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ELECTRONICS &COMMUNICATION ENGINEERING

SANTHIRAM ENGINEERING COLLEGE-NANDYAL

ELECTRONICS & COMMUNICATION ENGINEERING

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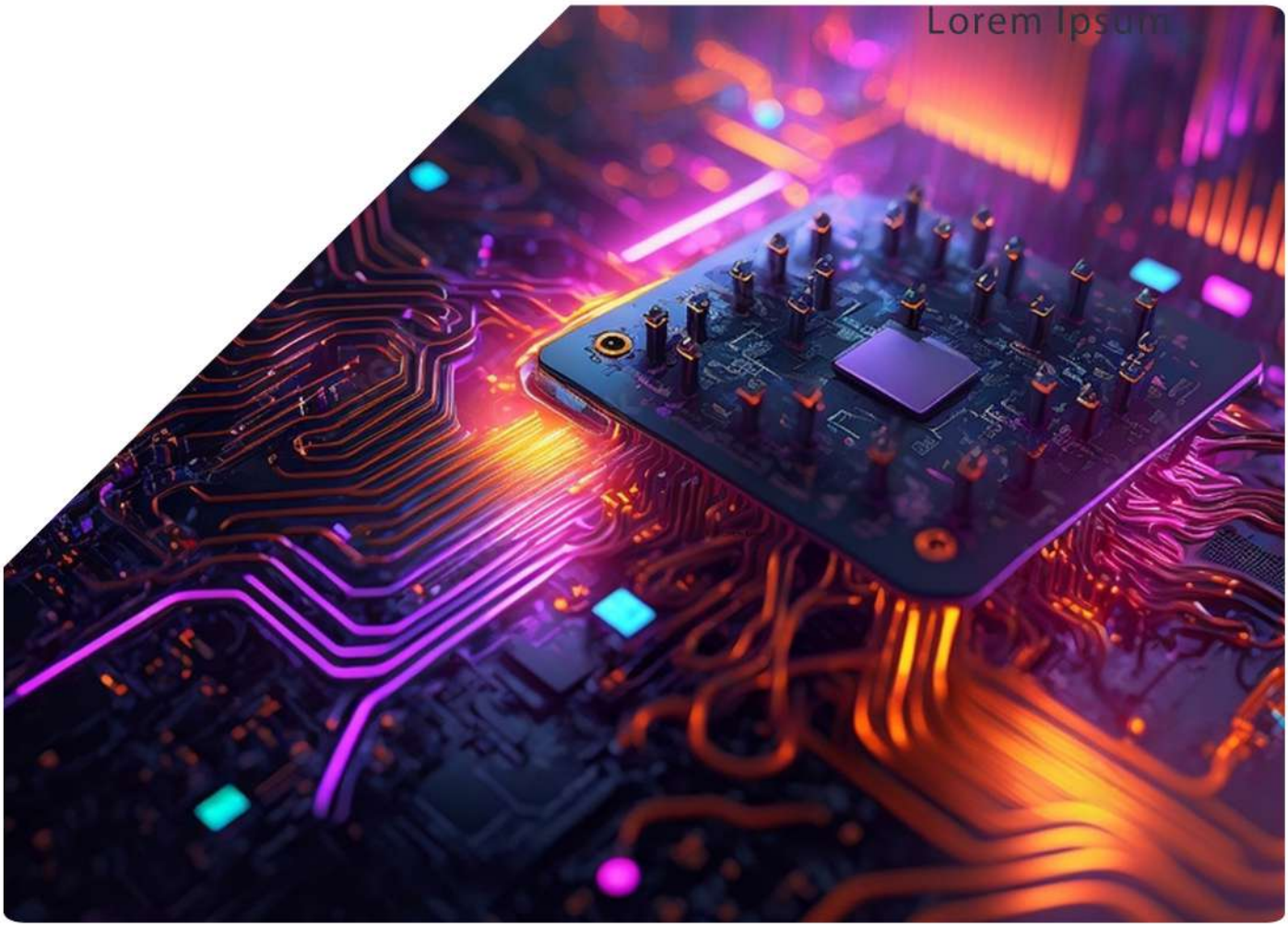

EDITORIAL BOARD

ABOUT THE COLLEGE

Santhiram Engineering College (SREC) is sponsored by M/s Sri Shirdi Sai Educational Academy, Nandyal. SREC is established under the able guidance of Dr. M. Santhiramudu, Chairman in the year 2007 with a noble motto “Education for peace and progress”. SREC is approved by AICTE, New Delhi: Recognized by UGC under 2(f) and 12 (B): Permanently Affiliated to JNTUA, Anathapuramu: Certified to anISO 9001:2015. The college is ranked as one of the Best Engineering Colleges of JNTUA. Ananthapuramu.

OUR MOTTO

EDUCATION FOR PEACE AND PROGRESS

Vision

To become a nucleus for pursuing technical education and pool industrial research and developmental activities with social-conscious and global standards.

Mission

To provide Advance Educational Programs and prepare students to achieve success and take leading roles in their chosen fields of specialization

To establish postgraduate programs in the current and Advanced Technologies

To establish an R&D Consultancy through developing industry institute interaction, building up exceptional infrastructure

To propel every individual,realize and act for the technical development of the society

ABOUT DEPARTMENT

Anticipating the significance of the electronics and wireless communication realistic role in the society, industry and among the public, the Department of Electronics and Communication Engineering has been started carrying up its rationale since 2007 concentrating and imparting electronic & technological solutions in to the young minds of the Society. The Department was initially started with an intake of 60 seats since the opportunities are stupendous and the increase in demand for the production of engineers it is upgraded to 120 seats in 2008.Forecasting the tremendous growth & opportunities in VLSI, the Department also started a Master of Technology(M. Tech) program in VLSI System Design in the year 2011 with an intake of 12 seats. The department received an ISO 9001:2015 certification for its qualitative functioning.The department received accreditation from the NBA in 2023.

The objectives of the department include: to produce quality engineers, indulge in research and promote the students to be active in entrepreneurship. The faculty has been involved in teaching and research in the diverse aspects such as Wireless Communications & Networking, Microelectronics and VLSI, Digital Image Processing and Antenna design. The department has state of the art laboratories. The faculty is entrusted to bring fine research, developmental and design experience into the classroom, ensuring that our students are being treated as professional engineers in all parts of global engineering and the scientific community.

The department extends its unwavering support for the growth of every student fulfilling their dreams. The department also extended its support to groom and nurture the qualities of teamwork, leadership, mutual understanding and co-ordination providing exposure to public and executive communication.

VISION

Emerge as a center for quality education in Electronics & Communication Engineering so as to create competent professionals.

MISSION

M1: Offer quality programs in Electronics & Communication Engineering aimed at fulfilling the needs of society and industry.

M2: Impart skills and develop scientific temper to solve complex technological problems of current times.

M3: Nurture ethics, talent and entrepreneurship to inculcate professional development of students.

Under graduate Program Outcomes

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Under Graduate - Program Educational Objectives (PEOs)

1. PEO1: Have in-depth knowledge in Electronics and Communication Engineering to innovate, design, and develop modern electronic systems.
2. PEO2: Sustain intellectual curiosity in professional career through life-long learning.
3. PEO3: Have strong work ethics, professional attitude, team spirit, leadership skills, and enterprising skills to serve industry and society.

Post Graduate -Program Outcomes:-

PO1: An ability to independently carry out research /investigation and development work to solve practical problems.
PO2: An ability to write and present a substantial technical report/document.
PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

Post Graduate -Program Educational Objectives (PEOs) :-

M. Tech. in VLSI Design Program, graduates will be able to:
1. PEO1: Identify and apply appropriate Electronic Design Automation software and electronic equipment to analyze, synthesize and evaluate to solve real-world problems in the VLSI domain to create innovative products and systems.
2. PEO2: Purse research studies in the core or allied areas of the VLSI circuits and systems.
3. PEO3: Inculcate positive attitude, professional ethics, effective communication, and interpersonal skills to succeed in the profession exhibiting creativity and innovation through research and development both as a team member and leader.

MESSAGES

CHAIRMAN MESSAGE

PRABODHINI of ECE Department. Exclusively meant for churning out the latent writing talent. I congratulate all the contributors for bringing out such a beautiful magazine. It bears immense potential to sharpening the students skills as part of their overall personality development. Good things remain good only because they are always scarce. It gives me immense pleasure to pen a few words as prologue towards technical magazine PRABODHINI of ECE Department Exclusively meant for churning out the latent writing talent which bears immense potentiality of sharpening the students skills as part of their overall personality development.

Dr.M.Santhiramudu
Chairman/Founder

MD'S MESSAGE

I am pleased to learn that the department of Electronics and Communication Engineering will publish its technical magazine PRABODHINI this academic year (2023-24). This is a useful technical material and secondary skill development tool for students. I also commend the team's coordination and efforts in bringing this issue to light. I wish them all the best.

Mr. M. SivaRam
Managing Director

" ONLY EDUCATION TO EVERY INDIVIDUAL WILL MAKE EVERY INDIVIDUAL A CEREBRAL AND RESPONSIBLE CIITIZEN "

PRINCIPAL'S MESSAGE

I am very much pleased to know that the Electronics and Communication Engineering Department has emanated out with magazine PRABODHINI. Efforts like publication of the magazine are extremely valuable on academic campuses in enhancing, developing and honing the editorial skills amongst the literary-minded students, in addition to playing the role of a mirror to the past and the possible future that holds great importance for the students. With the ever-changing priorities of the generations of the student communities that pass by the institute, such efforts can be sustained only through the commitment and dedication of the Students and Faculty members. I extend my warm patronage to all those who have contributed their best to achieve success.

Dr. M.V.Subramanyam
Principal

HOD'S MESSAGE

The Department of Electronics & Communication Engineering (ECE) has consistently maintained an exemplary academic record. The greatest asset of the department is its highly motivated and learned faculty. The available diversity of expertise of the faculty with the support of the other staff prepares the students to work in global multicultural environment. The graduates of the Electronics & Communication Stream have been selected by some of the world's leading corporations & as well as by most of the leading Indian counter parts. We hope that we will continue to deliver our best to serve the society and mankind. It is also expected that our students will continue to pass-on the skills which they have developed during their stay at this department to whole of the world for better society.

Dr.Y.Mallikarjuna Rao
HOD-ECE

TECHNOLOGY CATCHMENT AREA

IOT IN TESLA'S SELF-DRIVING CARS

The automotive industry is one of the many sectors that the Internet of Things (IoT) is changing. Automakers are now able to develop cutting-edge and creative solutions thanks to this technology. IoT applications give automakers enormous potential to improve the usability of their cars, gather consumer data, and maintain market competitiveness. One of the largest brands in the automotive sector, Tesla Motors, is also using IoT to improve the intelligence and usability of its connected cars.

Application of IoT in Tesla's Self-Driving Cars

Application of IoT in the Automotive Industry

IoT in the automotive industry refers to embedding sensors, actuators, and other IoT technologies into automobiles. The goal is to create solutions that make vehicles smarter, efficient, and more intelligent. There are many IoT-based solutions that are shaping the new automotive age, including:

- Predictive maintenance
- Advanced Driver Assistance Systems (ADAS)
- 3G/4G/5G powered Wi-Fi functionality
- Car2Car connectivity
- In-vehicle infotainment system

With IoT, connected cars are making life easier for both drivers and carmakers, in terms of electronic upgrades. An IoT embedded car enables you to control and monitor your vehicle's stats. You can do this with just a single tap on the app.

What is Tesla's Self-Driving Car?

A self-driving car refers to a driverless car that uses the Internet of Things (IoT) and Artificial Intelligence (AI) to function. Self-driving cars can drive themselves without the driver taking care of the tasks such as handling the steering, changing the lanes, parking, etc. This can significantly improve traffic and safety.

Tesla cars use mobile connections to offer various functions such as remotely setting temperature and

Features & Benefits of IoT Powered Tesla's Self-Driving Cars

Autopilot

Tesla produces cars with software available for Autopilot and Full Self-driving capabilities. Tesla's Autopilot feature is an Advanced Driver Assistance System (ADAS). It reduces your tasks as a driver and improves safety and convenience. The Autopilot system is built on a deep neural network. It is capable of taking care of the car controls in some situations.

The latest Tesla cars come equipped with 8 external cameras, 12 ultrasonic sensors, and a robust onboard computer. They provide drivers with a sense of the environment and surroundings around the car.

Over-the-air Updates

Previously, the only way to update cars was by sending them to the dealers. As the lives of car buyers become more complex, it is very inconvenient for the consumer to take the car to the dealer. In the case of Tesla cars, the owners can skip taking the car to the dealer and can go about their day while the car fixes itself.

Tesla's Model S was the first car to get over-the-air software upgrades. Like a smartphone, Tesla cars download new software to introduce new functions and eliminate bugs.

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Connectivity

Tesla cars are bundled with Standard Connectivity that provides access to connectivity features over Wi-Fi only. In addition, the services include music and media streaming services and live traffic details using Bluetooth. Tesla also offers Premium Connectivity. It offers all connectivity features over cellular, in addition to Wi-Fi.

Apps

Tesla's mobile app allows car owners to unlock or lock the car, flash the lights, or trigger the horn. You can use the Summon feature. It moves your car in and out of a tight space using the mobile app.

Using the app, you can set the climate control of the car,

Potential Challenges & Risks of Self-driving Cars

Some of the potential risks associated with IoT-based self-driving cars include:

1. Hacking: Since the cars are connected to the Internet, hackers can gain access to the driverless car's computing system or control of the car, which could be dangerous.
2. Integration with Traditional Cars: Riding an autonomous car sounds great. However, it is unclear how self-driving cars will react on the roads with traditional cars which are driven by human drivers.
3. Road Accidents: Our present road infrastructure is not developed for self-driving vehicles. Driving on current infrastructure is uncertain. Autonomous cars will have to operate on existing highways, roads, and city streets. This may require them to cope up with sudden changes which can cause accidents.
4. Exposure to Radiation: Self-driving cars are equipped with many technologies. They come with Wi-Fi, GPS, remote controls, power accessories, Bluetooth, and more. These technologies may expose the passengers to high levels of electromagnetic field radiation. Exposure to such radiation can cause serious health issues.

Conclusion

For many people, the ultimate goal for commuting life is to leave everything to their cars. They want to get in the car in the morning and not have to worry about traffic, weather, or traffic lights until they arrive at their destination. IoT is enabling car makers and buyers to achieve this goal by providing innovative and advanced solutions.

Ms.V.Nagamani
Asst.Professor

Wireless Power Transfer

.Wireless Power Transfer

Wireless power transfer (WPT) is revolutionizing how we interact with technology. It allows us to charge and power devices without the clutter of cables. This innovative approach is crucial in driving efficiency and sustainability in technology use, particularly in automotive, consumer electronics, and other sectors. As the world moves towards greener solutions, interest in and demand for WPT technology are on a steady rise.

SimScale offers powerful, easy-to-use online simulation tools that enable engineers and designers to explore, design, and refine WPT systems efficiently. With Time-Harmonic Magnetics, a feature of SimScale's Electromagnetics solver, SimScale supplies engineers with cloud-native simulation capabilities for visualizing and analyzing the dynamics of wireless power transfer, helping optimize design, performance, and efficiency.
This article provides insights into WPT fundamentals, its diverse applications, and how SimScale's cloud-native simulation platform makes wireless power simulation more accessible and practical.

The Fundamentals of Wireless Power Transfer Technology

Wireless Power Transfer (WPT) technology facilitates the transmission of electrical energy without physical connections or wires. Also known as wireless charging, WPT offers a wireless solution for charging devices, eliminating the requirement for conventional power cords. As a result, products can become less intrusive and convoluted, rendering charging and powering devices convenient and efficient.

WPT utilizes several mechanisms based on electromagnetic fields and waves:

- Magnetic Field Wireless Power Transfer
- Capacitive Wireless Power Transfer
- Radiative Wireless Power Transfer
- Optical Wireless Power Transfer
- Ultrasound Wireless Power Transfer

C

Magnetic Field Wireless Power Transfer

Magnetic WPT is an innovative technology that enables the wireless transmission of electrical energy through magnetic fields. This approach is categorized mainly into two methods: Inductive Power Transfer (IPT) and Magnetic Resonance Coupling (MRC). Each serves different applications with distinct operational principles

INDUCTIVE POWER TRANSFER (IPT)

Grounded in electromagnetic induction, Inductive Power Transfer is a well-established method that has seen practical applications since the 1970s, with significant advancements made since 1991 at the University of Auckland. This technology forms the basis of wireless charging in devices ranging from cordless phone handsets to electric toothbrushes and has been pivotal in industrial applications like factory transport systems.

The principle of IPT involves generating a magnetic field through a current-carrying coil (primary side), which then induces a voltage in a nearby coil (secondary side) through electromagnetic induction. This induced voltage, in turn, generates a current in the secondary coil, enabling power transfer.

Magnetic Resonance Coupling (MRC)

The advent of magnetic resonance coupling (MRC) marked a significant leap forward, as demonstrated by a 2007 breakthrough from MIT. MRC utilizes the resonance phenomenon to enable highly efficient power transmission over distances up to 2 meters, vastly expanding WPT's practical applications.

Capacitive Wireless Power Transfer

Capacitive Wireless Power Transfer (CWPT) is a method of transmitting energy wirelessly using electric fields between conductive plates, a concept initially demonstrated by Nikola Tesla in 1891.

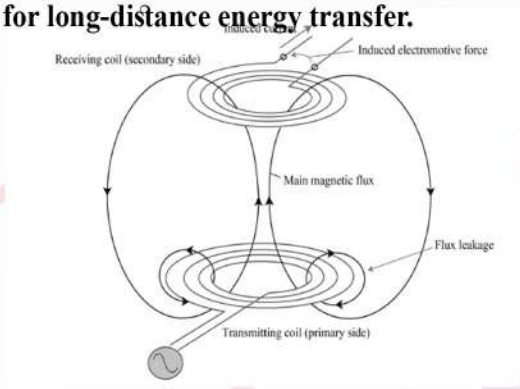
CWPT operates efficiently over short distances and is based on electric induction or capacitive coupling, where alternating current induces a displacement current across a dielectric medium situated between transmitter and receiver plates. The efficiency of CWPT is defined by the capacitance equation:

Radiative Wireless Power Transfer

Radiative Wireless Power Transfer (RWPT) harnesses electromagnetic waves, notably in the microwave or radio frequency (RF) spectrum, to transmit energy over substantial distances.

Historically challenging due to efficiency issues in beam divergence and RF-DC conversion, RWPT has seen advancements like the highly efficient rectennas developed by William C. Brown in the 1970s, achieving over 90% efficiency. Recent research has focused on enhancing each part of the RWPT system — from DC-RF conversion through beam propagation to RF-DC conversion — to minimize efficiency losses and improve the system's overall performance.

The appeal of RWPT, especially for far-field applications, is growing. It promises truly wireless operation for devices ranging from mobile phones to electric vehicles. This growth is driven by the potential for RWPT and energy harvesting methods to charge devices more efficiently and reduce reliance on environmentally unsustainable batteries. With ongoing improvements in system **components and a better understanding of managing beam propagation and reception, RWPT is poised to play a crucial role in the future of wireless power transmission, offering a solution for long-distance energy transfer.**



.Wireless Power Transfer Applications

WPT methods have been used in various applications, from recharging smartphones to powering electric vehicles. The transmitted power can range from microwatts to several kilowatts. Below are some examples of application areas where WPT is employed.

Industrial Applications

In the industry, WPT offers durable solutions against the harsh conditions that typically damage traditional wiring. It not only boosts operational efficiency and safety but also curtails maintenance costs. The deployment of WPT in powering sensors and industrial robots exemplifies its role in enhancing safety and ensuring continuous monitoring, marking a significant step toward automating and optimizing industrial processes

Automotive Industry

The introduction of WPT, especially in EV charging, has substantially transformed the automotive sector. This technology facilitates both stationary and dynamic charging, directly addressing range anxiety and user convenience concerns.

The rise of WPT in EVs exemplifies the shift towards more sustainable transportation methods, significantly contributing to the reduction of carbon emissions and fossil fuel dependence [7].

Aerospace Applications

NASA's exploration of WPT for space applications underlines its potential beyond Earth. The ability to transmit solar energy harvested by satellites to other satellites or back to Earth showcases WPT's capability to support long-distance energy transfer, opening new avenues for energy distribution in space exploration and satellite operations .

Consumer Electronics

The widespread adoption of WPT in consumer electronics has fundamentally changed how devices are powered. Wireless charging is now a standard feature for smartphones, laptops, and wearables. This shift enhances user convenience and aligns with environmental sustainability goals by potentially reducing the reliance on disposable batteries [9].

Medical Field

WPT offers revolutionary solutions for powering medical implants and devices in healthcare, providing a safer alternative to traditional wired power sources. This advancement improves patient mobility and comfort and

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Medical Field

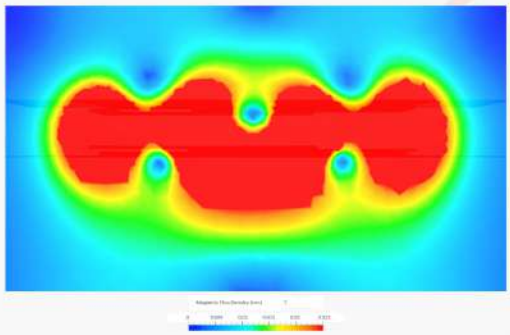
WPT offers revolutionary solutions for powering medical implants and devices in healthcare, providing a safer alternative to traditional wired power sources. This advancement improves patient mobility and comfort and facilitates the transmission of real-time health data, contributing to more personalized and effective treatments.

Wireless Charging Simulation with SimScale

Wireless charging simulation is enabled by the Time-Harmonic Magnetics feature on SimScale, which offers a robust framework for simulating the dynamic interactions within WPT systems. This feature is grounded in the time-harmonic approximation of Maxwell's equations, addressing electromagnetic fields that exhibit sine or cosine time dependencies.

The tool allows for a meticulous examination of how electric and magnetic fields interact across different scenarios, enabling engineers to accurately map out and visualize these interactions within various materials and geometrical configurations. Whether it is determining the optimal coil alignment for maximum power transfer or assessing the potential interference effects of surrounding materials, Time-Harmonic Magnetics offers a comprehensive simulation environment.

Integrating WPT simulations into the design process via SimScale brings several transformative benefits. It enables a profound understanding of the inner workings of WPT systems and the electromagnetic behavior underpinning successful energy transfer. This preemptive insight significantly diminishes the need for physical prototyping, leading to substantial cost savings and a quicker turnaround from concept to market-ready solutions. Moreover, SimScale's inherent collaborative nature encourages real-time sharing and iteration of designs, fostering a dynamic environment for cross-team and cross-geographical design optimization.



IImproving Power Transfer Efficiency

Engineers utilize the Time-Harmonic Magnetics simulations to confront and overcome the common hurdles WPT systems face, such as optimizing energy transfer and minimizing losses. Through SimScale, you can fine-tune coil configurations, test the effects of different materials, and adjust operational frequencies to enhance efficiency. The platform's comprehensive analysis capabilities enable a deep dive into phenomena like eddy currents and the skin effect, which are crucial for refining your WPT design for peak performance and reliability.

The power of SimScale's simulations to inform and guide the design process is transformative. Diving deep into the electromagnetic characteristics of WPT systems allows for innovation that pushes technological boundaries forward, creating more effective, compact, and secure wireless charging solutions. Simulations ensure data-driven decision-making, pinpoint potential issues early and guarantee that the end products are effective and perfectly tuned for practical application.

SimScale's cloud-native simulation platform reinforces WPT system design, offering comprehensive electromagnetic simulations through the Time-Harmonic Magnetics feature. It also facilitates the exploration of thermal management features, enabling multiple physics analyses simultaneously in one place. Its accessibility, scalability, and collaborative tools streamline the optimization of wireless charging solutions, significantly reducing development time from concept to reality. Engineers can harness these advanced simulations to navigate the complexities of wireless power transfer with greater efficiency and precision. Discover more about SimScale's electromagnetic and thermal simulation capabilities.

Ms.N.Jyothsna
Asst.Professor

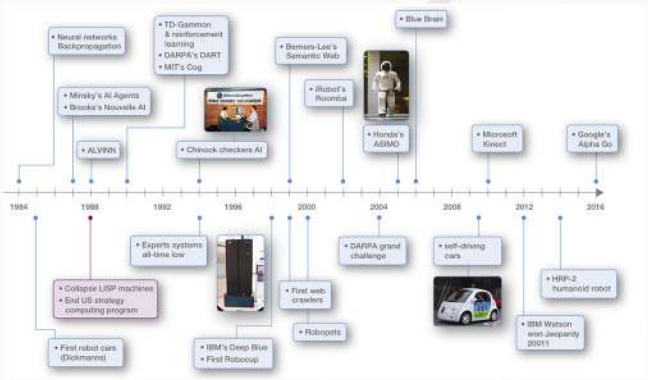
Artificial Intelligence (AI) is a commonly employed appellation to refer to the field of science aimed at providing machines with the capacity of performing functions such as logic, reasoning, planning, learning, and perception. Despite the reference to "machines" in this definition, the latter could be applied to "any type of living intelligence". Likewise, the meaning of intelligence, as it is found in primates and other exceptional animals for example, it can be extended to include an interleaved set of capacities, including creativity, emotional knowledge, and self-awareness. The term AI was closely associated with the field of "symbolic AI", which was popular until the end of the 1980s. In order to overcome some of the limitations of symbolic AI, subsymbolic methodologies such as neural networks, fuzzy systems, evolutionary computation and other computational models started gaining popularity, leading to the term "computational intelligence" emerging as a subfield of AI. Nowadays, the term AI encompasses the whole conceptualisation of a machine that is intelligent in terms of both operational and social consequences. A practical definition used is one proposed by Russell and Norvig: "Artificial Intelligence is the study of human intelligence and actions replicated artificially, such that the resultant bears to its design a reasonable level of rationality" [1]. This definition can be further refined by stipulating that the level of rationality may even supersede humans, for specific and well-defined tasks. Current AI technologies are used in online advertising, driving, aviation, medicine and personal assistance image recognition. The recent success of AI has captured the imagination of both the scientific community and the public. An example of this is vehicles equipped with an automatic steering system, also known as autonomous cars. Each vehicle is equipped with a series of lidar sensors and cameras which enable recognition of its three-dimensional environment and provides the ability to make intelligent.

Decisions on maneuvers in variable, real-traffic road conditions. Another example is the Alpha-Go, developed by Google Deepmind, to play the board game Go. Last year, Alpha-Go defeated the Korean grandmaster Lee Sedol, becoming the first machine to beat a professional player and recently it went on to win against the current world number one, Ke Jie, in China.

The number of possible games in Go is estimated to be 10761 and given the extreme complexity of the game, most AI researchers believed it would be years before this could happen. This has led to both the excitement and fear in many that AI will surpass humans in all the fields it marches into. However, current AI technologies are limited to very specific applications. One limitation of AI, for example, is the lack of "common sense"; the ability to judge information beyond its acquired knowledge. A recent example is that of the AI robot Tay developed by Microsoft and designed for making conversations on social networks. It had to be disconnected shortly after its launch because it was not able to distinguish between positive and negative human interaction. AI is also limited in terms of emotional intelligence. AI can only detect basic human emotional states such as anger, joy, sadness, fear, pain, stress and neutrality. Emotional intelligence is one of the next frontiers of higher levels of personalisation. True and complete AI does not yet exist. At this level, AI will mimic human cognition to a point that it will enable the ability to dream, think, feel emotions and have own goals. Although there is no evidence yet this kind of true AI could exist before 2050, nevertheless the computer science principles driving AI forward, are rapidly advancing and it is important to assess its impact, not only from a technological standpoint, but also from a social, ethical and legal perspective.

Weak and Strong AI

When defining the capacity of AI, this is frequently categorised in terms of weak or strong AI. Weak AI (narrow AI) is one intended to reproduce an observed behaviour as accurately as possible. It can carry out a task for which they have been precision trained. Such AI systems can become extremely efficient in their own field but lack generalisational ability. Most existing intelligent systems that use machine learning, pattern recognition, data mining or natural language processing are examples of weak AI. Intelligent systems, powered with weak AI include recommender systems, spam filters, self-driving cars, and industrial robots. Strong AI is usually described as an intelligent system endowed



Mr.kiran Kuma
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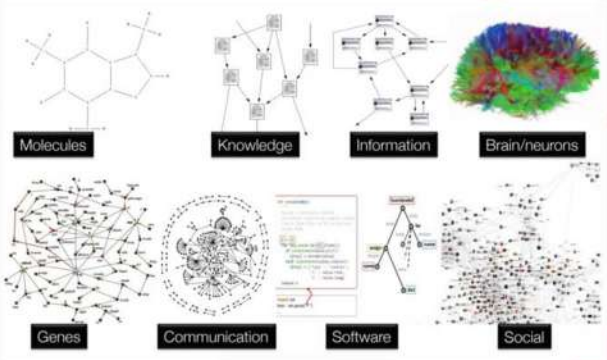
GRAPH NEURAL NETWORKS

Graph neural networks apply the predictive power of deep learning to rich data structures that depict objects and their relationships as points connected by lines in a graph.In GNNs, data points are called nodes, which are linked by lines — called edges — with elements expressed mathematically so machine learning algorithms can make useful predictions at the level of nodes, edges or entire graphs.An expanding list of companies is applying GNNs to improve drug discovery, fraud detection and recommendation systems. These applications and many more rely on finding patterns in relationships among data points.Researchers are exploring use cases for GNNs in computer graphics, cybersecurity, genomics and materials science. A recent paper reported how GNNs used transportation maps as graphs to improve predictions of arrival time..

Many branches of science and industry already store valuable data in graph databases. With deep learning, they can train predictive models that unearth fresh insights from their graphs. “GNNs are one of the hottest areas of deep learning research, and we see an increasing number of applications take advantage of GNNs to improve their performance,” said George Karypis, a senior principal scientist at AWS, in a talk earlier this year. Others agree. GNNs are “catching fire because of their flexibility to model complex relationships, something traditional neural networks cannot do,” said Jure Leskovec, an associate professor at Stanford, speaking in a recent talk, where he showed the chart below of AI papers that mention them.

LAmazon reported in 2017 on its work using GNNs to detect fraud. In 2020, it rolled out a public GNN service that others could use for fraud detection, recommendation systems and other applications. To maintain their customers’ high level of trust, Amazon Search employs GNNs to detect malicious sellers, buyers and products. Using NVIDIA GPUs, it’s able to explore graphs with tens of millions of nodes and hundreds of millions of edges while reducing training time from 24 to five hours. For its part, biopharma company GSK maintains a knowledge graph with nearly 500 billion nodes that is used in many of its machine-language models, said Kim Branson, the company’s global head of AI, speaking on a panel at a GNN workshop. LinkedIn uses GNNs to make social recommendations and understand the relationships between people’s skills and their job titles, said Jaewon Yang, a senior staff software engineer at the company, speaking on another panel at the workshop



To date, deep learning has mainly focused on images and text, types of structured data that can be described as sequences of words or grids of pixels. Graphs, by contrast, are unstructured. They can take any shape or size and contain any kind of data, including images and text. Using a process called message passing, GNNs organize graphs so machine learning algorithms can use them. Message passing embeds into each node information about its neighbors. AI models employ the embedded information to find patterns and make predictions

Ms.ChandanaPriya
21x51a0428.

Massive MIMO

Massive MIMO is the new wireless access technology in 5G, in both sub-6 GHz and mmWave bands. Since its inception about a decade ago, it has evolved from a wild "academic" idea to become the core technology that likely will be utilized in all future wireless technologies.

Massive MIMO is a multi-user MIMO (multiple-input multiple-output) technology that can provide uniformly good service to wireless terminals in high-mobility environments. The key concept is to equip base stations with arrays of many antennas, which are used to serve many terminals simultaneously, in the same time-frequency resource. The word "massive" refer to the number of antennas and not the physical size. The antenna arrays have attractive form factors: in the 2 GHz band, a half-wavelength-spaced rectangular array with 200 dual-polarized elements is about 1.5 x 0.75 meters large. Massive MIMO operates in TDD mode and the downlink beamforming exploits the uplink-downlink reciprocity of radio propagation. Specifically, the base station array uses channel estimates obtained from uplink pilots transmitted by the terminals to learn the channel in both directions. This makes Massive MIMO entirely scalable with respect to the number of base station antennas. Base stations in Massive MIMO operate autonomously, with no sharing of payload data or channel state information with other cells.

Massive MIMO techniques

Massive MIMO is based upon the three key concepts of spatial diversity, spatial multiplexing, and beamforming. MIMO builds on the fact that a radio signal between transmitter and receiver is filtered by its environment, with reflections from buildings and other obstacles resulting in multiple signal paths .

The various reflected signals will arrive at the receiving antenna with differing time delays, levels of attenuation and direction of travel. When multiple receive antennas are deployed, each antenna receives a slightly different version of the signal, which can be combined mathematically to improve the quality of the transmitted signal.

This technique is known as spatial diversity since the receiver antennas are spatially separated from each other. Spatial diversity is also achieved by transmitting the radio signal over multiple antennae, with each antenna, in some cases, sending modified versions of the signal.

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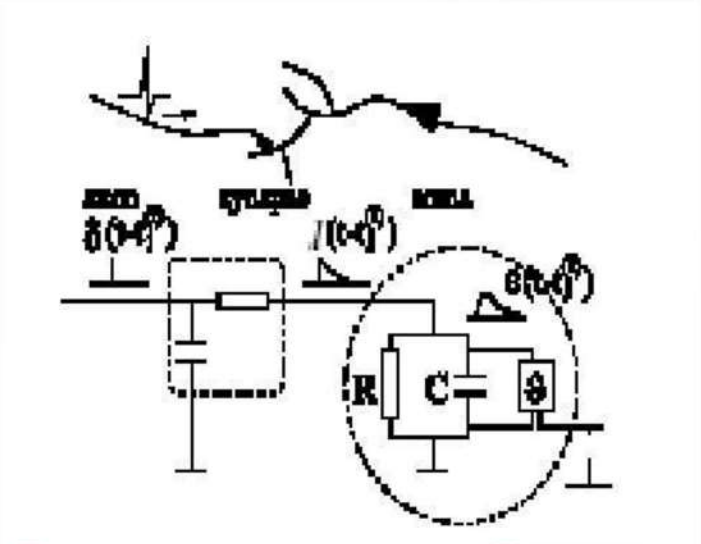
Spiking Neural Networks

neural networks are better suited forhardwareimplementations due to two facts* inter'neuron communication consists of sin!le bits and the neurons themselves are actuall" onl" wei!hed leak" inte!rators.+ecause onl" sin!le bits of information need to be transmitted# a sin!le wire issufficient for connection between two neurons. hereb" the routin! of neuralinter connection on a 2D chip is implied. The neural model that isused is the 'integrate-and-fre' model. Neurons here are leakyintegrators, which fre and reset the neuron when a threshold is reached Mobile feedbacks to the network, allow the network's beam to find any point in space, so a mobile user can always be served by a focused beam to their devices, as they are moving on the street or between different floors in a building. Also having such narrow, direct beams reduces interference between beams directed indifferentdirections.

This shared transportation of data means a faster and more efficient system for all users (see illustration below). That adds up to the ability to download or stream with an improved experience for the user, even in crowded areas.

Also, networks can dynamically switch between serving one or multiple users. When a single user is served, typically the beam is more direct and power is more focused. However, with multiple users, beams tend to be wider as users may scatter in various directions.

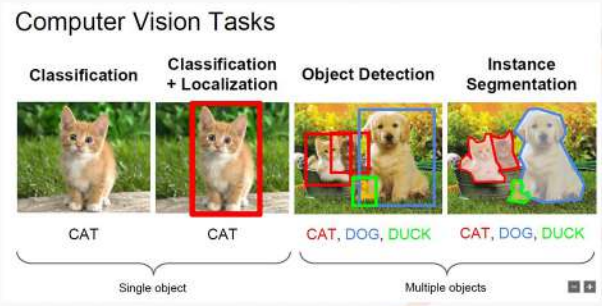


Ms.Haripriya
21x51a0467.

CNN Architecture on FPGA

Convolutional neural network(CNN)

One of the most widely used deep learning algorithms in recent years is CNN. In a number of computer vision tasks, including objective detection, picture classification, and image segmentation, it embodies the state-of-the-art capability. In terms of picture categorization, CNN has already surpassed humans and is even more proficient at a few specialized tasks.



Why use FPGA?

CNN has very high computational costs. More than 20 GFLOPs are needed for each image by recent deep CNN models, which are difficult for CPUs to handle. Using a strong GPU to speed up the process is a frequent technique because of its large parallel computing capabilities. The power consumption of GPU accelerators is their bottleneck, and this might be a critical issue for embedded devices or cloud servers.

FPGA is also good at parallel computing because of its parallel architecture, which enables both task and traditional data parallel computing. Better yet, by creating a redesigned circuit and data channel that produces a result per clock cycle, FPGA may accomplish pipeline parallel. The energy consumption of FPGA is another important advantage. FPGA uses less than 10% of the power of a GPU while operating at the same speed.There are many research about using large-scale FPGA like Intel Arria 10 to completely replace GPU in PC or workstation and accelerate both back-forward pass and forward pass process of CNN. more CNN applications, such as face recognition on smartphones and object detection on drones or robots, are appearing on these platforms.

ECE EVENTS

A hands-on experience program on IoT and its Applications''was conducted by the Department of ECE from the 16th of January to the 21st of January 2023, with the assistance of Mr. JACKSON, technical trainer and developer, as a resource person.

Ms. V Nagamani organized one day project expo for 28 students during SIGMA 2K23 on March 3, 2023, an event held by the Department of ECE.

Department of ECE held a one-week add-on program on "Digital Circuits Simulation Using LOGISIM" from March 27 to April 3, 2023, with the backing of Dr. Y MallikarjunaRao, Dr. Shivnath, and Mr.N.SrinivasaRao as resource persons.

INSPIRATIONAL QUOTES

MENTAL ENERGY IS WASTED IN CASTE DISPUTES AND VILLAGE FACTIONS.

SRI. MOKSHA GUNDAM VISVESVARAYA

MANY NEW TECHNOLOGIES COME WITH A PROMISE TO CHANGE THE WORLD, BUT THE WORLD REFUSES TO COOPERATE.

HENRY PETROSKI

TAKE UP AN IDEA, DEVOTE YOURSELF, STRUGGLE IN PATIENCE, AND THE SUN WILL RISE.

SWAMI VIVEKANANDA