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A STEM NEWSLETTER

LabLinks

ISSUE 4 - Engineering and Applications of AI

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THIS MONTHS TOPIC (A BREIF OVERVIEW)

Artificial Intelligence (AI) is revolutionizing the world, blending engineering with cutting-edge technology to solve real-world problems. From self-driving cars and medical diagnostics to smart assistants and creative tools, AI transforms ideas into impactful innovations. Engineers design systems that mimic human intelligence using algorithms and data, enabling applications like robotics, natural language processing, and personalized recommendations. In this issue dive into AI and see how it's redefining our future!

A MESSAGE FROM THE FOUNDERS AND EDITOR IN CHIEF

Welcome to the fourth edition of Lablinks - The Newsletter! This time, we delve into the fascinating world of AI and its engineering marvels. From groundbreaking applications to its potential for reshaping our future, we hope to inspire curiosity and innovation. We are extremely grateful to have been joined by new, talented writers from our community and sincerely hope that you enjoy this issue! If you have any questions or queries drop a mail at lablinksofficial@gmail.com!

Regards, Nitya Kashyap, Tara Pratapa

All Acorns: Squirrel AI and its Implications in Education

By Shreyank Enugu

In 2009, online schooling would have been received with a dainty laugh, and a boatload of skepticism. Today, it's a term collectively addressed by every single member of the education sector, as relevant. And with drastic developments in artificial intelligence, the idea of a school with no roof, floor, or even designated classrooms, is not too farsighted. In 2014, Squirrel AI was founded to provide an adaptive solution to 'the teacher engagement issue'.

The teacher engagement issue

Since the founding of the traditional school system, a teacher's job was to yield information to a student, which was then to be subsequently reflected in one's actions, or simply understood by the student. With time, the global school system also understood the perennial link between the way a teacher taught, and how much the respective student actually listened. But how could your normal, day-to-day human infer what sparked a young learner's mind, and what really didn't? That's where adaptive accumulation and data collection make their mark.

What and Why squirrel AI?

A single line from the Squirrel AI founder Derek Li, explains precisely why we need AI in the education sector. "In the future, AI will not just assist teachers, but also fundamentally change how students learn and how teachers teach, ensuring no student is left behind." – Based on how a student replies in class, scores on tests, or even moves; the system analyzes what makes the learner tick in a school environment. The program then sends all this data to the viable professional, allowing for more personalized and effective teaching modules. All of this with the help of a simple, downloadable app.

Factoring in the works

Unfortunately, Squirrel isn't perfect yet. Posed with questions on fundamental human ethics, people are reconsidering 'robots' monitoring how we learn. And with a growing concern towards cyber security, Squirrel AI crosses the line for a lot of individuals

In the end, the perfect school environment is still a prospect of the future; but by going for all the acorns, we might as well reach there.

Efficiency Is Key: The Uses and Importance of Predictive Maintenance

By Gayatri Papagari

One problem that companies with a lot of hardware often face, mundane as it may be, is maintenance. Maintenance is actually quite expensive, with regulatory compliance and a shortage of skilled labor adding another level of complexity. However, it is unavoidable because the risk of unplanned shutdowns and possibly accidents is too high. The approach that most companies used to take is planning frequent – often unnecessary or harmful – maintenance visits. Now, a new innovation is making this necessary action so much more efficient and easier: predictive maintenance.

Predictive maintenance is a proactive maintenance strategy that uses a combination of data analytics and artificial intelligence (AI) to forecast when equipment is likely to fail or require service. It helps companies identify, detect, and address issues, reduce risk, and predict the potential future state of equipment. This helps minimize costs, reduce downtime, and enhance operational efficiency because now, maintenance is only done when needed.



So how does the implementation work?

First, you must invest in the hardware and software required, and maintain a quality stream of real-time data from the machines while using sensors. These sensors monitor outputs like sound, temperature, and vibrations to identify anomalies like misalignment, blockages, and wear-and-tear. Apart from real-time data, these analytic or machine learning (ML) techniques must create predictive models, like previous maintenance records, failure events, inspection records, and engineering diagrams. Essentially, the more data, the better.

Predictive maintenance is currently being used in many different industry sectors, like energy, manufacturing, telecommunications, and other industries that are based on consistency, like railways, civil infrastructure, and defense. And this is not a stagnating innovation. There is the possibility of using AR and VR to simplify inspections, by creating virtual simulations of a physical asset that simulates fault scenarios and solutions throughout an asset's life cycle without risk. This possibility for future development makes it an invaluable innovation, and one that is greatly helping companies all around the world.

The Backbone of Human Progress

- Different Career Paths with Engineering

By Dhruv Tarak

The extent of today's progress as humans can be attributed to engineering as a backbone. From the establishment of the steam engine in the 18th century to the development of artificial intelligence and the digital world, engineers have been playing the role of innovators - driving the force that aids in embracing the 4th industrial revolution. Currently, in the 21st century, engineering is paving career pathways at a rate never seen before.

Old is Gold

Traditional engineering disciplines such as mechanical, civil and electrical engineering have all been cornerstones in piloting the movement to high peaks of industrial and infrastructural development. These fields remain crucial - but have been granted wings - through the rapid thrust of AI and technology into all professional domains. For one, civil engineers have long since simply designed bridges and buildings, for now they are key operators in creating smart cities. Similarly, mechanical engineers have a grip around more digital gadgets than metal tools. The current fourth industrial revolution houses infrastructures equipped with technology-driven sensors - monitoring traffic patterns to environmental conditions. In the mechanical field, self-driving cars and robotic manufacturing has truly taken the spotlight.

Novel Avenues

However, in today's data innovation-driven world, are improving upon old ways enough to drive progress? As aforementioned, engineering has also developed new and novel roles in the large and diverse domain - through the implementation of artificial intelligence and interdisciplinary learning - branching into fields of AI engineers and cybersecurity engineers. With the ever-growing population of the world, data has become diverse and numerous. AI engineers tackle this modern crisis using modern solutions. They make use of rapidly evolving machine learning models to recognize patterns and draw conclusions with minimal human intervention. Furthermore, the increased accessibility of this population to technology has led to questions on cyber-safety, which is where cybersecurity engineers come to play - developing new safety barriers to protect sensitive information from cyber attacks - playing a crucial role in maintaining the efficiency of technology by countering its negative implications.

Engineering Currently

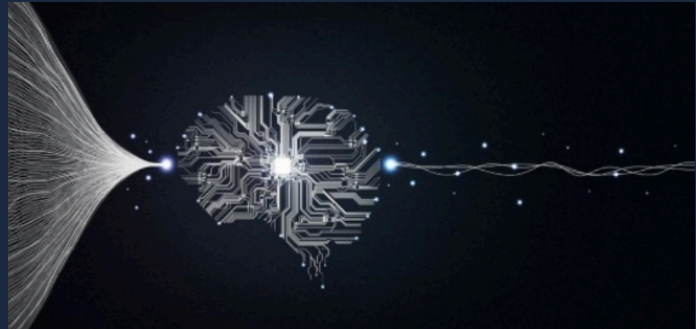
Currently, engineers are expected to have hybrid skills to foster interdisciplinary learning to not only combine traditional engineering with rapid technological advancements, but to implement machine learning and artificial intelligence to innovate new fields and domains in this ever-evolving domain. In conclusion, technology serves as a catalyst for human progress, and with the current state of engineering-based career paths, engineers are promised with the task of being the centre of human development - preserving the past and redefining the future.

The New Era of AI: Unlocking the Brain's Power

By Saanvi Parige

Nothing short of a technological revolution, neuromorphic computing is a growing field in computer engineering that aims to mimic/replicate the brilliance of the human brain.

The radical shift in computing breaks away from the rigid processing of international systems—which process information using binary logic. Neuromorphic systems are designed to operate more like neural networks. This allows for more efficient processing of tasks. The computer will be able to adapt, think and learn just like a human brain.



One of the features of neuromorphic chips is their use of spiking neural networks (SNNs), which simulate the way neurons in the brain communicate (through electrical impulses). This enables the hardware to process data asynchronously, significantly reducing power consumption. When compared with traditional systems, neuromorphic processors can perform more complex tasks with far less energy, which makes them efficient for AI applications.

Cutting edge companies like Intel and IBM are pioneering this technology with chips— Intel's Loihi 2 and IBM's TrueNorth. Intel's Loihi includes over one million artificial neurons that are able to adapt in real time, similar to human/biological brains. Their new ability to adjust based on stimuli opens doors to incredible opportunities in healthcare and robotics.

Neuromorphic computing also holds significant promise in fields like robotics, autonomous vehicles and healthcare. Neuromorphic chips can be used to develop prosthetics that communicate directly with the human nervous system, providing real-time feedback to users, for example. This has the ability to elevate artificial intelligence beyond today's static algorithms to create countless systems capable of unsupervised learning and cognitive computing.

As the demand for energy-efficient AI increases, neuromorphic computing is expected to play a pivotal role in next-generation technologies. Its potential for creating smarter and more adaptable machines positions it as a key technology for future AI and robotic systems.

Striking a Balance between Innovation and Sustainability in the Biomedical World

By Nidhi Chandrapu

Biomedical engineering, a field that marvelously fuses the preaching concepts of healthcare and engineering, has surprised our modern world with its significant contribution, to keeping patients healthier. From life-saving pacemakers and artificial organs to numerous diagnostic machines such as MRIs, biomedical engineering plays a critical role in the healthcare industry. However, like all major technological advantages, it presents a range of various disadvantages.

One of the most significant environmental impacts of biomedical engineering revolves around the amount of waste generated. Medical devices, particularly ones intended for single use only, such as catheters and syringes are essential for preventing infections and ensuring patient safety. However, the disposal of these products often leads to a considerable amount of waste, including plastic and various non-biodegradable materials which are sent to large landfill plots. From here, there are very high chances of water and air contamination, endangering the environment for both us and the aquatic species. Pharmaceutical engineering, a subset of biomedical engineering, also has a large environmental impact as the production of medication includes the use of various chemicals, some of which, if not disposed of properly, can be a danger to the environment.

Another potential problem with the biomedical engineering industry, is the high resource consumption in the process of manufacturing these products, relying mainly on raw materials such as metals, plastics, and numerous synthetic chemicals. Many of the advanced medical devices we use today, such as dialysis equipment, require large amounts of energy to both produce and utilize increasing the carbon footprint of all the stakeholders involved. As this healthcare demand grows, so does the resource consumption.

Despite these challenges, numerous ongoing efforts are being put in place to reduce the environmental impact of biomedical engineering. Engineers are developing more biodegradable medical devices, which will help reduce the reliance on single-use plastics and create more energy-efficient medical equipment. Additionally, recycling programs for medical plastics and the correct disposal of pharmaceutical waste are being implemented, to mitigate environmental harm.

In conclusion, while biomedical engineering has certainly revolutionized healthcare, it comes with a significant amount of environmental challenges, specifically regarding incorrect waste disposal and energy consumption. However, with an increasing emphasis on sustainability today, the field is evolving towards more greener solutions that balance innovation with environmental responsibility.

Innovation in engineering

By Srishti Sriram

Imagining a world where vehicles take over and can navigate challenges like traffic on their own seems implausible – but well now it isn't. In the past few years' automation in the field of transportation, backed by artificial intelligence (AI) has been at the forefront of technological evolution. An example of this are the autonomous cars, a groundbreaking innovation in the field of engineering.

Going further, main functions in autonomous cars include a combination of many sensors, cameras, radars and AI. Autonomous vehicles create a map on their own of the car's surrounding view and use it instead of the typical Advanced Driver Assistance Systems (ADAS) used in non-autonomous vehicles, which requires a human to control the vehicle. Another mechanism used in autonomous vehicles are the Convolutional Neural Networks (CNNs) which are majorly used to find objects and connections around the specific vehicle. Lastly, autonomous cars consist of a rotating Light Detection and Ranging (LIDAR) sensor placed on the roof; it's a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances).

Nonetheless, there are disadvantages to autonomous cars. Those include a hefty amount of finance required for production of the vehicles. In addition to that, the autonomous vehicle industry is predicted to contribute to an upcoming unemployment crisis, with manual car companies predicted to have a downfall in sales and economic rates as the former's economic rates have a progressive increase; this can further lead to economic instability. However, there are positive implications too.

According to a study done in the United States, one of the most prominent implications is that due to a reduction in accidents and an increase in productivity with autonomous cars, a greater savings is leading to economic gains of around 936 billion dollars per year. A similar study estimated a 50 billion pound benefit in the UK by 2030.



We could consider the progressive improvements of autonomous vehicles as the stepping stones to futuristic transportation. But the ongoing discourse between the advantages and disadvantages of such upcoming technologies keeps us obscured about how the future of the industry might change.

Innovations in AI : in the Field of Education

By Salla Sreshta

Artificial Intelligence (AI) has grown tremendously these past few years, especially in the field of education. It is revamping and reconstructing the educational system through varied impacts, those include: enhancement in teaching and learning through the tailoring of educational content to specific needs; the production of adaptive content; streamlining tasks for teachers and easing their workload; lastly it also plays a role in supporting persons with disabilities (PWDs) through increasing accessibility, utilizing AI powered speech recognition tools, or predictive text tools.

Moreover, there are multiple companies that focus on this sector of AI, one of those is Knewton, founded in 2008 by Jose Ferreira. Its mission is "To put achievement within reach for everyone through adaptive learning technology and products that deliver personalized and lasting learning experiences." Knewton's AI not only has the ability to analyze a student's performance on assessments and assignments but also their interactions with the resources on the platform. Based on this, they provide personalized lessons along with the precise resources required. Last but not the least, they also identify an individuals' strengths and weaknesses – overall leaving them with test results that have increased by 62% and reduced anxiety levels in students by 20%.

Going further, Smart Sparrow is another company in the field of AI in education. Founded in 2011 by Dr. Dror Ben-Naim, it is an adaptive tool used by teachers to create lessons based on a student's progress. The system tracks how students interact with the content, including their answers to questions, their movement through a simulation and more. Based on this information, the AI changes the difficulty, speed and type of content; allowing teachers to design courses that adapt to students' needs. Through its tools and AI, Smart Sparrow was capable of keeping students engaged, leading to a 30% increase in retention based on reports.

To conclude, AI is transforming education through offering personalized learning experiences, increased administrative efficiency, and provision of innovative tools for students and teachers. But with newer companies coming up with newer technologies, we are yet to know what is in store for the future of AI in education.

Kinetic Tiles: Mankind's Masterful, Moral and Mechanical Marvel - Student Spotlight Edition

By: Samaira Saraf

"Movement is the only way you have of affecting the world around you." This quote by neuroscientist Daniel Wolpert has become increasingly relevant in recent times. It emphasizes the need to explore the vast world in which we live, particularly its problems, and remain unflagging in our efforts to exact meaningful change in developing and developed communities. These students have taken the quote quite literally, combining principles of STEM and movement to recreate "Kinetic Tiles."

Kinetic Tiles are a unique form of flooring that are installed in small sectors of a room. The tiles are designed to slightly flex when someone stands on them. The downward motion of their foot gets converted into rotational motion. This process sets off a circuit that produces electricity, which is then stored in a super-capacitor. It is a battery-like component that enables a person to generate between one and ten watts by continuously stepping on the tile. For reference, a phone charger uses five watts to fully charge a phone within three hours. Moreover, the electricity generated by the kinetic tile can later be used to supply power to lights, chargers, Wi-Fi hotspots, etc.

Eighth-grade students – Isha Posham (team leader), Shaina Kapoor, Amaira Madan, Smyan Kaveti, and Grushnesh Dhyandeep – aim to use their recreation as a way of supplying power to Kondakal High School. On a daily basis, this government school faces frequent and long-lasting power cuts, hindering their intellectual stimulation and tainting their educational experience. The group of students have prepared a prototype of Kinetic Tiles, and aim to take their project to the next step!

Isha Posham and her team envision a more energy-efficient version of the school where the students are much more enthusiastic about learning. They hope that post-installation, the Kinetic Tiles will instill values of curiosity and critical thinking into young minds, helping them delve deeper into vital concepts of physics, engineering, and sustainability. To conclude, Kinetic Tiles provide much-needed security, enabling students, and simultaneously society, to flourish in an improved, adapted, and eco-friendly environment.



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