AMRITA VISHWA VIDYAPEETHAM
DEEMED TO BE UNIVERSITY

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GEN-E
EEE & ELC STUDENTS ASSOCIATION
Amrita School of Engineering, Coimbatore

Students Association of EEE & ELC (GEN-E)

Department of Electrical and Electronics Engineering

About the Department

The department, established in 1994 has enough academic and support staff, committed to research and teaching, and well-equipped laboratories and library, meeting the requirements of undergraduates, postgraduates and research students. Graduates and postgraduates of Electrical and Electronics Engineering will be able to explore challenging career options in a wide range of industries and engage themselves in research and development. The department has Power electronics, Electric Machines and Control Systems, Electrical Measurements and Embedded Systems Laboratories in addition to Electrical Workshop. Each laboratory is equipped with instruments and equipment for teaching, learning and research. Under the MoU signed with Uppsala University, Sweden, a faculty member is doing research leading to Ph.D. degree under twinning programme. In addition, faculty members and students are undergoing research in various European Universities under EURECA Programme.

Mission

- Empower students with knowledge in electrical, electronics and allied engineering facilitated in innovative class rooms and state-of-the art laboratories.
- Inculcate technical competence and promote research through industry interactions, field exposures and global collaborations.
- Promote professional ethics and selfless service.

Vision

Mould generations of electrical and electronics engineers on global standards with multi disciplinary perspective to meet evolving societal needs.

What is Gen-E?

Gen-Electric **(Gen-E)** is a student association for the Electrical and Electronics Engineering (EEE) and Electrical and Computer Engineering (ELC) streams, previously known as the Association of Electrical and Electronics Engineering (AEEE). It operates within the Department of Electrical and Electronics Engineering, aiming to enhance intra-department student connections. Gen-E also fosters an environment where students can explore their technical interests while providing opportunities beyond academics.

Elektron, the department E-magazine, is published by Gen-E, and carries numerous articles from both students and teachers alike from the department. It has been brought back into publication, starting 2022. The fields of Electrical, Electronics and Computers are always evolving, and it has become necessary to keep up with the state-of-the-art technology. The magazine aims to provide a space to every student to encourage and explore various areas of interest, both technical and non-technical that goes beyond books and to provide a platform to share them.

Contents

Addressing Space Debris: Challenges and Solutions

Space debris, also known as space junk, poses a significant threat to both crewed and uncrewed space missions. The debris consists of defunct satellites, discarded rocket stages, and even tiny chips of paint, all of which orbit Earth at high speeds. With thousands of objects in orbit, collisions are a real concern. Even small debris pieces can cause severe damage due to the high velocities involved.
On March 21, 2024, the Indian Space Research Organisation (ISRO) marked a milestone with the managed re-access of the PSLV Orbital Experimental Module-three (POEM-three), minimizing orbital particles.

ISRO's Achievement: POEM-three Mission
ISRO's a hit crowning glory of the PSLV-C58/XPoSat mission, reaching a fantastic discount in orbital particles.
The terminal level of the PSLV becomes repurposed into POEM-three, allowing managed de-orbiting from 650 km to 350 km, thereby mitigating particle dangers.

Space Debris Cleanup Concepts
Overview of proposed ideas for area particle cleanup:

- **Giant Lasers**: Employing high-powered lasers to slow down particles for managed re-access, with an anticipated value in line with the item of approximately $1 million.
- **Space Balloons (GOLD System)**: Using inflatable balloons to grow drag on particles, accelerating re-access and doubtlessly lowering re-access time.
- **Self-Destructing Janitor Satellites**: Small satellites designed to seize and self-destruct at some point of re-access, minimizing, in addition, particle creation.
- **Wall of Water**: Rockets liberate water to slow down particles and manually it again to Earth, minimizing environmental impact.
- **Space Pods**: Nuclear-powered pods to cast off defunct satellites from orbit, using revolutionary propulsion methods.
- **Tungsten Microdust**: Deploying microdust to slow down smaller particles, facilitating faster re-access at the same time as addressing fitness and environmental concerns.
- **Space Garbage Trucks (EDDE)**: Equipping spacecraft with nets to scoop up particles for managed re-access, improving particle series capabilities.
- **Recycling Satellites (Phoenix Program)**: Salvaging additives from defunct satellites for brand-spanking new technology, selling sustainability in area operations.

- **Sticky Booms:** Robotic palms with adhesive homes for specific particle seizure and disposal.

Challenges and Environmental Concerns
Cleanup ideas that specialize in bringing particles again to Earth boost environmental concerns, specifically concerning ocean contamination.

The capability fitness and environmental dangers related to sure cleanup methods, along with liberating tungsten microdust into the atmosphere, require cautious consideration.

Current Efforts and Strategies
Ongoing efforts to control and mitigate area particles, consisting of surveillance through the USA Space Surveillance Network and global collaboration.
Challenges posed through the abundance of smaller particle fragments necessitate proactive measures to save you from collisions and in addition particle proliferation.
The significance of accountable area sports in stopping catastrophic events, along with intentional satellite TV for PC destruction, underscores the want for global policies and agreements.

Conclusion
Effective control of area particles is vital for making sure the protection and sustainability of area exploration and satellite TV for PC operations.
Continued innovation, international collaboration, and environmentally conscious practices are vital for addressing the pressing issue of space debris and safeguarding the future of space exploration.

Shubashri V P [CB.EN.U422042]

Smart Home Energy Management Systems: Enhancing Energy Efficiency with IoT

In the landscape of smart home energy management, a groundbreaking change is underway: the integration of cutting-edge artificial intelligence (AI) algorithms. Imagine a world where your home learns, adapts, and optimizes its energy usage in real-time, seamlessly aligning with your lifestyle and environmental conditions. Recent research in an IEEE paper on "Transactions on Smart Grids", unveils the power of AI-driven algorithms to revolutionize how we consume energy. Your home intelligently adjusting energy consumption based on your preferences, weather forecasts, and electricity bills, all while reducing loads to enhance grid stability. This isn't science fiction; it's the future of residential energy management.

The increasing electrification of households has led to a surge in residential energy consumption worldwide. As energy costs continue to rise and concerns over environmental sustainability are increasing, we must find ways to enhance energy efficiency in residential buildings. Smart home energy management systems empowered by Internet of Things (IoT) technologies offer a promising solution to this challenge by enabling real-time monitoring, control and optimization of energy usage. By integrating sensors, actuators, and communication networks, an IoT-enabled energy management systems can intelligently regulate home appliances, heating, cooling, and lighting systems to minimize wastage and maximize efficiency.

Smart home energy management systems have evolved rapidly in recent years. These systems typically consist of sensors positioned throughout the home to monitor the energy usage, along with actuators that control devices based on predefined user preferences. By collecting real-time data on patterns of energy consumption of the home, smart home energy management systems can identify opportunities for optimization and recommend actions to reduce wastage and save costs. IoT-enabled devices can communicate with each other and with cloud-based platforms to exchange data, receive commands, and even adapt their behaviour in response to changing conditions. This technology to improve the energy production and consumption patterns of homes systematically by scheduling home appliances intellectually is called a home energy management system (HEMS). For example, smart thermostats equipped with IoT capabilities can learn user preferences, adjust temperature settings dynamically, and participate in demand-response programs to reduce energy consumption. Similarly, IoT-enabled lighting systems can adjust brightness levels based on occupancy, natural light levels, and time of day, further enhancing energy efficiency and user comfort. Intelligent appliances offer homeowners a window into their energy consumption, promoting energy efficiency and eco-conscious behaviour. These household devices come equipped with built-in intelligence and communication capabilities, allowing remote monitoring and control. From washing machines to refrigerators and dishwashers, a variety of appliances have undergone the smart transformation.

A project conducted by Schneider Electric deployed IoT-enabled energy management solutions in a group of smart homes and observed significant improvements in energy efficiency and user satisfaction. For example, Schneider's chief AI officer Philippe Rambach explained on a recent podcast that implementing AI-powered services means fewer faults, extended equipment lifetime, lower maintenance costs and reduced risks. These findings underscore the potential of IoT-enabled energy management systems to transform residential energy consumption patterns and contribute to a more sustainable future.

In conclusion, smart home energy management systems are a promising solution to enhance energy efficiency and reduce electricity consumption in residential buildings. By using Internet of Things (IoT), these systems can intelligently monitor, control, and optimize energy usage, leading to cost savings, environmental benefits and improved user comfort. However, the widespread adoption of IoT-enabled energy management systems faces challenges related to cybersecurity and user acceptance. Addressing these challenges will require collaboration among researchers, policymakers and industry stakeholders to develop standard protocols, better security measures and user-friendly interfaces. Nevertheless, the potential impact of IoT on residential energy consumption patterns and grid stability is substantial, offering a pathway towards a more sustainable and resilient energy future.

Devisree Sumesh [CB.EN.U4ELC23016]

OFF ACADEMIA

“I feel I’m still young”

“EEE cannot survive independently”

“I try to listen to Ilayaraja's songs”

“I was a little scared of this environment”

Explore the fascinating story of our respected vice-chairperson,

Dr. Jayabarathi R.

as she shares her journey spanning over two and a half decades at Amrita.

About Dr. Jayabarathi R.

With over two and a half decades of experience at Amrita, Dr. Jayabarathi has been a witness to the dynamic evolution of Electrical and Electronics Engineering (EEE) since 1998. From its roots in traditional university-level education to its current innovative project-based approach, Dr. Jayabarathi has seen it all. Let's delve into her insights on the changes in EEE, her passion for power systems, and her advice for students navigating the ever-evolving field of engineering.

You've been with Amrita since 1998, more than 2 and a half decades. According to you, how has the course of EEE changed throughout the years?

EEE was initially at the university level. We were under Anna University, Bharathiar University and slowly we moved on to deemed university in 2003, And now there’s a drastic change in the syllabus and also the students and how they’re taking in, how it’s made as project-based courses, like that. There’s some gradual improvement in all the courses as far as the courses are concerned.

What got you interested in the field of power systems? And what’s your message to students who’re interested in this field?

Basically I’m interested in power systems and did my M.Tech in power systems and slowly we’re moving on to smart grid – that’s, if we see the Indian scenario, the conventional power system (the Indian power system) is slowly moving to the smart grid. So it’s necessary that we should take care of those in the Indian context. Many are available in the foreign context but for 50Hz and this power system, as we modernize, it all comes in the new stages and the grid has to be made completely smart.

Is there anything you’ve noticed that has changed drastically from 1998 when compared to the present day when it comes to the mindset of students pursuing engineering?

1998, so far we’d got only one section and we were very close with the students, that’s closely monitoring each and every student. We knew their names and everything. But now, students are coming from different backgrounds and I feel that they’re more mature, that’s the maturity is more as far as this present generation students. They’re able to cope on their own. If some help is required, they might come to the faculty.

Was your area of interest always EEE? If so, why? If not, what was it?

Basically, maybe..... My father was an electrical and electronics engineering professor and so I took the same profession. And I got into the electricity board also, that’s also an additional thing where I prolonged in EEE but EEE cannot survive independently. CSE should be a part along with EEE.

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What is something you'd advise the students to start practicing/working on from their first year in college? It could be a skill, a habit, a domain, anything.

From the 1st year, what I feel is that students should have whatever they've inculcated in school – the basic respect to the faculty that they shouldtake up to their final year. Along with that they should learn new courses, in the sense along with existing courses, they should take up new swayam based courses to enrich their knowledge in the coming fields because they're growing nowadays. So they should enrich themselves in the new fields of everything which's new (and relevant). They've to learn it and equip themselves. Only then when they come to the final year, they'll be equipped with all the things which are necessary for placement.

What do you feel is the best part about teaching and why?

The best part in teaching which I consider is being along with students who are young minds. Although I've grown up, being with young minds, I feel I'm still young. That's the best thing. I try to be along with the students which I feel is very very good, that's being with the students and admiring their good and bad. It's very good.

According to you, what is the greatest invention in the field of EEE and why?

Previously we had all the energy meters, even now it's there, where they had to come to the house to take readings but everything's made smart now, in the sense in the centralized location, we're getting all the parameters of generation, transmission and distribution in a single side. Along with security, if we're able to do it, it's an added advantage for EEE.

What was the project you enjoyed working on the most and what part of it specifically kept you on your toes?

The part of the project which I enjoyed is the "dual axis tracker" which we tried to do during the COVID period. Although the students were at home, they tried their level best to do it although all were individually at home. That's the best thing which I thought was a total innovation by that entire set of students.

What misconception about EEE would you address and what is your opinion about the same?

Many students are now coming for CSE and because they do not get CSE, they enter EEE. What I want to advise them is that EEE is also a great field where they can inculcate their CSE talents so that everything will go on well because you cannot survive without electricals and all those things. Please include computer science along with electrical so that your things become smarter.

What are some other things you do especially when you find free time?

During free time at home, I just listen to music, I try to listen to Ilayaraja's songs

As a teacher, what are the things you find different within you from your earlier self?

Earlier, while starting, I had just completed my M.Tech from REC (NIT) Trichy and joined here. So I was a little scared of this environment, of teaching and everything. Now I think I just got that.... to face the students and find out their problems. I think there's some maturity which I got during these two decades.

Learning never stops, even for a teacher. What're some of the things you learned from your students?

There are many things I've learned from the students. In the sense, their minds are very young. Whatever there is, they'll grasp it very fast and from them we try to learn because our grasping power has become a little less. I think from them we can learn whatever is good, bad....there are so many things. Many students are coming long distances, staying in the North and all. They all are small children but they're coming and staying. So I think many things can be learnt from the students of younger generations.

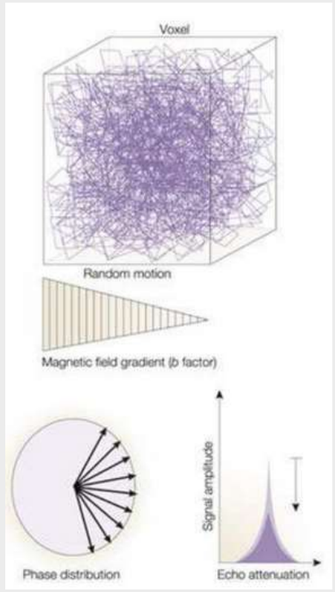
Diffusion Magnetic Resonance Imaging (dMRI)

The ability to measure molecular diffusion of water in tissues gave rise to diffusion MRI (dMRI). While applicable in many tissues including kidney and muscle, dMRI is also used as a non-invasive imaging technique that can be used to examine white matter pathways in the brain. A strength of Magnetic Resonance Imaging (MRI) is the great number of tissue contrasts that can be created through the design of the acquisition sequence and selection of parameters. Examples of tissue contrasts include T1 contrast that is used for anatomical imaging and T2* for functional imaging.

Diffusion is the random motion of molecules due to kinetic energy. This motion, which is often referred to as “Brownian” motion after the botanist Robert Brown, was well described by Albert Einstein. Since diffusion is a random process, it is not possible to predict the motion of a single molecule. However, in a free medium the translation probability distribution of a molecule is well described using a 3-dimensional Gaussian distribution.

In the 1960s it was discovered that magnetic resonance is particularly well suited to the quantitative measurement of diffusion. By adding a pair of magnetic field gradient pulses with equal magnitude on either side of the refocusing RF pulse of a spin echo pulse MRI sequence, scientists at that time enabled the measurement of diffusion of water molecules, albeit in one direction at a time. To measure the diffusion of water along a specific direction (e.g. x), a magnetic field gradient is applied along this direction of interest (e.g. x). This magnetic field gradient labels the location of the water molecules along the gradient direction. After a short delay a second magnetic field gradient is applied with the same amplitude and in the same direction as the first gradient. Water motion along the direction of the applied gradients, between the applications of the pair of gradients, leads to an attenuation of the MR signal from the collection of water molecules in each voxel, and the magnitude of the signal loss is used to calculate the apparent diffusion coefficient.

Even though this concept was described in 1960s, the measurement of diffusion using MR was not developed into an imaging modality until the mid 1980s, Biomedical engineers showed that diffusion measurements could be made using a clinical scanner. Due to long imaging times, however, subject movement artifacts made these measurements very difficult. The development of echo-planar imaging (EPI) which enabled a single slice to be imaged in small amount of time comparing to the earlier models, thus largely solving the intra measurement movement problem. In a medium without barriers and in the absence of flow, mean displacement across all water molecules is zero but the mean square of the displacement is non-zero, proportional to time, with the proportionality constant (the diffusion coefficient D) dependent on molecular weight, viscosity, and temperature. n areas without barriers, such as cerebral spinal fluid (CSF) in the brain, the diffusion coefficient is about 3 × 10-3 mm2 /s and the order of magnitude distance water molecules diffuse during the diffusion encoding of the sequences is 10 μm. In tissue, however, water diffusion is hindered or restricted by the various barriers created by the cellular microstructure. Such structures are typically smaller than the characteristic distances travelled by water molecules during diffusion imaging. Interactions with cellular structures will tend to reduce the mean distance travelled by water molecules compared to the intrinsic diffusion of Brownian motion. To indicate that dMRI is sensitive to effects beyond Brownian motion (cellular interactions, flow, and other biological processes), the diffusion measured in dMRI is referred to as the apparent diffusion coefficient (ADC). Indeed, dMRI is sensitive to tissue microstructure specifically because it is a measurement of the voxel-by-voxel deviation in from that of the intrinsic Brownian diffusivity of water.



Principles of diffusion magnetic resonance imaging (dMRI)

In the presence of a spatially varying magnetic field (induced through a magnetic field gradient, the amplitude and timing of which are characterized by a ‘b’ factor), moving molecules emit radiofrequency signals with slightly distinct phases. In a small volume (voxel) containing a large number of diffusing molecules, these phases become randomly distributed, directly reflecting the trajectory of individual molecules (that is, the diffusion process). This diffusion-related phase distribution of the signal results in an attenuation of the MRI signal. This attenuation (A) quantitatively depends on the gradient characteristics (embedded in the b factor) and the diffusion coefficient (D), according to A = e–bD. As diffusion effects are small, large gradient intensities must be used, which requires special MRI hardware.

Challenges

An eddy current is a transient electrical current created in the conducting structures of the magnet by the changes in the magnetic field gradients. Echo planar diffusion imaging is particularly prone to eddy-current artifacts because of the long EPI readouts combined with strong diffusion gradients which are switched rapidly.

Unlike the distortions created by main field in homogeneities, eddy currents effects are dependent on the strength and direction of the diffusion encoding gradient. These eddy currents cause translation, stretching and shearing distortions in the phase encoding direction of the image, depending on the direction of the gradient.

Eddy current distortions lead to gradient direction-dependent spatial misregistration between the different diffusion-encoding directions and the images collected without diffusion encoding. Eddy current distortions are typically corrected using a twelve degree of freedom affine registration of the 4D volume to the image collected without diffusion encoding, simultaneously correcting the data for subject motion. Such methods work reasonably well for data collected with the b values of about 1000 mm2/s used. At b values greater than 1000 mm2/s, these methods may fail due to the lack of signal intensity needed to perform the necessary registrations.

Conclusions

As to the future, dMRI methods will continue to be used by neuropsychologists and other investigators studying neurological and neuropsychiatric questions. The nature of these studies will continue to improve concurrently with advances in dMRI methods. Hardware and sequences for acquiring dMRI data are constantly evolving with the development of new scanners with faster acquisition (e.g. multiband) that address previously noted shortcomings. dMRI analysis methods are also evolving from basic tensor models to more sophisticated models that better describe the complex white matter architecture of the brain. The ability to examine changes in microstructural complexity may allow for the examination of synaptic plasticity in dMRI studies performed both before and after intervention.

V V N S C Madhava {CB.EN.U4EEE22051}

From Textbooks to Tangible Projects: Internships, A Secret Weapon

Engineering is all about bringing ideas to life. Imagine applying your bookish knowledge to design a prototype by analysing real-world data and troubleshooting a system – that's the kind of hands-on experience any engineer needs because acing engineering isn't just about technical knowledge but more about teamwork and problem-solving and internships are like a bootcamp for these skills. The world runs on connections, so does the process of securing an internship and finding potential mentors serve as a crucial gateway to the process. Our journey to this internship began with realizing the importance of connections. Fortunately, connecting with Dr. K.R.M. Vijaya Chandrakala Ma'am led to an opportunity at Schneider, Coimbatore. While landing the internship fulfilled a desire, initial tasks like electric material inspection and supply process management felt mundane and frankly, uninspiring until, one problem statement changed it all.

Schneider, a leading multinational conglomerate recognized for its excellence in engineering and construction, among its many divisions, specializes in manufacturing switch gears under the Electrical & Automation (E&A) unit and maintaining safety is crucial. These switchgears consist of multiple racks in an enclosure containing various switches and wires. At the end of each enclosure, there's a bus bar where all the power wires connect which helps in distribution of power across all the modules. Schneider employs two temperature monitoring points: first, an ambient sensor attached to the door of the enclosure, which tracks the overall temperature inside the enclosure. Second is the power tag, a sensor that monitors the temperature of the bus bar. Measuring the temperatures of bus bars in switchgears can detect and prevent hazards like overheating, which may result in fire or equipment damage. Early detection of temperature variations also allows maintenance, helping to prevent failures before they occur. When the temperature of the bus bar is greater than the value recorded by the ambient sensor, a fault is detected. Our focus was on the power tag sensor, which contains a winding core.

It's connected to the bus bar through a ferromagnetic metal strip that runs between the windings inside the sensor and wraps around the bus bar externally. The windings are insulated from the bus bar and encased in plastic, forming a basic transformer-like structure that powers the power tag through mutual inductance. Like any other equipment, these power tags needed testing before deployment. However, during testing, they took a significant amount of time to charge, roughly around 3 minutes per sensor, before becoming operational. Our challenge was to develop a method to reduce the charging time of these power tags.

As electrical engineering students, our first instinct upon encountering the problem was to turn to Electrical Machines, specifically transformers. Having knowledge of the fundamental principle of a transformer, which maintains constant power on both primary and secondary sides, with the turns ratio being inversely proportional to the ratio of currents on each side, we contemplated adjusting the turns ratio to enhance the current on the secondary side where we aimed at connecting the power tag. However, our simulation proved futile as we discovered our misunderstanding regarding the charging mechanism of capacitors. We had erroneously assumed that current was required, neglecting the necessity of applying voltage across the capacitor to induce electron flow. Additionally, we realized that tap changing transformers were impractical due to their size and complexity, an aspect the company likely did not desire. This led to us abandoning our conventional approach and sought out a newer, more viable solution. Then came to our aid a subject many of us struggle with: Power Electronics. Realizing that high currents were unnecessary but rather a high Electromotive Force (EMF) across the capacitor was needed for quicker charging, we focused on electrical phenomena rather than mechanical components like turns. Our strategy involved increasing the change in flux on the primary to boost the induced EMF on the secondary which was done by elevating the frequency of the signal effectively solving the problem.

The success of the simulation motivated us to embark on creating a prototype, expecting it to be straight-forward. Initially, we planned to derive AC from a standard switch, convert it to DC, and then back to AC with a higher frequency. However, with only a week left, we had to proceed with the DC approach. Crafting a full-fledged inverter was challenging, so we improvised. Utilizing a three-wire input transformer, we provided DC to the primary by connecting wires to the top, middle, and bottom, where the middle wire acted as the positive input and the top and bottom as negatives. By alternating between the top and bottom, we produced an AC square wave. Unfortunately, during testing, a spark and a little smoke were released, indicating damage to the secondary winding of our transformer. With little time left, we improvised. Breaking the transformer's core, we removed the secondary winding and directly attached the power tag. Although this approach was unlooked for, it worked. The sensor, which previously took 2 to 3 minutes to charge, now charged within 40 to 50 seconds.

Despite the chaos it caused and the loss of multiple microcontrollers and a transformer, we couldn't contain our joy at seeing our prototype function. After all, what's the fun in creation without a little chaos? It was an incredible experience turning textbook theories into engineering solutions which could not have been possible without the guidance and support of Vijaya Chandrakala Ma'am. So as a group of four aspiring engineers, all we stress to emphasize is that when it comes to ideas, perfection isn't a prerequisite. After all, we were never flawless; we simply dared to try.

Jagruti N [CB.EN.U4EEE20033] **T Vijayaraja [CB.EN.U4EEE20056]**
Prashansaa W [CB.EN.U4ELC20050] **Vatsalya Nag [CB.EN.U4EEE20053]**

OFF ACADEMIA

> *“Our labs are treasure troves of free resources, yet students barely scratch the surface of their potential.”*

> *“I was not really interested in teaching”*

> *“Right now I’m doing at least 4 or 5 different online courses”*

Discover the journey and insights of,

Dr. Sivraj P.

as he reflects on his passion for research, interdisciplinary expertise, and his commitment to inspiring the next generation of engineers.

About Dr. Sivraj P.

Dr. Sivraj champions self-directed learning beyond the traditional curriculum, encouraging students to harness free software tools and resources to expand their skill sets. He advocates for integrating hardware and software expertise within EEE, emphasizing the need for modern engineers to be adaptable across multiple disciplines. A passionate researcher, Dr. Sivraj values collaborative projects and strives to inspire students by blending strong foundational knowledge with cutting-edge advancements in the field. Let’s delve into his insights and explore his vision in the following interview.

Your expertise lies in various field of electronics such as embedded systems, Automotive electronics, and the use of networking such as smart grid, IoT (Internet of Things). What got you interested in this wide and diverse domain?

Ummm.... My father is an electrical engineer, my brother is a computer engineer. That’s why I’m maybe a mix of both. That is what networking and automation is all about, I mean, I believe. I did my B.Tech in EEE. Towards the first 3 years of my course, I was really interested in power systems, then whatever automation I was reading through-subjects like microcontrollers that I've learnt, programming courses really were.... I had a great interest in those things. Then slowly I started looking into automation in power systems which took me to embedded system and then you know, naturally IoT and everything followed. So basically, I should say my teachers, my education made my background.

What in your opinion is a skill/domain that a student should pick up on their own during these 4 years?

Ok, that is a very very vast, I believe, kind of a question. See there are a lot of skills. In any engineering trade, it’s practically not, this is my belief, I don’t think it’s practically possible to kind of impart every skillset that’ll come under a particular domain. Particularly in this world where now so much of evolutions are happening. Things are particularly changing. So, there can be a set curriculum that can teach a lot of concepts but to apply these concepts in real world problems, a lot of skills that can software, that can be hardware, that can be ...you know, skills to operate certain tools or machines. To an extent, a lot of software tools are free now as part of the open education policies that a lot of companies follow. A lot of these tools, at least for educational purposes, they’re free. So, students I believe should definitely outside of their curriculum, should enroll into such options provided by the companies. For example-Google, Intel, Microsoft, all of them customize the AI/ML libraries, the hot keywords now are AI/ML. So those libraries, they customize. Then they provide them as tools for different platforms. All of you would, students normally you know through a lot of .....whatever is the domain they’re enrolled into, they’ll learn about AI/ML under different courses. But I don’t know how many of these students will be skilled enough to use a particular library, maybe even in a microcontroller or a device that’s very resource constraint. So there, the implementation of it, the usage of whatever we’re learning, that skillset, definitely students can acquire. Opportunities are there so if students are willing, definitely they can acquire it outside the curriculum.

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What are the resources provided in Amrita that you'd urge every student in EEE use and why?

Oh, definitely there are a lot of things and this is something you know, in the faculty meeting, we ponder about, we kind of debate, we kind of bring in strategies. Somehow, we feel that certain strategies are not up to the mark that you know…every time we feel that students are not using, I mean I really talk well about the embedded systems lab because I've been part of the first M.Tech batch here. Then I've been part of this course right from 2010 to 2024, so I know what is there and what is not there. I'll work on every single kit available in the embedded lab, every single software available in the embedded lab, so I know the capabilities you can get. Again, we were talking about the skill. Skill – you can acquire by working in that. I will know that because I've done that personally. I know people who've done that. There were a few faculty members, they are not right now with Amrita but the were….even they studied M.Tech here and then they were again, doing the same things… so they were also equally skilled, or even more I would say. So that skillset, I somehow feel that, students are not able to acquire because, you know, they're not spending that time. Of course, from the department's side, from the campus's side, I'd definitely believe that we can facilitate an opening of the labs even after office hours, maybe till 10:30, maybe till late night…and then that can be a facility where you can come to. Most of these things, you know, are kind of "self-learning viable". You don't need somebody to sit and teach you how to work on these things. If the facility is open, a LOT of things are there, particularly hardware kits, microcontroller boards, softwares, licensed softwares which you'll otherwise have to spend lakhs to get a hands-on experience. All of those things are free. Facilities that you see here in the renewable energy lab, the microgrid facility, there's an EV charging simulator facility. None of you would've eve seen that. So these things I definitely…. see…these cannot be brought through a course. You've a lot of restrictions in the 45 compact hours, then the 2-hour lab sessions that we have. So that's not feasible. Beyond the lab, it's the students' interests. I very clearly remember back in 2011, 2012 and 2013, I just joined, so I was a new faculty, students… I don't know. That is all based there. There's a frequency match. So, students at that point were very comfortable approaching me and talking to me. So, all of them were part of a lot of competitions like the hackathons what we call right now, those times, they were competitions, so…a lot of students were participating in the competitions, they were doing extra stuff after the college hours…where they were getting exposed to all these things. So yeah…there are a lot of things, in so many labs we've a lot of things.

What do you think is the next big thing that'll be incorporated into the world of EEE and why?

I don't think it's the next big thing. It was always there. Basically it's sharpening your programing skills. When I say programming skills, I don't mean…. You know, we ask ChatGPT, they give you a code. So I'm not going to tell that you've to develop everything from scratch but see, ultimately when you go into a company, I don't think you can end up in a company where you can now be called as a hardware engineer where you only work on hardware.

Even hardware systems you'll have to simulate, you'll have to design…software you use. So, exposure to that soft tools…bringing in the intelligence into your system, you'll need software. So how to work with software? It need not be programming from scratch. It need not be knowing how an 'if loop' is written or a 'for loop' is written? Where is a semicolon put? Those things…. I'm not talking about the syntax or the structured learning of that. I'm telling how to use things. So, I would say usage of software is one thing that EEE students don't really focus on. They somehow treat it like that's something that computer science will do, we're the EEE guys so we'll work on the hardware and things like that. But I don't know how many B.Tech graduates and M.Tech graduates will really sit down and then solder and make boards. That's all mechanized now, so, usage of software, usage of tools is something that EEE students will have to really pick up on. And then of course, be the so called "microcontroller programs" you'll have to pick up on a big way because you know, most of your smart systems, your network systems, that's all microcontroller-based.

What, according to you, is some old/redundant practices students or staff need to opt out of as it isn't required/relevant in this day and age?

I would not say we should opt out of anything because see, when were doing somethings, that is definitely because a lot of people thought it was useful. It's not like you know, somebody found something unwanted and then a lot of people are still following it over the years, that will never happen. So whatever we're doing as a university, we're doing it because a lot of people thought that was good enough. I mean, I wouldn't say "opt out of it" but I would say "reprioritize". That would be the perspective I'm taking. A lot of our hardware-oriented experiments when we say, what we really do is we may go into a lab, we give priority in making the connections and there'll be always, you know, issues with the boards, for example – a breadboard or a wire or another thing that's there. So I don't know whether an engineer should be good in making breadboard connections, making connections between an armature terminal and a meter that's there. A lot of that can be of the data acquisition system. You should know about the device, the machine or whatever you're working with and then you should be basically understanding about the operation, about the issues that can come into that, about how to rectify those issues. So the experiments really can go out to that shape rather than, you know, standard tests that we talk about, characteristics that we talk about. They can be done. But, are you thinking they can be done in a software environment. Ultimately the characteristics of a machine will not change if you properly configure a software simulator (i.e.) the simulation environment, you can do your characteristics there. And I'm not saying you shouldn't do it in hardware. If you can find time, go ahead, do it. But I'd say there little more new things that have come up which we should focus on before we go back to the old way of doing it in the characteristics and what else it's about.

Which project that you worked on, either with other staff or students, are you most proud and fond of and why?

I'd say the first project that I've worked on with my mentor – Dr. Sasi. He was my DST supervisor. He was a professor in our department. He's not with Amrita, he has retired. And that is one project, you know, I was not part of the team that submitted the proposal but, he, the professor – Dr. Sasi, he was gracious enough to…… As a faculty who just joined the department,

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I had no role in that project but he was..... Somehow he identified that I was at the embedded systems. The project was in the embedded domain. He came to me, he discussed about it to me. I got..... I was always somebody who was interested in research, I'd say more research than anything else. Research is my no.1 interest, a thing that is there. So, he introduced the project to me. I was very happy to work on that project. So, even not being part of a team, that was my project. I got the opportunity to do a lot of things, learn a lot of things more importantly, collaborate with a university like KTH, travel around to Sweden, be a part of the, you know, informatics department in KTH, spend a good amount of time there, do a lot of collaborative research there, interact with ABB in Sweden, work with.....work on real....., you know, meant that was the first time I saw how industries plan something and then..... of course I had fun also travelling around Sweden, seeing places, all of those things. That project is always special to me, the first one, a real funded project that I was part of. It was an Indo-Swedish collaborative project between Amrita and KTH, started in 2011, finished of in 2014.

According to you, what is the greatest invention in the field of EEE and why?

Oh my God!. Hahahaha. That, I don't know. Maybe.....should be, it HAS to be electricity! Hahahaha. Otherwise none of your machines will work. None of your devices will work. But the, see.....maybe I'd put it this way. Electricity is the one factor that I find fascinating in the electrical domain because we talk about machines, we talk about electrical systems, we talk about power electronics, we talk about devices. But then all of it finds its importance because we can provide electricity and that domain, where you have your power system, you have the generation, you've to carry it off, the micro-grids we talk about, the smart-grids we talk about. How to fine-tune your devices for a better grid? So maybe I'd say a smarter electric system? The evolution of electric system I would say is the single most fascinating thing that I have experienced in the electrical engineering.

What misconception about EEE would you address and what is your opinion about the same?

Misconception.....
Again, see, EEE..... I've seen this. I've seen this. I've seen a lot of senior professors, when I say "senior professors" I mean people who have retired now. That's what I meant. So when I was a student, those were the people teaching me. So, they used to tell what they learned. I somehow feel that there's a lot of that thing still continuing as part of our curriculum. A LOT of old things. And that's there because we still feel that they're basics and we should somehow learn them. But I believe that's happening at the cost of missing out on missing out a lot of advancements that are happening in the field. I'm pretty sure that a lot of things that the students have already learned maybe at a very basic level in their +2 or other things are being repeatedly taught to the students over the foundation courses of electrical engineering

across universities I feel that is. When I look into the syllabuses of the premiere universities of the world – Stanford, MIT, and other things, I don't find these things there. There has to be a reason. I feel that somehow the Indian electrical engineers has the misconception. This is my thought, maybe I'm wrong, I don't know. But I feel that we still go.....we love our old....great things that we have. We stick on to that. We feel that's the most important thing. But then, always we can learn them, but move forward, we can focus on the new advancements that're happening. Maybe as I was telling, as responses to 1 or 2 questions earlier, we should have a balance between the intelligence, the smartness that's coming in. it's not about just taking an ML algorithm and running it over somewhere. You've to understand your system, you've to incorporate that into your system. So you've to be a good..... I don't know whether there's any concept of a CS engineer, electrical engineer, electronics engineer going forward. I feel you've to be a good engineer and you should know everything. If you're working on a system, you should know the system, you should know the components involved in that, you should know the software involved in that, you should know the hardware involved in that. So you've to be a good engineer and you've to be a good electrical, good electronics, good mechanical, good computer science engineer. You can's just be a good electrical engineer anymore. I don't think that's possible and I don't think the world really needs somebody like that. So misconceptions is all about how you see what should we be capable of after learning a particular trade. I think that is the one thing that should change. And definitely there are efforts. In every curriculum revision, we're strongly working on that. We're trying to see how we can improve things without avoiding the basics, without ignoring the basics, how we can do that. It's a great challenge. So rather than a misconception, it is the biggest challenge also that's there. So, somehow, collectively, the society will have to work towards addressing that.

What are some other things you do especially when you find free time?

Now that I've a kid, I....hahahaha, spend my complete time with her. But otherwise, I'm a hardcore cricket fan. I just love cricket so I don't miss anything if cricket's happening whether it's T20, One-Day, Test whatever it's. Ummm... football, when the World Cup is happening, I really stick onto that. Otherwise, I kind of love movies. I watch almost every movie that's there. I love going around. Pre-Covid, I used to travel a lot but post-Covid, because I've a small kid and I'm not brave enough to travel with her. Not because of the Covid related issues hahaha, but managing the kid's is really difficult while travelling. But yeah, I mean I really miss it. Soon, start back to travelling around. So yeah, travel will take a lot of time. Then otherwise, in front of T.V . watching movies, cricket and other stuff. I make it a point that if it's free time, I call free time when I don't do technical things.

As a teacher, what are the things you find different within you from your earlier self?

I should say when I was.....when I started my career as a teacher in 2010, I was not really interested in teaching. I joined the university because I could do research. Always research was and research is my first priority. It's my passion. I want to do research. But I've understood that research can be fruitfully done if we focus a lot on teaching and research is only useful to the society if I can share the knowledge that I gain. So that's something that I've realized over my tenure as a teacher. I've understood that, of course I knew but I was reluctant to accept because maybe I was interested in research and I think I didn't want -

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teaching to overtake that, I was reluctant to accept that a teacher can positively influence students and make them do good things. I've realized I can do that. I've realized that it can improve personality of an individual also beyond technical skills. You can influence people to become better people, better individuals. That's something that a teacher can do. And more than anything I've realized that you've to just sit and listen to students to really understand what their problems are. And that usually solves half of the problems. That's something that I've understood from my experience. Most often what happens to a student is issues that come out of concern rather than real issues that're there so if you listen out, if you patiently hear out a student, if you then understand or try to understand what the problem is, the problem might normally be something you can easily solve. And from my experience I've found that, most of ten that works also. You listen, then you really understand most of the problem would really be a simple one. You'd give a suggestion to students, himself/herself will solve that problem and then you go forward.

Learning never stops, even for a teacher. What're some of the things you learned from your students?

A lot of things.....
I'm being serious here because, you know, every time I make it a point that when I give a project to the student, I don't give a closed project. I don't give a project for which I've already a result in my mind or a result which I've already done. Yes, sometimes I give it because, you know, I want to test out a certain thing I might give, but you take 90% of the projects I give to students, it'll be an open-ended project. I would want the students to explore and I make it a point that they work on some tools or systems that I also don't know. I learn along with them, I learn through them. The approach, the positive attitude, you know, I've seen really good students who will not give up until and unless they reach to a point. There are a lot of things I've learned from students. And again, see, the point is, even now I do a lot of online courses. Right now I'm doing at least 4 or 5 different online courses. Every time! I'm not telling it's a great thing. I'm doing that because there are questions that are coming to me, coming from the students and I've to answer those questions. I'm responsible to answer those questions so I'll have to do it. So, basically what's.....if I have to summarize everything that I've learnt from a student, I've learned from students that I should never stop learning.

Team Creative Coders Wins Abhisarga 2024 at IIIT Sri City

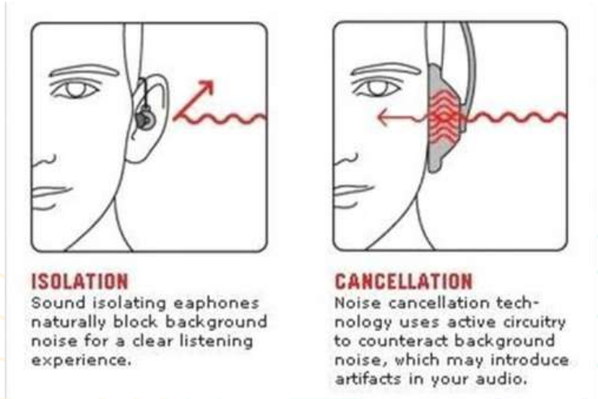
The development of a comprehensive prepaid utility management system conceived by Team Creative Coders during TechTales' The Connexion, an inter-college techno-cultural fest organized by the IoT Club of IIIT Sri City for Abhisarga'24. The project aimed to promote responsible water use and improve water management through a user-friendly and efficient system. Aswin. S (CB.EN.U4EEE21106) developed a mobile application using Flutter, displaying real-time water usage, remaining credit, and a payment option. Ruthra. L (CB.EN.U4EEE21145) established the hardware connection between the Raspberry Pi and various components, including a relay for controlling the solenoid water valve and a pressure sensor. Sudheep Jashwanth (CB.EN.U4EEE21154) utilized an MQTT server to establish communication between the hardware and the mobile application. Throughout the 36-hour hackathon, the team, guided by Dr. R. Anand, divided tasks based on each member's strengths and addressed challenges such as integrating MQTT with the mobile app. Their innovative approach, which included machine learning techniques for predicting future resource needs, was well-received by the judges. As a result, Team Creative Coders won Abhisarga 2024, securing a prize of ₹25,000.

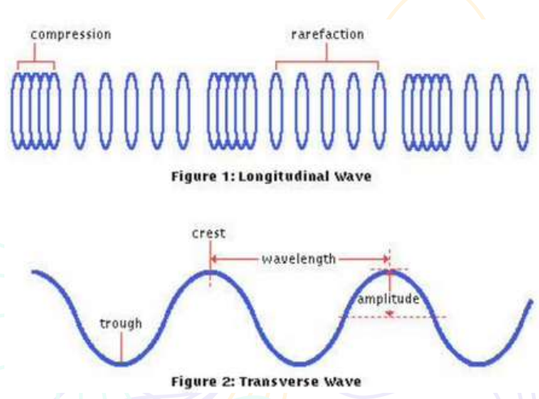
Content: AMRITA DARPAN, Volume 3, Issue 5

The Engineering Behind Modern Sound Cancellation Technology

We all know the latest buzz in earphone technology and one such catchy one is ANC(Active Noise Cancellation)/NC(Noise Cancellation). But a consumer gadgets that claim to provide such feature need to know what the tech behind it is to better understand and judge what they are paying for. There are two primary types of noise cancellation:

- **Passive noise cancellation:** These are generally attained by creating physical barriers between you and the source of noise. These can be in the form of baffles and acoustic panels in studios that absorb and reduce sound entering a recording room or can be the industrial ear muffs construction workers wear in order to dampen the noise from the heavy machinery surrounding them.
- **Active noise cancellation:** This is exactly what we are going to explore in this article. In essence, it is a method to reduce noise by cancelling out the sound waves with the aid of some electronic components.





But to understand noise cancellation, let's understand what noise is and by extension, the science of sound.

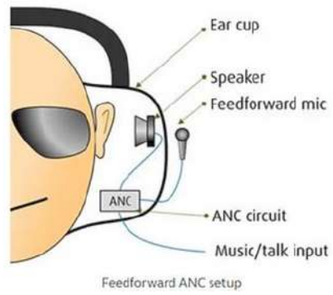
Sound is a phenomenon where particles of air or any medium for that is pushed and pulled into to create a wave, similar to how a slinky moves when pushed back and forth from its ends. This continuous pattern of movement is called a longitudinal wave and this can be interpreted in the form of a transverse wave too where each compression can be considered as a crest and each rarefaction can be considered as a trough. The intensity of compressions and rarefactions determine the amplitude of the transverse wave whereas the length of the segment up till which the compression or rarefaction is sustained can be considered as the wavelength. Frequency is the number of compressions/rarefactions happening in a particular interval of time and is measured by hertz (Hz) and the volume of the sound is directly proportional to its amplitude and is measured in decibel (dB).

Now to get a basic idea of ANC, let's look at a feedforward ANC technique. This method involves placing a microphone outside the earpiece to detect noise. The main functionality is to:

- Detect sounds that occur outside the headphone, also known as "sidetone".
- To hear your voice during conversations since being incapable of hearing yourself can be perplexing to oneself.

In feedforward ANC, DSP and other ANC processing hardware are used to map noise signals to frequency responses you'll hear on the inside of your headphones/earphones.

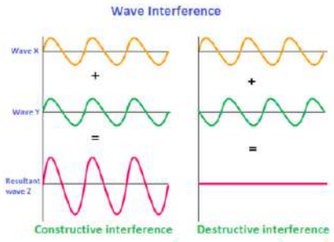
Next comes the cancelling out of the noise which is done by creating an 'anti-noise' which is nothing but the noise signals of the same amplitude and frequency but in an inverted phase.



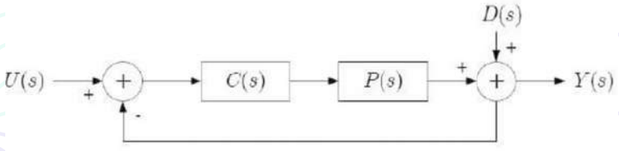
Feedforward ANC setup

In feedforward ANC, DSP and other ANC processing hardware are used to map noise signals to frequency responses you'll hear on the inside of your headphones/earphones. Next comes the cancelling out of the noise which is done by creating an 'anti-noise' which is nothing but the noise signals of the same amplitude and frequency but in an inverted phase.

The second image on the left is a simple representation of what constructive and destructive interferences are. In destructive interference, a signal having the same frequency and amplitude as that of the original signal but of an inverted phase can nullify that particular signal, something like the Hulkbuster armour nullifying Hulk's punch with a punch having the same force but against the original attack.



An improvement on the feedforward ANC technique is the feedback ANC technique where the microphone is present inside the ear to detect the noise that have made it into the ear. This enhances the outcome of of cancelling noises compared to passive and feedforward which tries to block out all forms of noises, even the redundant ones.



The immediate left diagram displays the block diagram of a feedback loop and this can be used to analyse how this technique differs from the feedforward ANC technique.

A third technique is a hybrid technique where the best workings of feedforward and feedback techniques are combined desiring a seamless noise cancellation experience.

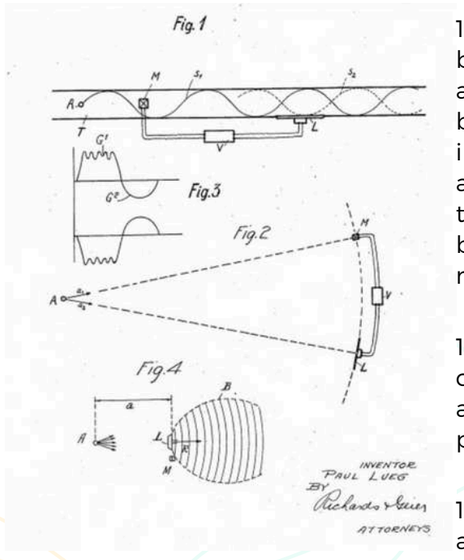
The drawback of this form of microphone setup is that it struggles with higher-frequency noises. While it's easier with to align the anti-noise signals of lower-frequency noises due to their longer waveforms, higher-frequency noises are more prone to misaligning and shifting which creates feedback. The feedforward microphones struggle to predict and adapt to these shifts and therefore only a partially nullifying anti-noise signal is produces. The feedback microphones struggle with higher-frequency noises too but for the reason that such noises are harder to perceive in the ear. ANC headphones thus generally have a drop in performance at around 1khz. In the end, an economically viable solution is obtained by blending passive noise cancellation using earpads or ear-tips of appropriate sizes and a decent ANC setup implemented into the headphones/earphones.

Okay, now that the physics and the engineering behind active noise cancellation, its interesting history is equally paramount. So, story time fellas...

cont.d

The Engineering Behind Modern Sound Cancellation Technology

1933 – Way ahead of what technology of his time could achieve, German physician, physicist and philosopher Paul Lueg patented the idea of phase advancing a sinusoidal tone in a duct and reversing the polarity of any tone around a speaker. Sadly, with the Nazi's uprising in 1933, he faced grim controversies which ruined his remaining life.



1953 – The first prototype used in real time was developed by Dr. Lawrence Jerome Fogel to protect a pilot's hearing in a helicopter's cockpit and also help them communicate better. This device was the first significant stride in the implementation of active noise cancellation technology although restricted to the field of aviation safety but, not the first time something invented for a specific purpose has been repurposed for something completely different in modern society, right?

1957 – Willard Meeker developed a realistic model for ANC control for earmuffs. The maximum attenuation was approximately 20dB, but its design was far from either perfect or complete.

1978 – Founder of Bose Corporation Dr Amar Bose (yes he's an Indian, NRI albeit) witnessed the emergence of in-flight entertainment systems during a flight from Zurich to Boston which featured a new headphone weighing only around 57 grams (the older models weighed around 450 grams) and was really excited to test them out only for him to be distraught by the noise the plane produced (usually it's crying babies for me). So, Dr. Bose chucked the headphones, grabbed a piece of paper and began sketching his initial ideas on what would be the first noise cancelling headset.

The Bose Aviation Headset (left) in 1989 was offered to the crew of the Rutan Voyager while still being in its prototype stage and was a massive success. The Rutan Voyager was the first aircraft to circumnavigate the globe whilst neither stopping nor refuelling and to achieve this, the model was designed with idea of reducing as much weight as possible to save on fuel and this meant that there would be no insulation around the cockpit. I hope now a picture is painted on why these headsets were trailblazing. As a result, pilots everywhere clamoured for one of these and these became the first commercially available noise cancelling headphones in the world.

As in any other domain in today's gizmo-filled world, AI (Artificial Intelligence) is being effectively utilized to enhance the noise cancellation experience provided. A discussed previously, normal ANC headphones are great for cancelling low-frequency noises but might not fare well against noises having higher frequencies. With AI-based-noise cancellation, continuous adaptability and optimization is achievable which makes this technology more versatile by being capable of cancelling noises from diverse environments. One such example could be virtual meetings where background noises of different intensities and frequencies might come into play along with other technical qualms such as microphone feedback. With more and more capable AI getting rolled out, the applications of noise cancellation technology widen. Efficient adaptive noise cancellation technology could make daily use of ANC more seamless and AIs in fact are now being used in hearing aids to help the listener filter out undesired noises in various environments such as public transportations, restaurants, etc. DNNs (Deep Neural Networks) are used to understand how a brain of a person without hearing loss would respond to sounds and are implemented in hearing aids to mimic a more natural form of hearing which helps boost the user experience, signal-to-noise ratio and the overall sound quality.

All-in-all, too much noise is bad, physics works, engineering CAN solve the world's problems, and in the end, everybody requires so quiet time.

Adithya H [CB.EN.U4EEE20102]

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Govt's Flagship Scheme - PM Surya Ghar Muft Bijli Yojana

Over the years, government policies have made it cheaper to install solar panels in homes. The recent PM Surya Ghar Muft Bijli Scheme has made it even more affordable, aiming one crore households with solar power. Remarkably, there have already been over 1.28 crore registrations. This initiative to promote rooftop solar (RTS) installations is a significant step towards sustainability. The government offers subsidies ranging from Rs. 30,000 to Rs. 78,000, depending on the solar plant capacity.

Solar Plant Capacity	Subsidy (in Rs.)
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2 KW	60000
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A 1 KW solar plant can generate approximately 4 to 5 units of electricity per day. It is advisable to choose the solar plant capacity as per our needs. The PM Surya Ghar official website lists numerous registered vendors, allowing consumers to select the best option. The government also plans to implement a rating system for vendors to help consumers make credible choices. Financing options are available through the National Portal 'Jan Samarth,' which offers seamless digital processing.

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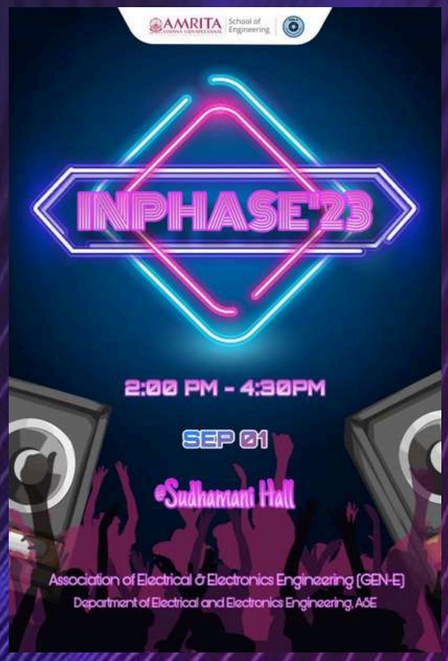

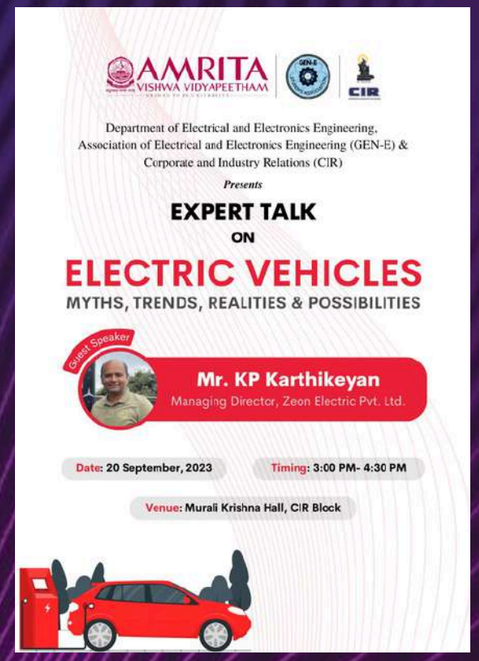

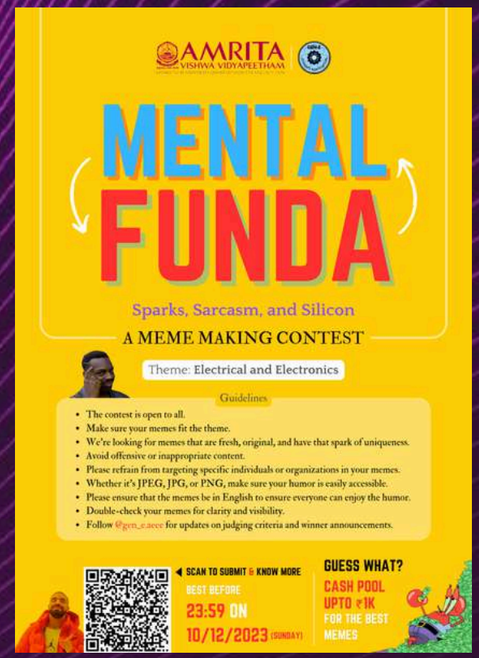

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