr. Josephine R.L., Faculty Advisor, EEEA

EDITORIAL TEAM

“Time stands still best in the moments that look suspiciously like ordinary life”

Atlast, we have completed a semester completely offline for once, in the past 2 years. Credits to the COVID-19 outbreak and its after effects, that kept us away from our campus and its vibrant lifestyle. But fret not! We are already up and running. We, the students of the Electrical and Electronics Engineering Department, bring to you the Issue 1 of Tronicals (2023).

This time, we bring to you articles on various topics that are a matter of bleeding-edge research at several research groups across the globe. The topics range from super junction transistors to aerospace electrification and are written by the students after going through existing literature that is legitimate. We have tried to provide a birdseye overview of the aforementioned topics and hope you are intrigued by the same!

In addition to the articles, we have put together a collection of Intern Diaries, that gives insights into the students perspective on their Research/Company Internship experience, hoping to help the interested juniors to take up this experience as a stepping stone for their future endeavors.

We hope that this edition of Tronicals will keep you enamored with well-curated content on enriching experiences and fascinating articles.
Stay tuned!

N. Srikrishna and J. Soundarya
Editors-in-Chief, Tronicals
Batch of 2019-2023


J. Soundarya


N. Srikrishna


K. Rajalakshmi


Koustabh Sau


Yash Chaturani


Fahmida Hiba Fathima


Shakambari Saxena

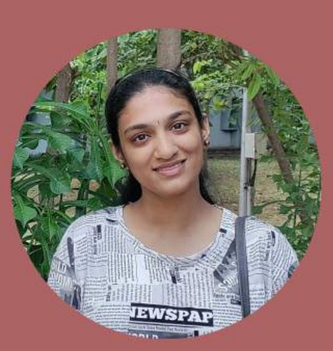

Jyosna


Manush Patel


Janam


Keerthana


Sreeya


Uma Gomathi


Akshaya


Diya


Sriram


Varun


Abinisha


Tanuja


Saranya


Varshini


Muskan Sachan


Suganth

VISION AND MISSION OF THE DEPARTMENT

ABOUT

The Department of Electrical and Electronics Engineering, NIT, Tiruchirappalli was started in the year 1964. It offers one Under-Graduate programme (B.Tech.), two Post-Graduate programmes (M.Tech. in Power Systems and Power Electronics) and also research programmes (M.S. and Ph.D.) in the various fields of Electrical and Electronics Engineering. After the institute became NIT, the department has grown not only in terms of student and faculty strength, but also in improving the laboratory facilities for the teaching and research purposes. Thus, the department has dedicated and state of the art teaching / research laboratories. The department is recognized for excellence in research (First Department in NIT-T to be accorded QIP status for Ph.D. programe), teaching and service to the profession.

The faculty members have strong sense of responsibility to provide the finest possible education for both graduate and undergraduate students. The academic strength of the faculty is reflected by the alumni, many of whom are in the top echelons of industry and academia both in India and abroad.

MISSION

To be a centre of excellence in Electrical Energy Systems.

VISION

- Empowering students and professionals with state-of-art knowledge and Technological skills.
- Enabling Industries to adopt effective solutions in Energy areas through research and consultancy.
- Evolving appropriate sustainable technologies for rural needs

B.TECH
PROGRAMME

PROGRAM EDUCATIONAL OBJECTIVES (PEOS) :

The major objectives of the B.Tech. programme in Electrical and Electronics Engineering are to prepare students:

for graduate study in engineering

- to work in research and development organizations
- for employment in electrical power industries
- to acquire job in electronic circuit design and fabrication industries
- to work in IT and ITES industries

Programme Outcomes (POs) :

- will have an ability to apply knowledge of mathematics and science in EEE systems.
- will have an ability to provide solutions for EEE problems by designing and conducting experiments, interpreting and analysing data, and reporting the results.
- will have comprehensive understanding of the entire range of electronic devices, analog and digital circuits with added state-of-art knowledge on advanced electronic systems.
- will have knowledge and exposure on different power electronic circuits and drives for industrial applications.
- will have in-depth knowledge in transmission and distribution systems, power system analysis and protection systems to pursue a career in the power sector.
- will have a good knowledge in microprocessors/microcontrollers, data structures, computer programming and simulation software.
- will be able to develop mathematical modelling, analysis and design of control systems and associated instrumentation for EEE.
- will be able to systematically carry out projects related to EEE.
- will have an ability to participate as members in various professional bodies as well as multidisciplinary design teams.
- will demonstrate the ability to choose and apply appropriate resource management techniques so as to optimally utilize the available resources.
- will be proficient in English language in both verbal and written forms which will enable them to compete globally.
- will have confidence to apply engineering solutions with professional, ethical and social responsibilities.
- will be able to excel in their professional endeavours through self-education.
- will be able to design and build renewable energy systems for developing clean energy and sustainable technologies.

M.TECH

IN POWER SYSTEMS

PROGRAM EDUCATIONAL OBJECTIVES (PEOS) :

The major objectives of the M.Tech. programme in Power Systems are to equip the students with adequate knowledge and skills in Power Systems Engineering and to prepare them for the following career options:

- research programmes in Power Systems Engineering
- employment in power research and development organisations
- to work in electric power industries and energy sectors
- faculty positions in reputed institutions

Programme Outcomes (POs) :

A student who has undergone M.Tech. programme in Power Systems (PS) will:

- have an ability to evaluate and analyse problems related to Power Systems and be able to synthesise the domain knowledge and incorporate the principles in the state of art systems for further enrichment
- be able to critically investigate the prevailing complex PS scenarios and arrive at possible solutions independently, by applying the acquired theoretical and practical knowledge
- be able to solve PS problems such as load flows, state estimation, fault analysis and stability studies
- be able to develop broad-based economically viable solutions for unit commitment and scheduling
- be able to identify optimal solutions for improvising power transfer capability, enhancing power quality and reliability
- be able to evolve new schemes based on literature survey, and propose solutions through appropriate research methodologies, techniques and tools, and also by designing and conducting experiments
- be able to interpret power system data and work on well-defined projects with well defined goals to provide real time solutions pertaining to PS
- be able to develop, choose, learn and apply appropriate techniques, various resources including hardware and IT tools for modern power engineering, including prediction and modelling with an understanding of the limitations
- be able to develop dedicated software for analysing and evaluating specific power system problems
- be able to participate in collaborative-multidisciplinary engineering / research tasks and work as a team member in such tasks related to PS domain, giving due consideration to economic and financial intricacies, and lead the team in specific spheres
- be able to confidently interact with the industrial experts for providing consultancy
- be able to pursue challenging professional endeavours based on acquired competence and knowledge
- be a responsible professional with intellectual integrity, code of conduct and ethics of research, being aware of the research outcomes and serve towards the sustainable development of the society
- be capable of examining critically the outcomes of research and development independently without any external drive.

M.TECH
IN POWER ELECTRONICS

PROGRAM EDUCATIONAL OBJECTIVES (PEOS) :

The major objectives of the M.Tech. programme in Power Electronics are to equip the students with adequate knowledge and skills in Power Electronics and to prepare them for the following career options:

- research programmes in Power Electronics and related areas
- employment in R & D organisations related to sustainable technologies
- to work in power electronic circuit design and fabrication industries
- faculty positions in reputed institutions

Programme Outcomes (POs) :

A student who has undergone M.Tech. programme in Power Electronics (PE) will:

- have an ability to evaluate and analyse problems related to Power Electronic Systems and incorporate the principles in the state of art systems for further improvement
- be able to investigate critical PE problems and to arrive at possible solutions independently, by applying theoretical and practical considerations
- be able to solve PE problems such as switching control, converter design, analysis and control of solid state drives and stability studies
- be able to develop appropriate power converters for sustainable energy technologies
- be able to identify optimal solutions for improvising power conversion and transfer capability, enhancing power quality and reliability through PE based solutions
- be able to evolve new power electronic topologies and control schemes based on literature survey and propose solutions through appropriate research methodologies, techniques and tools, and also by designing and conducting experiments
- be able to work on small, well-defined projects with particular goals to provide real time solutions pertaining to power electronics
- be able to develop, choose, learn and apply appropriate techniques, various resources including sophisticated digital controllers and IT tools for modern power electronic system simulation, including prediction and modelling with existing constraints
- be able to develop dedicated software for analysing and evaluating specific power electronics and control problems
- be able to participate in collaborative-multidisciplinary engineering / research tasks and work as a team member in such tasks related to PE domain, giving due consideration to ecological and economical intricacies, and lead the team in specific areas
- be able to confidently interact with the industrial experts for providing consultancy
- be able to pursue challenging professional endeavours based on acquired competence and knowledge
- be a responsible professional with intellectual integrity, code of conduct and ethics of research, being aware of the research outcomes and serve towards the sustainable development of the society
- be capable of examining critically the outcomes of research and development independently without any external drive.

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QUANTUM COMPTUTING/QUBIT

The quantum in "quantum computing" refers to the quantum mechanics that the system uses to calculate outputs. In physics, a quantum is the smallest possible discrete unit of any physical property. It usually refers to properties of atomic or subatomic particles, such as electrons, neutrinos and photons.

A qubit is the basic unit of information in quantum computing. Qubits play a similar role in quantum computing as bits play in classical computing, but they behave very differently. Classical bits are binary and can hold only a position of 0 or 1, but qubits can hold a superposition of all possible states.

What is quantum computing?

Quantum computers harness the unique behavior of quantum physics—such as superposition, entanglement and quantum interference—and apply it to computing. This introduces new concepts to traditional programming methods.

Quantum computing is a rapidly-emerging technology that harnesses the laws of quantum mechanics to solve problems too complex for classical computers.

Today, IBM Quantum makes real quantum hardware a tool scientists only began to imagine three decades ago available to hundreds of thousands of developers. Our engineers deliver ever-more-powerful superconducting quantum processors at regular intervals, alongside crucial advances in software and quantum-classical orchestration. This work drives toward the quantum computing speed and capacity necessary to change the world.

Why do we need quantum computers?

For some problems, supercomputers aren’t that super.
When scientists and engineers encounter difficult problems, they turn to supercomputers. These are very large classical computers, often with thousands of classical CPU and GPU cores. However, even supercomputers struggle to solve certain kinds of problems.

If a supercomputer gets stumped, that's probably because the big classical machine was asked to solve a problem with a high degree of complexity. When classical computers fail, it's often due to complexity Complex problems are problems with lots of variables interacting in complicated ways. Modeling the behavior of individual atoms in a molecule is a complex problem, because of all the different electrons interacting with one another. Sorting out the ideal routes for a few hundred tankers in a global shipping network is complex too.

How do quantum computers work?

Quantum computers are elegant machines, smaller and requiring less energy than supercomputers. An IBM Quantum processor is a wafer not much bigger than the one found in a laptop. And a quantum hardware system is about the size of a car, made up mostly of cooling systems to keep the superconducting processor at its ultra-cold operational temperature.

A classical processor uses bits to perform its operations. A quantum computer uses qubits (CUE-bits) to run multidimensional quantum algorithms.

Superfluids

Your desktop computer likely uses a fan to get cold enough to work. Our quantum processors need to be very cold – about a hundredth of a degree above absolute zero. To achieve this, we use super-cooled superfluids to create superconductors.

Superconductors

At those ultra-low temperatures certain materials in our processors exhibit another important quantum mechanical effect: electrons move through them without resistance. This makes them "superconductors."

Control

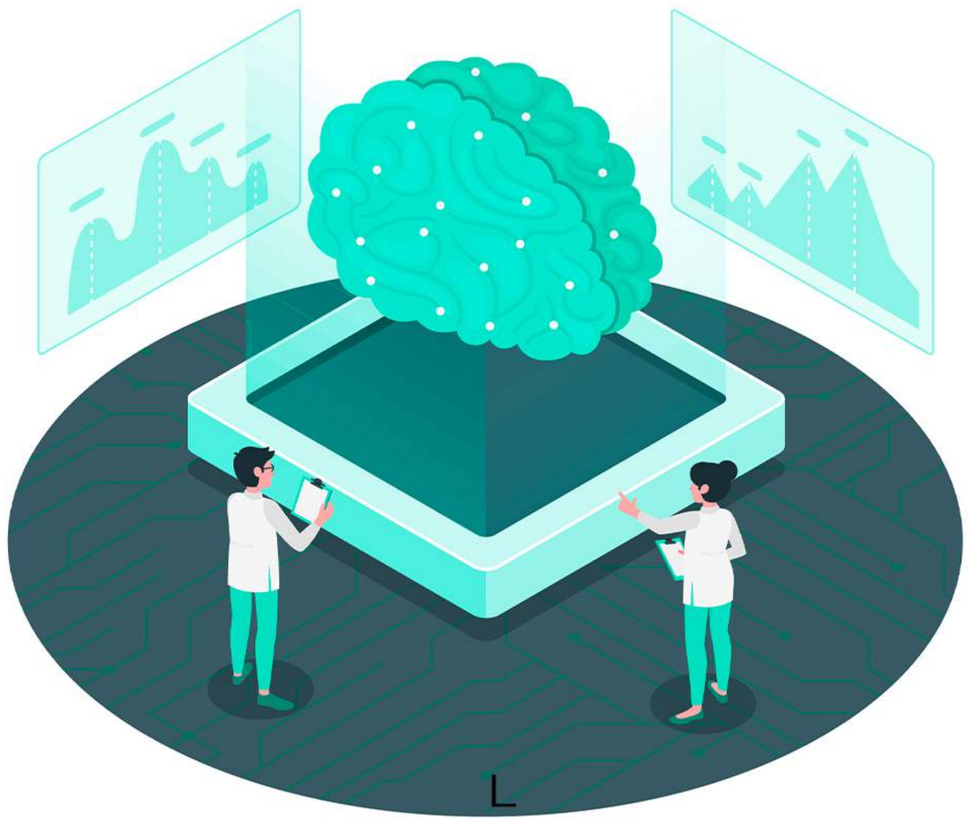
Our quantum computers use Josephson junctions as superconducting qubits. By firing microwave photons at these qubits, we can control their behavior and get them to hold, change, and read out individual units of quantum information.

Superposition

A qubit itself isn't very useful. But it can perform an important trick: placing the quantum information it holds into a state of superposition, which represents a combination of all possible configurations of the qutbit. Groups of qubits in superposition can create complex, multidimensional computational spaces. Complex problems can be represented in new ways in these spaces.

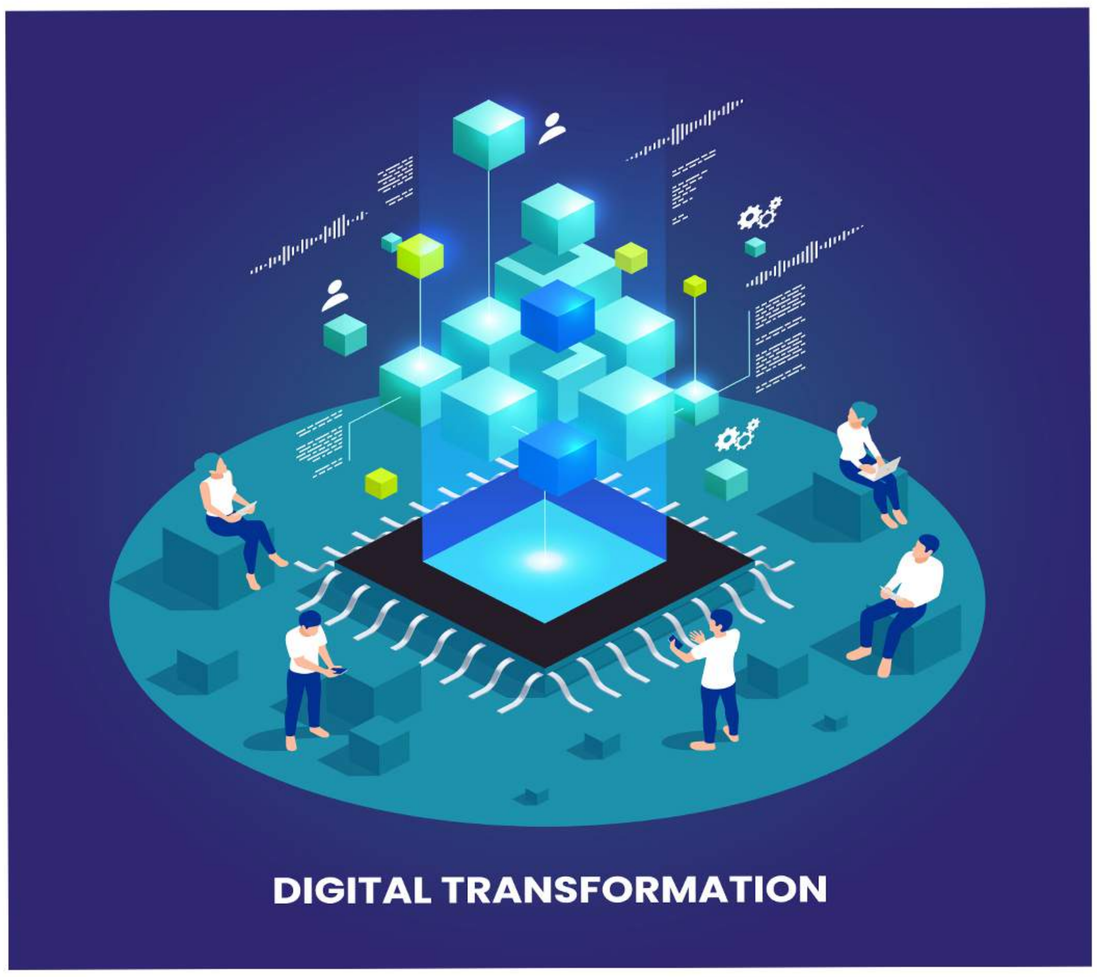
Entanglement

Entanglement is a quantum mechanical effect that correlates the behavior of two separate things. When two qubits are entangled, changes to one qubit directly impact the other. Quantum algorithms leverage those relationships to find solutions to complex problems.



How might it change the world?

One of the tasks that's impossible for today's computers, but easy for quantum computers, is figuring out what numbers you need to multiply together in order to make any given really big number, a process called prime factorization. This matters because factorization is what underlies digital cryptography. Once quantum computing arrives in force, today's secure encryption techniques for communicationts are toast. So is bitcoin. (The National Institute for Standards and Technology (NIST) is working on post-quantum encryption algorithms.)



Another exciting frontier will be quantum artificial intelligence. As a machine learning algorithm is trained, it sifts through vast amounts of data, so a quantum computer's ability to process multiple possibilities at once might allow it to reach unprecedented levels of performance.

And that's just for starters. Quantum information science could well be one of those technologies that's so radically different that we might not be able to appreciate its impact until it's ubiquitous enough for anyone to innovate with its powers. After all, if even Einstein called it weird science, it's bound to have a few surprises in store.

Space-Based Solar Power

Space-Based Solar Power: The Future of Renewable Energy or a Bluff

Solar power has become one of the most popular sources of renewable energy in recent years, but as the demand for energy continues to grow, conventional solar panels on the ground will start to reach their limits soon. That's why the idea of space-based solar power is gaining traction. It has been under research since the 1970s.

What is Space-Based Solar Power?

Space-based solar power refers to collecting energy from the sun and converting it into electrical power using Solar panels Mostly or any other methods. These systems are placed in orbit around the Earth on Satellites where they are exposed to sunlight 24 hours a day and are not impacted by the weather or nighttime, unlike conventional solar panels. Further the Energy is sent back to earth for usage using a high frequency beam to aggregate collected power into a series of transmission antennas, which beam the energy to Earth's surface at a lower frequency.

Advantages of Space-Based Solar Power

There are several advantages of space-based solar power compared to conventional solar panels on the ground. The most significant advantages are:

24/7 Availability: Space-based solar panels receive sunlight 24 hours a day, 7 days a week. This means that they are not impacted by the weather or nighttime, making them an extremely reliable source of energy.

Increased Efficiency: Space-based solar panels are exposed to more intense and direct sunlight compared to conventional panels on the ground. This results in increased efficiency and the ability

Unlimited Potential: Space-based solar panels have the potential to provide an unlimited supply of energy. With a never-ending source of sunlight, space-based solar power has the potential to provide a sustainable source of energy for generations to come.

Lower Cost: With the technology for space-based solar power improving, the cost of installing and maintaining these panels is becoming more and more affordable.

No land usage: Space-based solar power does not require any land usage, which is a major advantage over conventional solar power on the ground. With increasing populations and limited land resources, space-based solar power provides a way to generate energy without taking up valuable land resources.

No environmental impact: Space-based solar power does not have any environmental impact, as it does not emit any greenhouse gasses or pollutants into the atmosphere. This makes it a cleaner and more environmentally-friendly energy source compared to conventional energy sources.

Overall, the advantages of space-based solar power make it an attractive alternative to conventional energy sources. With the ability to provide an unlimited and sustainable source of energy, as well as the reduced environmental impact and increased efficiency, space-based solar power is becoming an increasingly popular option for people all over the world.
As the world's energy demand continues to grow, it is clear that conventional energy sources will not be able to keep up. This is why the development of space-based solar power is becoming increasingly important. With the ability to provide an unlimited and sustainable source of energy, space-based solar power has the potential to play a major role in meeting the world's energy needs in the future.

Challenges and Conclusion:
One of the main challenges facing space-based solar power is the cost of deployment. Currently, the cost of launching and deploying space-based solar panels is relatively high compared to conventional solar panels on the ground. However, as the technology for space-based solar power continues to improve, it is expected that the cost of deployment will decrease. This will make space-based solar power a more affordable and accessible option for people all over the world.

Another challenge facing space-based solar power is the complexity of operations. Space-based solar power systems are complex and require specialized knowledge and expertise to operate and maintain. However, as the technology continues to improve, it is expected that the complexity of operations will decrease, making space-based solar power a more accessible and practical option.

In terms of the technology for transmitting energy from space to Earth, there is still much room for improvement. The current methods for transmitting energy from space to Earth, such as microwaves and lasers, are still in their early stages and require further development. However, as the technology for transmitting energy from space to Earth continues to improve, it is expected that the efficiency of space-based solar power will increase.

The future of space-based solar power looks bright, with advancements in technology and the increasing demand for renewable energy. As the cost of deployment decreases and the technology for transmitting energy from space to Earth improves, it is expected that space-based solar power will become a more affordable and accessible option for people all over the world.

In conclusion, space-based solar power has the potential to play a major role in meeting the world's energy needs in the future. With the ability to provide an unlimited and sustainable source of energy, space-based solar power is becoming an increasingly attractive alternative to conventional energy sources. With advancements in technology and the decreasing cost of deployment, it is expected that space-based solar power will play a larger role in meeting the world's energy needs in the future.

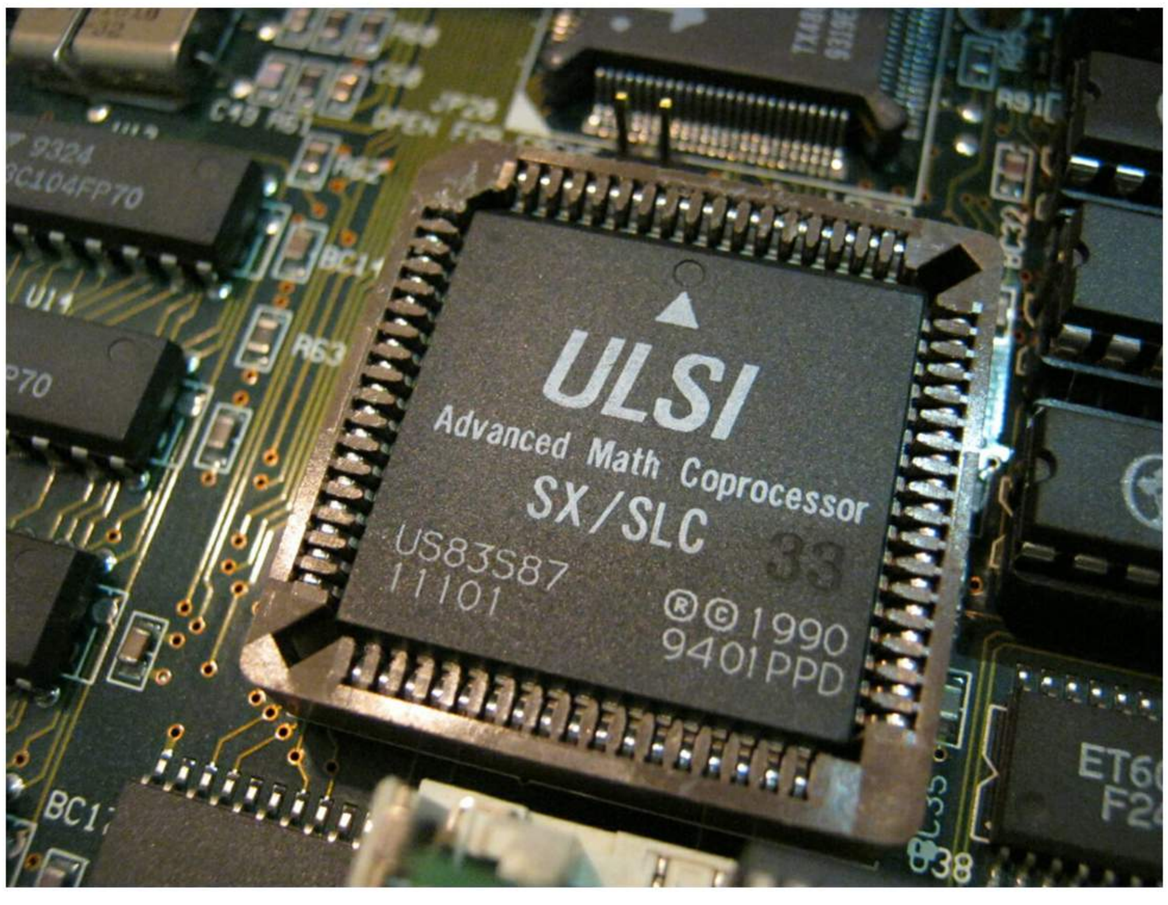
ULSI- FIFTH GEN'S TECHNO-GEM

The telephone was invented in the year 1986. Would it have been believable if the people of that era were told that any message or photo could be sent to any corner of the world with a single touch in seconds?

The Wright brothers invented a primitive flight in 1903. Had the people of their generation believed if they would have been told that hundreds of people would be able to fly together and make it in a blink to their destination.

What exactly is ULSI?

Electronic circuits integrate RAM, ROM, CPU, and some peripherals on a single circuit board assembly. However, ultra large scale integration technology enables an IC designer to embed all these in one chip. Over the years, we have seen rapid growth in the electronics landscape. Ultra large-scale integration (ULSI) is the process of integrating or embedding millions of transistors on a single silicon semiconductor microchip. ULSI technology was conceived during the late 1980s when superior computer processor microchips, specifically for the Intel 8086 series, were under development. ULSI is a successor to large-scale integration (LSI) and very large-scale integration (VLSI) technologies but is in the same category as VLSI.



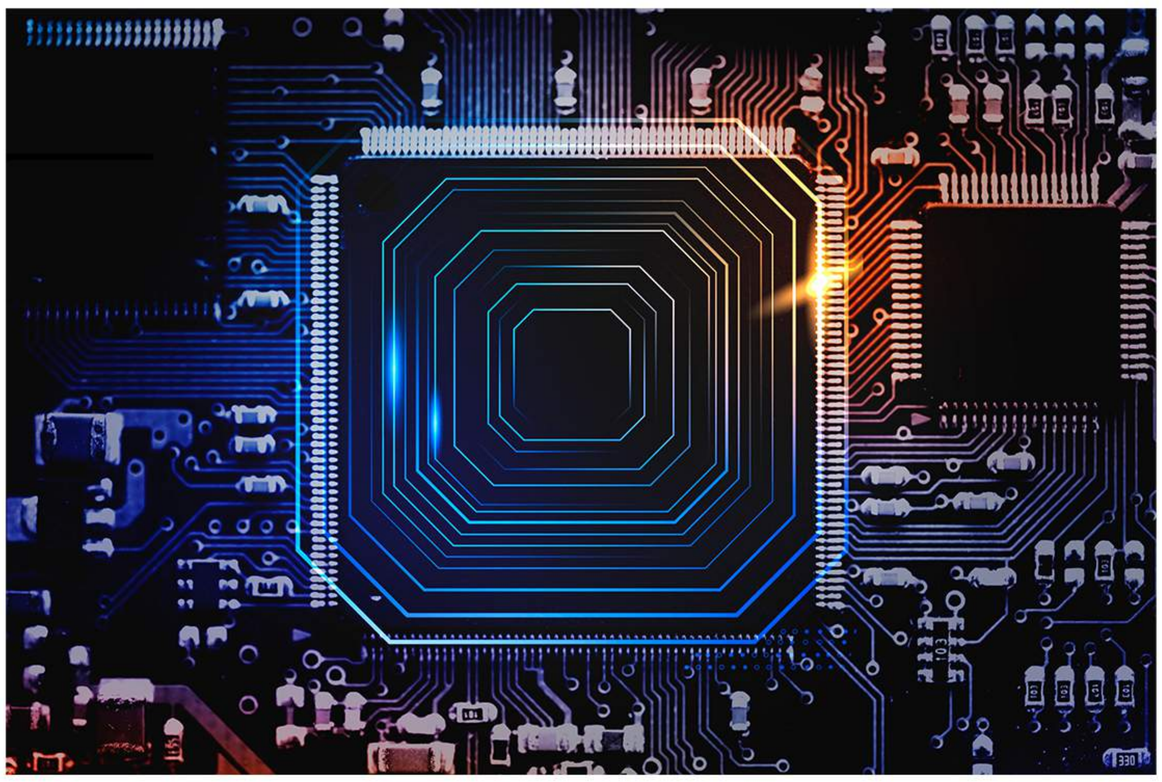
Why shift towards ULSI Technology? What exactly is the reason behind the boom of ULSI Technology over VLSI or its primitive technologies?

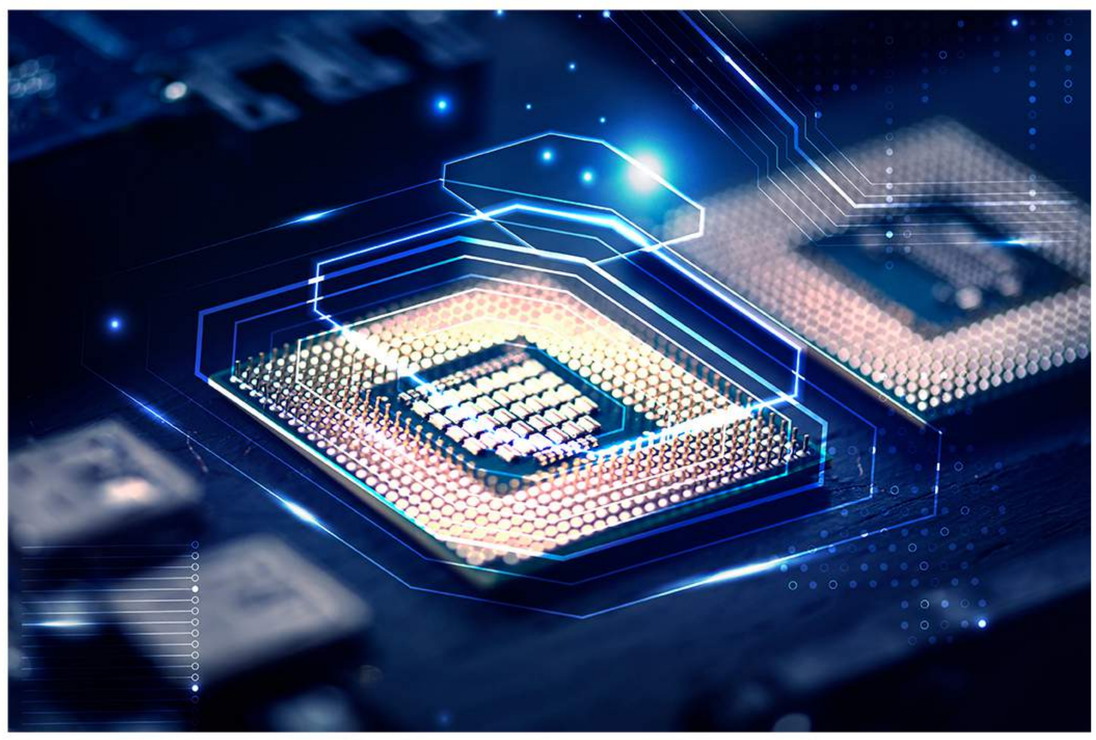
It is a natural tendency for human beings to adapt to newer developments, if proved advantageous. What exactly made us move from no phone to button phone to simple touch mobiles to iPhone 8 to 9 to any other version awaits across? Simple- better design, better features, better compatibility, more comfort. Since ULSI microprocessors allow the integration of numerous components in a compact fashion , this has resulted in the reduction of circuit size. The circuit elements used in ultra-large-scale-integration technology contain very many dissimilar materials in close proximity and having extremely small dimensions. With each chip generation, the feature sizes become smaller . Such integrated circuits

contain millions of transistors and comparable numbers of passive circuit elements, all connected by a few hundred meters of submicron-wide metal lines distributed on several levels .During operation, the current density within these wires can be well in excess of 10000 A cm−2 and the chip may consume 10 W or more, causing joule heating in the wiring and passive elements. In addition, the transistor junctions usually have operating temperatures around 100 °C and produce significant heat output.

Due to its impecable reduction in size, it can be utilized with great efficiency.Not just reduced size but, ULSI has also enhanced performance in operating speed of circuitsThis is the reason behind the quick decision making and response of the fifth generation computers and machines. Also, this new breed of computer is capable of carrying out some exceptionally complicated functions at an improved speed.

Furthermore, this technology has improved the reliability and functionality of devices. In computing applications, the ULSI microprocessor performs tasks and gives highly reliable results.In addition it has helped to promote the miniaturization of devices. Also, miniaturization involves installing more transistor nodes on a smaller IC. The ULSI technology has helped to promote miniaturization of computers





Since large use of ULSI in fifth generation computers is mentioned, that may raise another question. What are fifth generation technologies?

It is by far the most successful generation of computers, its major benefit being the incorporation of artificial intelligence and parallel processing hardware. Artificial intelligence enables the computer to be more human-like-more realistic to earthly existence.

Incorporation of ULSI into fifth generation computers:

Since the efficient development of artificial intelligence required the implementation of millions of transistors and chips, ULSI seemed to be the sole resort. Its compatibility with commonly used languages proved to be a boon.

On the whole, from vacuum tubes to microprocessors chips to artificial languages, from binary machine coding to higher level languages, the word has come through a great technological journey and achieved many milestones along way. ULSI has indeed become one of the essential milestones attained by the field of emerging science and technology.

CYBER SECURITY in smart grids

Our traditional power system majorly involves electrical energy and power balancing. Generally, the amount of power from a large central power plant is transmitted at high voltages and distributed at lower voltages. This is operated in a well-planned scheme in which bulk power follows the volatile load to reach the energy balance. This type of real-time power balance is an elementary need of power system security. The stability of a power system, i.e., the ability to recover from a disruption caused at equilibrium, is another essential requirement for the power systems security aspect. Control systems are used for maintaining and enhancing stability in such instances. The local information in such systems can accelerate power distribution due to the reduction of communication requirements. It also gives us clear information about any problems or disturbances propagating through the network, which makes it easier for us to rectify. A centralized controller and various local controllers are implemented to balance segments of the network. This emphasizes that stability and balance are key factors of power system security. Conventional power systems are operated using complex manual work methods to incorporate security. These methods ensure the system's security but fail to fulfil sustainability needs. This shortcoming is rectified by smart grids.

An electric grid used along with the traditional power system to gather data about consumption, wastage, and management of electric power is called a smart grid. It acts as a two-way flow of electricity and data, improving the electric network's quality. It is a low-carbon, intelligent and sustainable system that integrates advanced information and communication technologies thereby improving the power system quality. The accommodation of renewable energy sources in a smart grid is convenient. Also, with the development of a wide-area measurement system (WAMS) provides more feasible solutions to deal with various stability issues caused due to the integration of renewable energy sources.In smart grids, the data collected under its network is first exchanged between customers and energy providers, which helps calculate and manage peak demand in the system. This effectively reduces the electricity bill of consumers. It can accommodate more renewable energy sources along with fossil fuels and thus reduce greenhouse gas emissions.

Moreover, it also offers wide area measurement system (WAMS) which provides more flexible solutions to manage stability issues caused due to the integration of renewable energy sources to the system. Such features can maximize the effectiveness of dealing with increasing uncertainty. Although smart grids come with various benefits to the power systems, it is quite vulnerable as they might be a powerful tool for hackers.

The information collected through smart grids contains sensitive data which can be misused or manipulated by attackers and is also harder to detect. These security threats build the need for cyber security in smart grid systems. Smart grids rely on both wired and wireless network technologies. Supervisory Control and Data Acquisition (SCADA) systems are generally used to monitor power operation in transmission and distribution domains. The main cyber security solutions considered are the availability of information, the integrity of preserved/ unmodified data during power transmission, and the privacy of the data from unauthorized access.

It is prominent that cyber-attacks will have a negative impact on the existing power system network. Such attacks are mainly: Denial of service (DOS) attacks or False Data Injection Attacks (FDIA). Denial of service attack occurs when hackers communicate misleading instructions to a server disturbing their services to consumers temporarily or indefinitely. This is generally done by flooding the target network with excessive requests causing overload and failure of the system.

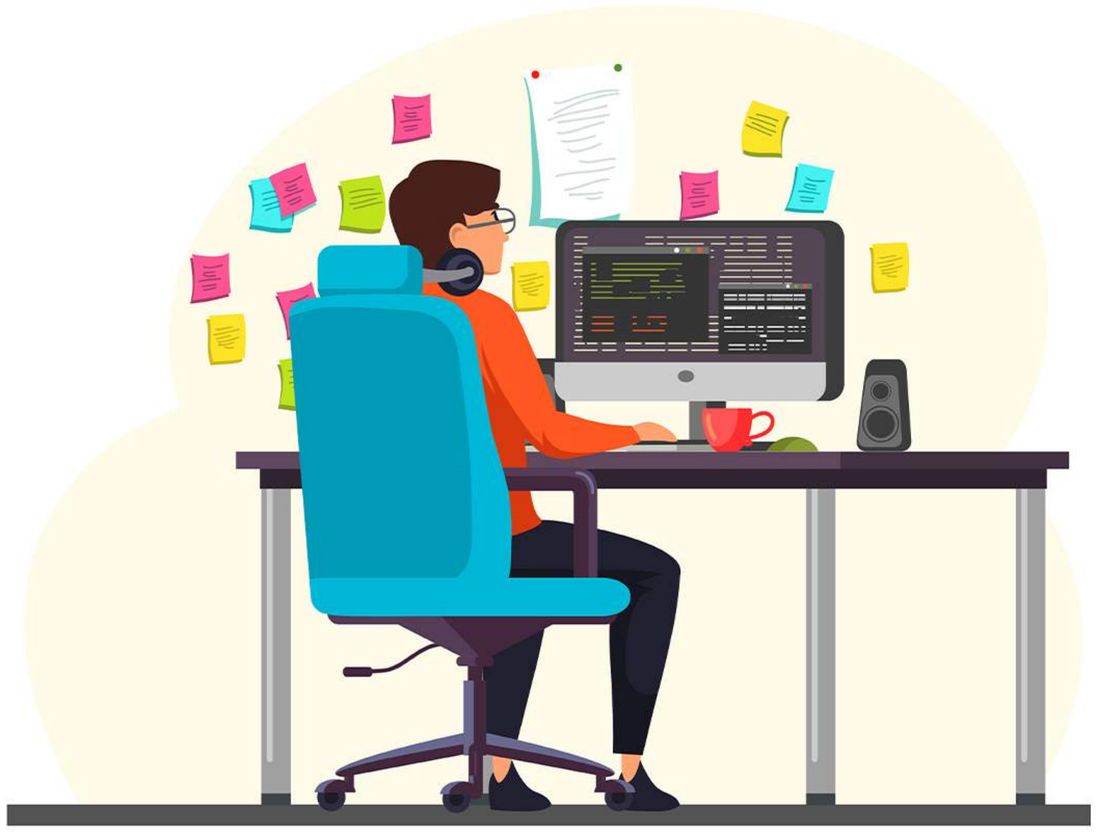
The False Data Injection Attacks can disturb the power system's estimation services and mislead the system operator, resulting in the non-credibility of data. This is done using false and malicious information to mislead the operation and control functions of energy management systems.Reliable defence strategies must be created to face this kind of attack. To create a defence against DOS attacks, attack mitigation systems can be used. There are mainly two types: Network Layer Mitigation and Physical Layer Mitigation. Network layer mitigation can be implemented by imposing a rate limit on a set of packets that might be vicious, filtering of source addresses of packets, or by reconfiguration of network architecture by isolating the attacks. Physical layer mitigation can be widely implemented in local-area systems using wireless communication methods in smart grids. These are three schemes in physical mitigation, direct sequence spread spectrum (DSSS), frequency hopping spread spectrum (FHSS), and chirp spread spectrum (CSS).

In many countries like Australia, smart grid networks are creating massive transformation which improves the efficiency of energy management, reduces the electricity bill of consumers, accommodates more renewable energy sources, and reduce greenhouse emissions. Cyber security becomes increasingly important for power industry, since traditional power grid is mainly based on private networks which do not need substantial cyber security concern. Thus cyber security in smart grid is a new research direction that has already attracted increasing attention in the academia and industry.

BRAIN COMPUTER INTERFACES

What if you could control your computer with your thoughts?

This is the promise of brain computer interfaces (BCIs), which are technologies that allow people to communicate with computers using nothing but their minds. By detecting brainwaves and then translating them into commands that the computer can understand, BCIs enable us to interact with machines in new ways. Although they are in their infancy, BCIs have the potential to transform the way we use computers and could even allow people with neurological disabilities to live more independent lives. Imagine having a device that could translate thoughts into text, allowing people with limited mobility to type using only their minds. Or imagine being able to turn your mind into a video game controller! There are already several companies working on developing BCIs. In this article, we will discuss the technology behind BCIs and look at some companies working to bring them to market. We will also discuss some ethical and legal issues associated with developing this technology. Finally, we will suggest future research directions in this exciting new field.



What is a brain computer interface?

A brain computer interface (BCI) is a technology that allows a person to control a device or computer with his or her mind. There are many ways that a BCI could be implemented, but the most common uses involve reading brain activity in order to convert it into commands that can be understood by a computer. For example, a person wearing a BCI headset might be able to move a cursor around a screen by thinking about moving the cursor in a certain direction. Another possible application would involve translating language into commands. A person wearing an EEG headband might be able to type on a computer simply by thinking of the letters that he or she wants to type. In the future, it may be possible to build a fully functional computer using only the brain as a power source. The possibilities are endless!

What is electroencephalography (EEG)?

Electroencephalography (EEG) is a technique for measuring electrical activity in the brain. This electrical activity is recorded as waves called "brainwaves." An EEG can measure the activity of many different parts of the brain at the same time. It can produce a large number of data points per second, making it very energy efficient. So how does it work? An EEG machine detects and records the brain's electrical signals using two electrodes placed on the scalp. The electrodes are typically placed on the forehead and behind the ear. Electrodes connected to the machine can detect the brain's electrical activity. The machine then analyzes these signals and converts the data into a set of numbers. These numbers are interpreted as the activity in different parts of the brain. This process is called "brainwave analysis." Each type of brain wave has a particular frequency and pattern associated with certain mental states. The brain uses different types of brainwaves at different times of the day to carry out different tasks. Alpha waves are emitted when the person is at rest or lightly concentrating on a task. Beta waves are produced when the person does mental tasks such as concentrating, problem-solving or recalling information. Gamma waves are produced when the person is feeling anxious or excited. Delta waves are produced when the person is asleep or in a coma.

What does a Brain-Computer Interface (BCI) do?

A Brain-Computer Interface (BCI) is a device that measures brain activity and controls external devices using this information. Usually, the device takes readings from electrodes placed on a person's scalp and translates them into commands sent to the devices the person wants to operate. The device can control computers, robots, prosthetic limbs, and other electronic devices. BCIs make it possible for people to use their thoughts to control objects around them - without typing or moving their hands! In the future, these devices may help people with motor impairments or paralysis to use a computer or a robotic hand to perform basic movements, such as grasping an object or pointing to something on a screen. In the gaming industry, BCIs are being used to create new forms of immersive experiences. For example, BCIs can be used to control virtual reality games, allowing players to interact with their virtual environments using only their thoughts. This can make the gaming experience more engaging and realistic.

How does it work? How can it translate thoughts into physical actions?

In the near future, scientists hope to develop a device that can translate a person's thoughts into actual physical movements. For example, a device could be placed directly on someone's head that would read their brain waves and interpret them as commands to move an arm, a leg, or even a hand. This technology is still in its early stages, but it may one day help people who suffer from muscle movement disorders and have lost the ability to control their bodies. In the meantime, some researchers have developed other devices that can assist people who are paralyzed or suffer from other movement disorders by allowing them to control artificial arms and legs with their minds. These devices are known as exoskeletons and have recently been introduced as treatments for people suffering from stroke or spinal cord injury.

Are there risks involved in using a Brain-Computer Interface?

Many people are concerned about the safety of these devices because of the risks they may pose to user health. While the side effects of these devices have not yet been thoroughly studied, it is known that they can disrupt normal brain function. Devices that direct electrical energy through the brain may cause seizures and dizziness. There is also a risk that the apparatus may be damaged by the electrical activity of the user's brain. But these risks are minimal, and most researchers believe this technology's benefits far outweigh the risks.

Ethical issues involved in the use of these technologies:

While many people believe that these advanced technologies have the potential to improve the quality of life for millions of people with debilitating medical conditions, others argue that they present too significant a risk of adverse side effects. They believe these technologies should be used only as a last resort to treat patients with no other treatment options. Others also express concern that using these technologies raises important ethical questions about privacy and human rights. For example, many worry that it will become possible for the government and other unscrupulous individuals to use this technology to spy on people without their consent. There are also concerns that the technology may allow people to cheat during mental tests such as lie detector tests and exams for psychological disorders such as depression. These are just a few of the ethical issues that have been raised about the potential use of Brain-Computer Interfaces. These issues will likely continue to be debated in the coming years.

Is it possible to create better BCIs in the future?

Many researchers are working to develop better brain-computer interfaces. In the next several years, we will likely see advances in this field that will make this technology more accessible and usable for a broader range of patients. We'll also likely begin to see the development of devices that allow users to communicate using only their thoughts. These devices may eventually make it possible for patients suffering from severe physical disabilities to communicate with other people. Despite these exciting developments, it is still unclear how widespread these devices will be in the years to come. Many people remain skeptical about their effectiveness and safety. As a result, it may take some time before they become more widely adopted. There is still much to be learned about the uses and limitations of this technology before it can be safely and reliably used by the general public.

What diseases could a BCI be used to help treat or manage?

There are a wide variety of medical conditions that a BCI could potentially be used to treat or manage. These include neurological disorders such as epilepsy, Parkinson's disease, and stroke. They also include several psychiatric disorders, such as autism and depression. In the future, it is hoped that these devices could be used to help people with these conditions lead more normal lives. However, they will probably only be effective in helping a small number of patients with these disorders. It remains to be seen whether they will ever be widely used for this purpose

How well are BCIs regulated and tested?

Many factors need to be considered when developing and testing a brain-computer interface. These include the size and placement of the device on the patient's head, the type of electrodes used, and the computer software used to analyze brain activity. All of these things need to be carefully tested and modified before they are used in an actual clinical setting. It is also important that the device is thoroughly tested on a number of different patients and various situations before it is used in a live case. Unfortunately, many devices currently in use have yet to be subjected to this type of rigorous testing. Until they are, they cannot be recommended for use by the general public.

What are the current limitations of BCI technology?

The first is that most devices are not designed for long-term use. This makes it challenging to use them in situations where a patient requires continuous monitoring for an extended period of time. As a result, many doctors are reluctant to recommend their use for patients with severe disabilities or health problems that require constant treatment and monitoring.

The second limitation is that some devices only detect single types of signals in the brain. Others are capable of detecting many different signals at the same time. In some cases, this may make it more difficult to distinguish between the various signals. This can make it tough to interpret the results obtained from a scan and may lead to errors in diagnosis

The third limitation is the fact that these devices are currently very expensive to manufacture. This makes it difficult for researchers and medical professionals to obtain the necessary funding to develop and implement them into clinical practice.

How safe is a BCI compared to traditional medical techniques?

One of the major concerns surrounding the development of brain-computer interfaces is their long-term safety. These devices are currently being tested by researchers at universities and medical schools around the world. Although some of the devices are relatively non-invasive, others involve the placement of electrodes directly on the surface of the brain. These electrodes have the potential to cause damage to brain tissue if they are left in place for an extended period of time. It is therefore recommended that the devices are used only under the supervision of a trained medical professional. Patients with certain medical conditions should also be advised that this device may not be appropriate for them. There is not yet enough information available about the safety of these devices to give a definite answer to this question. However, it is expected that further testing and research will help to clarify this issue in the near future.

Brain Computer Interfaces (BCIs) have the potential to revolutionize the way we interact with technology and the world around us. With the rapid advancements in artificial intelligence, machine learning, and wearable technology, BCIs are becoming more accurate and reliable every day. The potential applications for BCIs are vast and include improving human cognition, education and training, and the treatment of mental health conditions. Despite the challenges that must be overcome, the future of BCIs are incredibly promising and holds the potential for a new era of human-computer interaction. As research in this field continues to advance, it will be exciting to see how BCIs will change and enhance our lives in the coming years.

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