TURNING POINT

VOLUME 2 ISSUE 1

TECHNOLOGY INVENTION, INTEGRATION AND INNOVATION

UNRAVELING THE WORLD OF TECHNOLOGY

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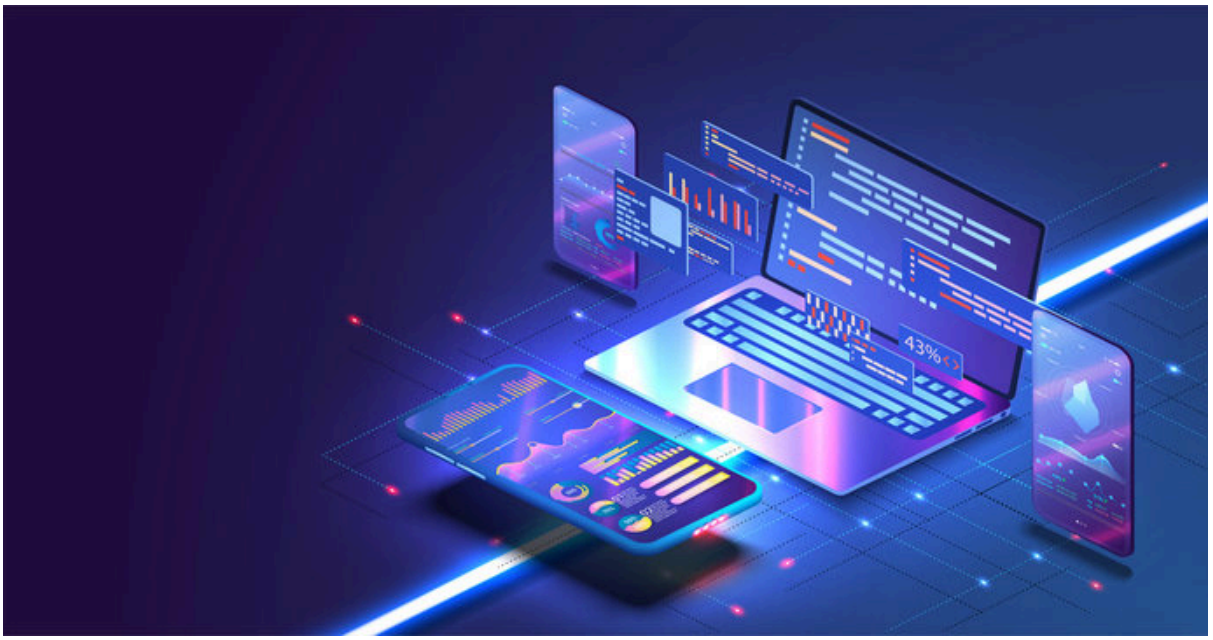

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Abstract:

This issue of Technology Invention, Integration, and Innovation features a collection of pioneering studies that explore the integral role of technology across various domains. Ranging from the history of technology we use everyday, to the science behind technology, possibilities and creativity in Turning Point is endless. This edition encapsulates the dynamic interface of technology with educational, environmental, and health-related fields, underscoring the pervasive influence of technological innovation on modern society.

Closed Ecological Systems

– By Ariel Zhao

Can we make a new earth? Closed ecological systems are ecosystems that do not exchange material with the outside world. Although the Earth itself certainly fits this definition, the term is primarily used to describe relatively small man-made ecosystems.In a closed environment, there must be producers, consumers and decomposers. It looks like a kind of fish sold in the flower, bird, fish and insect market. It's packed in a transparent bottle, and there are aquatic plants, a small fish, and bacteria you can't see in the bottle.In a closed ecological system, the maintenance of life happens through complete re-use of available material by means of cycles. Exhaled carbon dioxide and other waste matter is renewed chemically or by photosynthesis into oxygen, water and food.

The closed ecosystem was proposed by American economist Paulding in 1966. He believed that the earth's resources and production capacity were limited, and it was necessary to establish a circular production system on the earth with the conscious awareness that the capacity was limited and the future was closed.

There are already experiments underway with closed ecosystems.Biosphere 2 is located in Washington, the capital of the United States. It was jointly built by Israeli Prime Minister Ra'ad Dee and federal government elders. It is the largest enclosed building in Washington, the capital of the United States.But in 1993 it failed because Biosphere 2's water systems became polluted with too many nutrients. The crew had to clean their water by running it over mats of algae, which they later dried and stored. Also, as a symptom of further atmospheric imbalances, the level of dinitrogen oxide became dangerously high.

However, technology is still improving. Maybe we will build a new Earth, but we also need to cherish the Earth we have now.

History of Technology Used for Communication

– By Bella Abdullah

Communication technology has been around for many years. It allows us to communicate with one another and it helps us get difficult tasks done. I will be talking about the history of technology that has been going on for centuries.

The first technology that was created for communication was using pictograms during Ancient Egypt. Men were forced to create photos which were called hieroglyphics which were written on papyrus, carved in stone on tomb and temple walls. 1 They were used to help decorate objects and it was a way to communicate with each other. It was created before 3100 B.C and ended in the 5th century A.D. 2 Ancient men had to be creative with communication and made sure that it was being consistent to help others to understand over time. 3

Image source 4

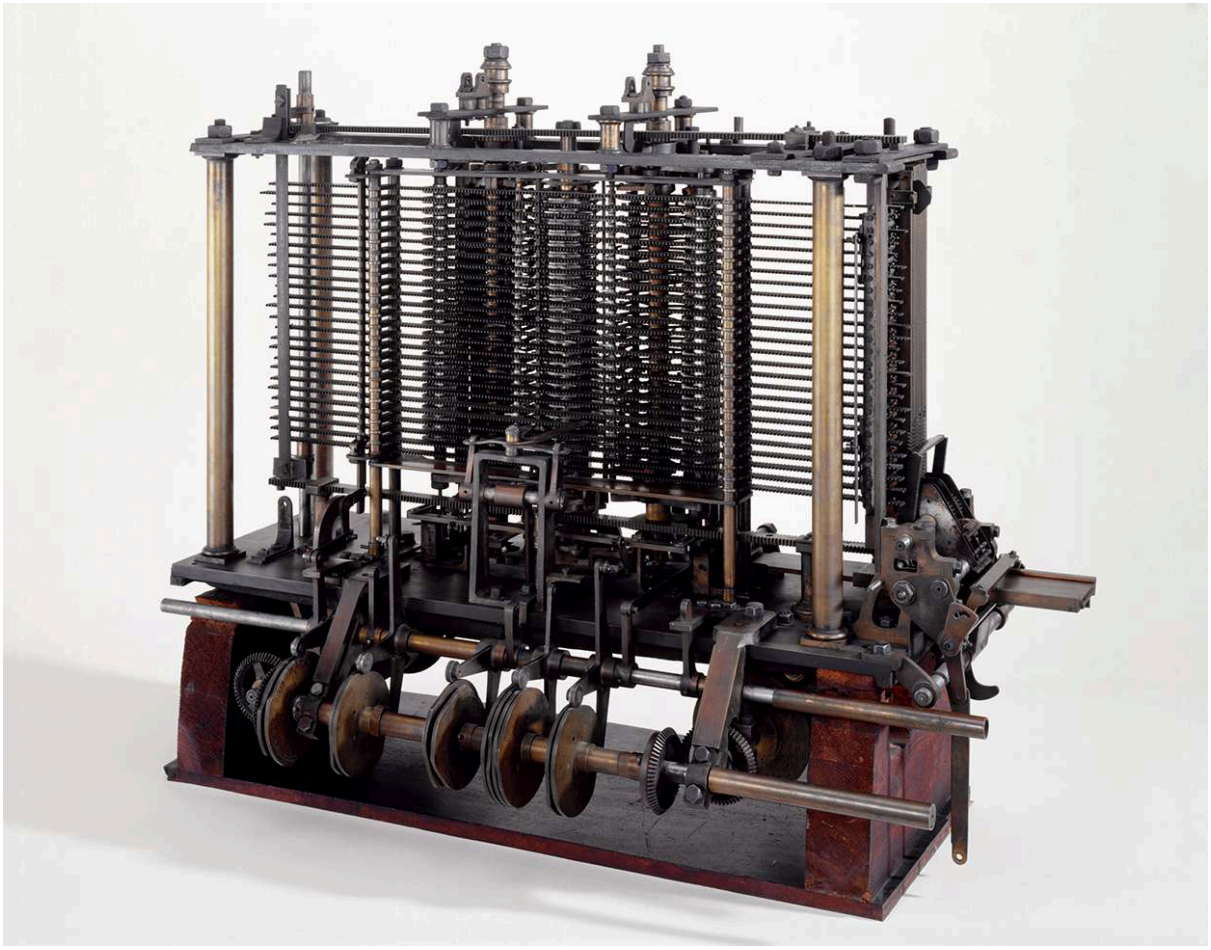
After the Ancient Egyptians, a few years later the printing press was invented in the 1300s, which removed the need for people to write on paper to send messages to each other. 5
It was invented during the Bi Shang and Wang Chen dynasties in China. This invention gave people the ability to conveniently produce large amounts of materials that supported the flow of information among people.

Image source 6

Later, during the 19th century the first typewriter was invented to help type up words on paper which made it easier to write emails,letters and books. It was produced by steel types striking the paper through an inked ribbon with the types being actuated by corresponding keys on a keyboard and the paper being held by a platen that is automatically moved along with a carriage. 7

Photo source 8

Soon after the typewriter was introduced to society, in 1837 Charles Babbage created the first computer which allowed information to be recorded and stored and even helped with communication. His aims were to reduce astronomical calculations to a more standard form and to circulate data. 9

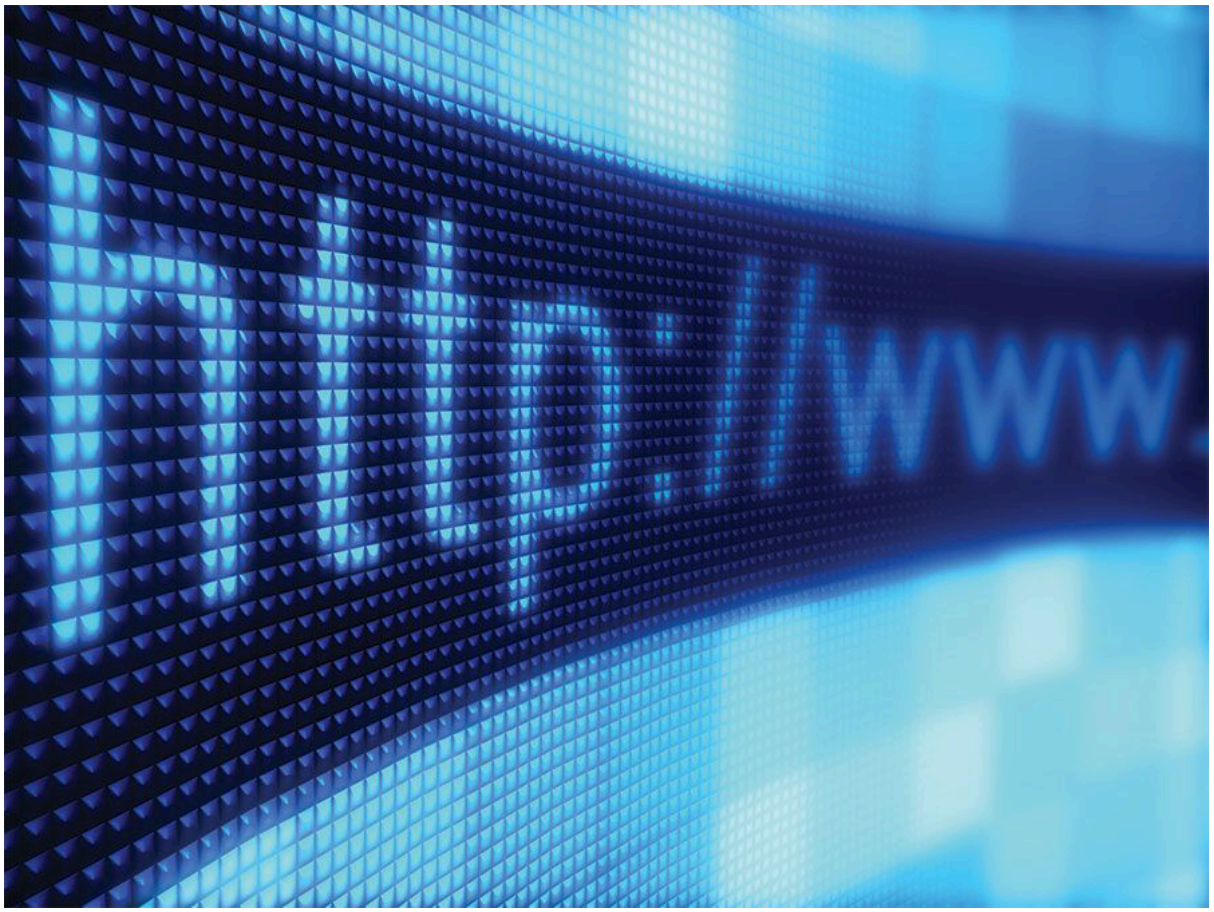


source of information

Then in 1971 a personal computer was created. It was designed by John Blankenbaker called the Kenbak -1. His desire was to create a computer that was affordable and educational for individuals that would later be impacted with this technology. 11

Source photo 12

Soon the internet was created in 1974. It was created by computer scientists Vinson Cerf and Bob Kahn. Cerf and Kahn developed a set of guidelines for data transfer using packet switching in 1980 calling them Transmission Control Protocol (TCP) and Internet protocol(IP). The TCP was in charge of packing data before it moves across the network and unpacking it once it has arrived. The IP was used as the trip coordinator and maps the movement of information from its start to end point. 13



Source photo 14

After that in 1984 mobile phones were brought out to the public. The Motorola DynaTAC 8000X was the first handheld phone that allowed people to make longer distance calls. 15 The idea first started on 3th April 1973 by Martin Cooper, a Motorola researcher and executive. He said his reason for creating the phone was “a cell phone ought to be an extension of a person, it ought to be with a person all the time." 16

Photo source 17

Then finally in 1992 the mobile phones were developed into smartphones. It was called the IBM Simon which was released in 1994, where it was designed to be a computer that could fit into pockets to make it easier to travel with. 18 This phone unfortunately discontinued in February 1995 one year after it was released. 19

Source photo 20

What opportunities and challenges are presented by A. I in reshaping the future of learning?

– By Calysta Lim

As the debate around AI (Artificial intelligence) being gradually implemented into our everyday lives becomes increasingly ubiquitous in media in recent times, a sharp division is drawn with optimists on one side, anticipative about the opportunities and benefits this new technology might hold— others more pessimistic about the problems that might come with such benefits. Currently, AI is transforming society across many different sectors— and education is no exception.

The rise of generative AI software, such as ChatGPT and Bard, holds great power in not only answering questions in depth and detail but also producing original content in various media (Bell & Velasquez, 2023). Among the millions of their users are students who have recognized the AI's capabilities and have quickly incorporated it into their homework, assignments, projects, and even tests (Westfall, 2023)— vital assessments for an educator as an honest measure of a student's performance that may be undermined by AI utilisation.

The breadth of what AI can do sets it apart from other educational technologies, such as calculators and translation software, which have only been programmed to perform a specific task that acts as one of the tools for answering a bigger question. This becomes a growing concern for educators because, unlike these formally accepted technologies, AI's ability to generate human-like text allows it to effectively pose as a student and produce or transform complete works that can pass off as not only original but also gradable content (Hern, 2022). Because of this, it becomes difficult for educators to determine whether or not answering open-ended questions, summarising a text, and generating ideas using AI constitutes cheating. A major challenge for educators that persists is the ability to detect AI content in student work. AI detectors are swayed by further-prompted AI-generated text, and have been reported to be repeatedly biassed against non-native speakers (Liang et al., 2023), as verified by OpenAI's Educator FAQ as well (*How Can Educators Respond to Students Presenting AI-generated Content as Their Own?*, n.d.) (*How Can Educators Respond to Students Presenting AI-generated Content as Their Own?*, n.d.).

A more pernicious challenge AI poses is its underlying negative consequences on the way students opt for when learning with AI. Whether it be through generated notes or full solutions to an open-ended problem — AI becomes another and perhaps more dangerous manifestation of passive learning when students view it as a shortcut to cut down workload rather than a tool to aid in unlocking a deeper understanding of the topic at hand. While some of the AI's actions seem relatively harmless, such measures of generative AI reduce vital steps in the thought processes of students that hinder their ability to engage effectively in learning during a "critical phase" in brain development (Cabrera Giraldez et al., 2018), also known as "cognitive offloading", that will cause "detrimental long-term effects" including

diminished problem-solving abilities, worse memory and even a decrease in one's ability to learn new things (Grinschgl & Neubauer, 2022). Like other passive forms of learning like lecture-style lessons where information is merely fed to students, information obtained from complete reliance AI feels easier to process, but learning that has been retained is far less than that from more effortful, active learning. (Deslauriers et al., 2023)

To mitigate student overreliance on AI, it becomes vital for educators to play a central role in guiding the responsible use and implementation of such technology in the classroom by setting guidelines for AI utilisation inside and outside of the classroom. (*UNESCO Survey: Less Than 10% of Schools and Universities Have Formal Guidance on AI*, 2023) found out that currently "fewer than 10% [educational institutions] have developed institutional policies and/or formal guidance concerning the use of generative AI applications" with schools having less than that of universities, echoing the uncertainties of this new technology and urging institutions to recognize the growing significance of AI usage within education by both students and teachers and promptly set guidelines to match the unabated pace and ever-changing nature of technological innovation and educate students about the opportunities and limitations (Thorbecke, 2023) there are to AI currently.

What is AI's largest danger to education can become its most beneficial yet: AI's most powerful feature is its ability to connect miscellaneous ideas, a key aspect of 'interleaved' learning as opposed to it being "blocked", as research demonstrates is a more successful approach to studying where multiple subjects or topics have been combined in studying, enhancing long-term retention and the transferability of learned material (*L2L Strategy - Interleaving | Arizona Site*, n.d.). The introduction of AI can be a highly effective revision resource that can create unique problems for students to challenge them to continuously recollect information and strengthen memory associations, widening the scope of what has been learned and achieving a deeper understanding of that learning, yielding better results than a passive and less fruitful AI utilisation for the completion of schoolwork.

AI-powered virtual assistants have the potential to provide a personalised learning experience by identifying learning gaps in each individual student, as well as bridging classroom learning and its practical application. Like a tutor, AI can be programmed to ask questions rather than answer them, allowing a student to engage in critical thinking. Similarly, AI can deepen a student's understanding through simulations and other interactive experiences which encourages the application of theoretical knowledge to real-life problems. An example of such education-specialised AI being deployed currently is Khan Academy's Khanmigo (*Khanmigo Education AI Guide*, n.d.), which "mimics a writing coach" to provide real-time support and feedback to a struggling student through prompts and suggestions.

Though the risk of AI misuse persists, banning it will only breed hostile relationships between student and educator and rob both of an opportunity to transform education for the better (Yang, 2023). Proper usage of AI can be an extremely valuable tool to aid teaching when more schools recognize AI's possibilities, embrace it and set guidelines on how to use this technology, and accelerate learning for the next generation of humans. With AI developers and educators working in tandem, a more equitable and innovative education system is within reach.

Like any other technology that precedes it, AI may cause scepticism at first — after all, the future of AI is still uncertain. As futurist Roy Amara had described human expectations of the effects of technology in his adage: "We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run" (Arroyo, 2021), the education system is strongly encouraged to set its sights a little further on what AI means for the future of learning.

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Technology and Neuroscience

– By Doris Zhao

Case study - Restoring functional vision for completely blind people by microelectrode array.

According to the International Agency for the Prevention of Blindness's Vision Atlas – a compilation of the very latest eye health data. Globally there are 43 million people living with blindness. Although there aren't any ways to completely cure blindness yet, scientists found that they can use a new implantable device to create a form of artificial vision via a visual prosthesis by using a microelectrode array.

The device is only in the early stages of clinical development, but the first trials on human participants were successful. The patients were able to perceive letters and shapes with the help of the equipment. We will see how the microelectrode array works in this process in the following paragraphs.

To begin with, microelectrode arrays, also called multielectrode arrays, are devices containing tens to thousands of microelectrodes through which neural signals can be acquired or transmitted, essentially acting as a neural interface connecting neurons to electronic circuits.

According to the *Journal of Clinical Investigation*, scientists implanted an intracortical microelectrode array consisting of 96 electrodes was implanted in the visual cortex of a 57-year-old patient who had been completely blind for 16 years. The scientists used MR imaging to surgery to create a three-dimensional reconstruction of the surface anatomy and neurovascular structures of the subject's primary visual cortex beforehand to optimise the implantation location of the electrode array, eventually selected a region of the right occipital cortex that could be accessed easily while avoiding major blood vessels. They carried out the clinical trial by measuring and recording the thresholds and characteristics of visual perception induced by intracortical microstimulation.

The patient had experienced random flashes of light — spontaneous positive visual phenomena (phosphenes) before implantation, as is common in many blind persons. She was trained to differentiate these from the electrically-induced phenomena. After the UEA implantation, the patient's spontaneous visual hallucinations had been temporarily increased, but gradually decreased over time.

The researchers then found that increasing the number of stimulating electrodes to more than two significantly improved the size, clarity, and brightness of the phosphenes. They observed that the patient was more likely to "see" dots of light when more than two electrodes were stimulated. She was able to identify different letters and whether they were uppercase or lowercase.

“In this context, the scientific and technological problems associated with safe and effective communication with the brain are very complex, and many problems have to be solved before a cortical visual neuroprosthesis can be considered a viable clinical therapy or option.” Said Dr. Fernández.

“One goal of this research is to give a blind person more mobility,” one of the scientists said as the purpose of the implant is to provide a degree of functional vision. “It could allow them to identify a person, doorways, or cars easily. It could increase independence and safety. That’s what we’re working toward,” said Dr. Normann. The research is still in the development stage, but bringing the hope for more people to regain their sight.

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How does technology influence income distribution and employment?

– By Ishika Chakraborty

Technological developmental research is a field that generates up to 2.4 trillion dollars in the form of R&D (Research and Development) globally in 2019 (a drastic surge from 726 billion dollars in 2000 - a 235.5% increase to be exact). This monetary figure invested in R&D, leads to the question whether all of these technological advancements are serving the economy or its people in a productive way or not. What is the point of the success or growth of the world of technology if it is causing a negative influence in the income distribution and a cause for a rise in the levels of unemployment?

Firstly, it is crucial to define what exactly is income distribution and employment. Income distribution refers to the measure of how income is distributed amongst individuals and households in a society. To put it in perspective, an equal distribution of income is associated with lower poverty rates in an economy. In terms of how income distribution is beneficial to governments and the economy in general is because income distribution is critical in determining the poverty rate at any GDP level for any country. Whereas, employment is defined as the state of having paid work.

Technological change leads to increased efficiency of production and reduced time of production. As we continue with the development of technology, we are faced with the increase in efficiency and potential when it comes to production, also reducing the time taken for the production. With the payment of the marginal product of technological change being a factor of production, there is Pareto equilibrium of income distribution.Therefore, nobody is worse off in income distribution. However, the effects of competition because of technological change lead to inequality in distribution of income. - By IVY panda

Technology is a key component in the changes to an economy or economic output, the performance does vary throughout the different counties. However, it is important to note that technology could be considered a driving factor in formulating wealth inequality as industries in technological fields are very skill-bias and skill focused, restricting unskilled workers in this newly established industry to not thrive - By UNESCAP.org

Quite a number of economic models have claimed that technological progress, which has been seen as the major source of economic development, may cause income inequality to increase whenever it impacts the productivity of the labour force in any way; in other words, whenever it is not neutral. For instance, one can claim that income inequality would increase if there was an introduction of new technologies that would increase the demand for skilled labour. However, one has also to take into account that the effects of technological progress

on education might be ambiguous if an “expansion in the pool of skilled labour” was a result of the higher growth that is correlated with the progress of technology - By core.ac.uk

If labour markets are flexible, meaning they could easily react to the changes in the industry and change their strategies to match the changes, then technological change will not cause unemployment or a decrease in wealth generation. However, if there are labour market inflexibilities, then it can cause unemployment – at least, for a certain time period.
For example, due to technological change, coal miners may lose their jobs, due to their occupational and geographical immobilities. Coal miners is a profession in the primary sector and that is the section of work that is most likely to be replaced due to technological advances. An example of this put into a real-life example would be a miner may not have skills to work in computers; he may find it hard to relocate.

In all, technological change can cause a temporary increase in unemployment – which will last until the coal miners develop greater skills and ability to move, becoming more occupationally mobile as this can significantly increase the demand of these workers.

Source: economicshelp.org

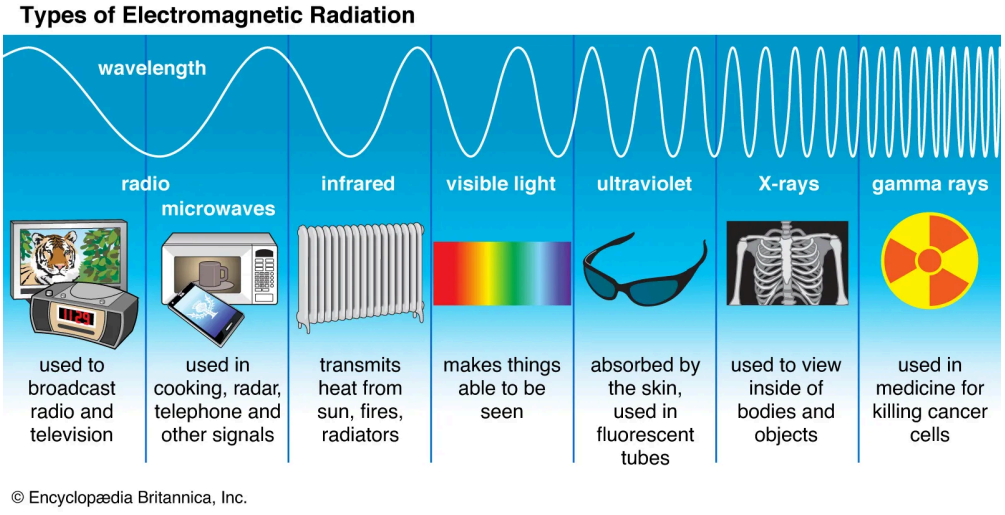
Radio technology

– By Julia Kim

What is Radio?

Before we dive into the science behind wireless communication, we first need to define what radio is. Radio, in this context, refers to a method of transmitting electrical energy(and thus information) from one place to another using electromagnetic waves.

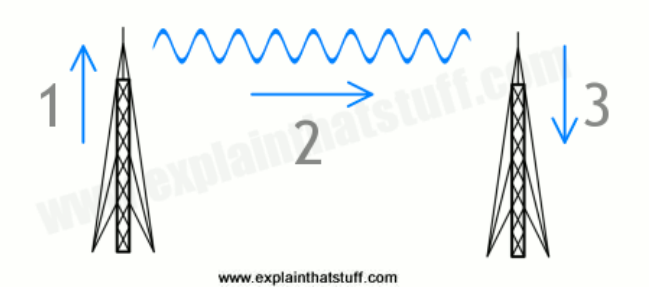
Electromagnetic waves, or radiation, is generated by the oscillation of a charged particle, eg. electrons. We classify these waves based on ranges of frequencies, with the lowest range being classified as radio waves and the highest range being gamma rays. Radio waves, microwaves, infrared radiation, visible light, UV light, X-rays, and gamma rays are all part of the electromagnetic spectrum that have various distinct uses. The waves all travel at an extremely fast speed of $3 \times 10^8 \, m/s$. All electromagnetic waves transfer energy, but some are unsuitable for everyday use. UV light, X-rays and Gamma rays are notorious for damaging human cells, because they are ionising and can cause potentially cancerous mutations in our genes. However, waves on the lower end of the spectrum are harmless to us.



You may be asking yourself, how could such tiny oscillating particles transfer sounds and images?

Analog Radio

Modulation



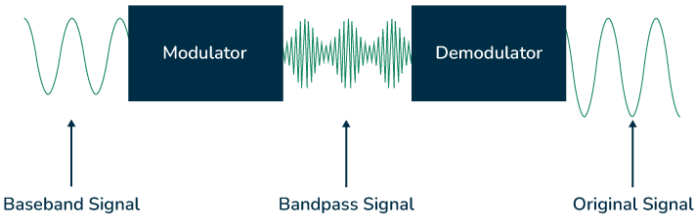
1. Transmitter
2. AM/FM signal
3. Receiver

Radio waves carrying information travel from transmitter to receiver. When a wave is transmitted, it undergoes modulation.
The process goes like this:

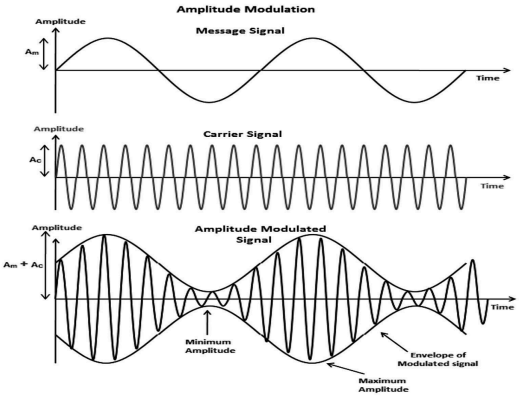
1. The transmitter takes a carrier signal, which is a constant sine wave with no changes in amplitude or frequency.
2. It also takes a message signal, which is the wave that represents the information you wish to transmit.
3. The two waves are combined, making changes in either the amplitude or frequency of the carrier signal.

The receiver receives the modulated signal and demodulates it using a detector circuit, turning it back into whatever form of media it once was.

An analogy that may help your understanding is morse code. A random series of taps wouldn't mean anything, but if we tap in a certain pattern it corresponds to the English alphabet and communicates useful information. Similarly, the letter 'A' could be represented by a small amplitude or lower frequency whilst the letter 'Z' could be represented by a large amplitude or higher frequency.

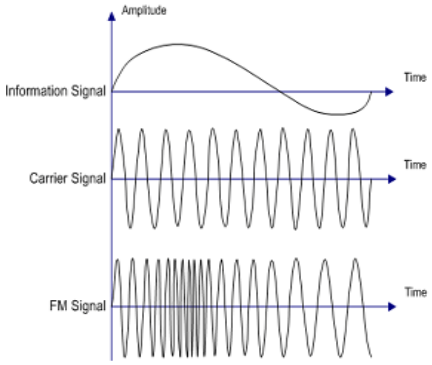


AM



Amplitude modulation is when the message signal increases or decreases the amplitude of the carrier signal whilst keeping the frequency constant.

FM



Frequency modulation is when the message signal increases or decreases the frequency of the carrier signal whilst keeping the amplitude constant.

Sending information by changing the shape of radio waves is an example of analog transmission; the information being sent is represented by a direct physical change(i.e. change in frequency or amplitude). A downside to AM and FM radio is that if the wave is disrupted or interfered on the journey to the receiver, some information may be lost. Lost information cannot be restored.

FM radios tend to sound better than AM radio. This is because AM modulation is more susceptible to interference and has lower audio fidelity. However, AM modulated signals are still used because they can travel farther than FM modulated signals.

Appendix

* I have linked a Wikipedia article that explains the process in more detail.

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Exploring the Latest in Nanotechnology

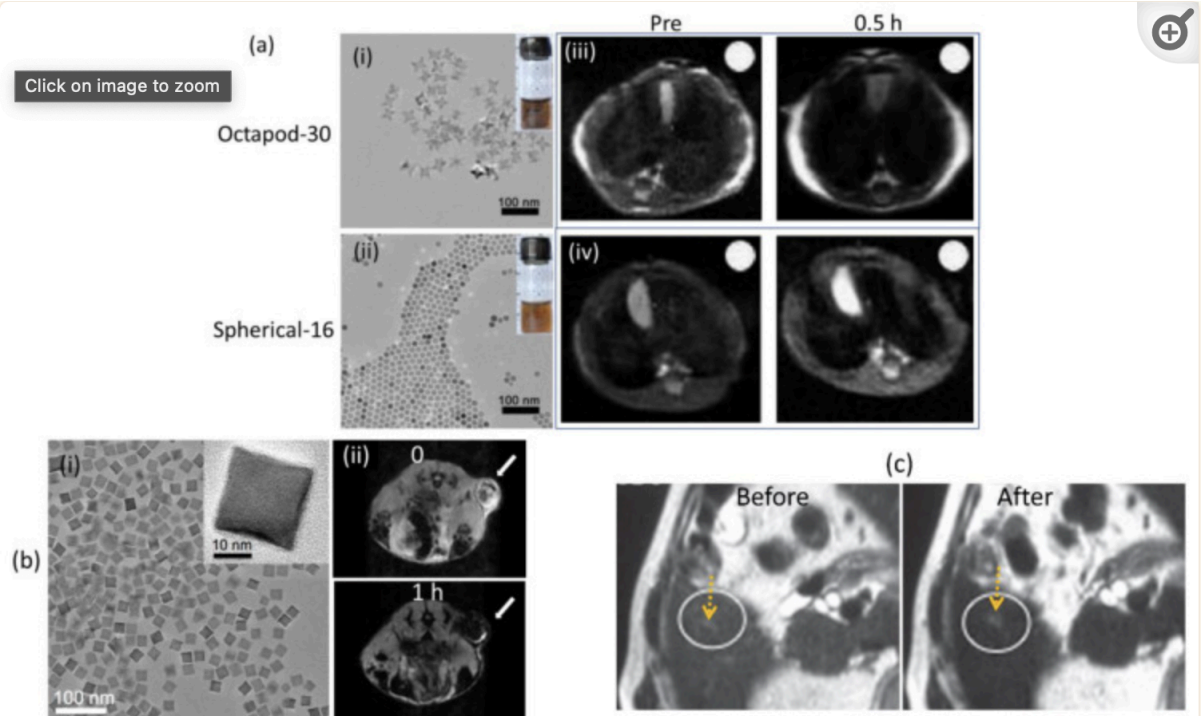
– By Mina Kim

In an era defined by relentless technological advancement, perhaps no field holds as much promise for transformative change as nanotechnology. With the ability to manipulate matter at the nanoscale, scientists and engineers are opening up a world of possibilities that once seemed confined to the realms of science fiction. From revolutionising healthcare and electronics to addressing pressing environmental challenges, the potential applications of nanotechnology are vast and varied. This article delves into the most recent advancements in nanotechnology research and development, examining how these discoveries are influencing our current state of affairs and laying the groundwork for an incredible future.

Revolutionising Healthcare:

The field of nanotechnology exhibits great potential for transforming the healthcare industry, especially in terms of developing precise drug delivery systems. These advancements entail the precise transportation of medications to specific locations within the body using nanoparticles. By leveraging this targeted approach, treatments become more effective while minimising undesirable side effects, thus ushering in a new era of personalised medicine. Furthermore, the early detection of diseases such as cancer is made possible in large part by nanoscale sensors and imaging techniques. This early detection paves the way for more effective treatment strategies and improved patient outcomes.

Recent research from the National Cancer Institute has delved deeply into the complexities of targeted drug delivery. Nanoparticles demonstrate vast potential in transforming healthcare practices, particularly in targeted drug delivery and early disease detection. In targeted drug delivery, nanoparticles act as minuscule delivery vessels meticulously engineered to identify specific molecules present on diseased cells, ensuring precise transportation of therapeutic cargo directly to these targeted cells. This not only enhances drug concentration at the site of disease but also minimises adverse effects by sparing healthy cells from exposure. Likewise, in the realm of early disease detection, nanoparticles play a pivotal role in advancing imaging techniques. By binding to molecules associated with diseases, nanoparticles enable the visualisation of diseased cells during imaging procedures like MRI scans, allowing for the identification of abnormalities at their nascent stages.



This heightened visibility facilitates prompt intervention, potentially leading to improved treatment outcomes. With their versatility extending across various ailments such as cancer and Alzheimer's, nanoparticle-based strategies present promising avenues for elevating healthcare standards and enhancing patient welfare.

Sources : 1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3249419/
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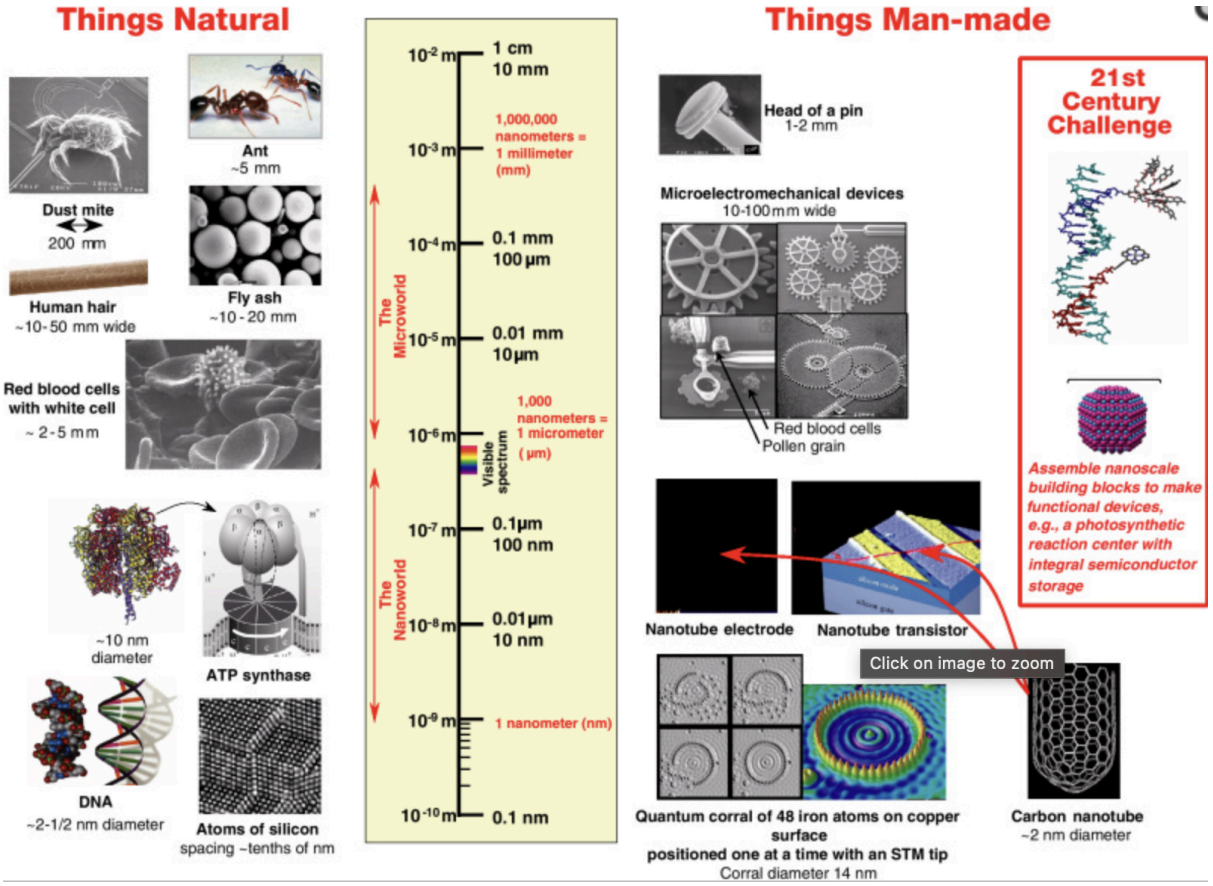
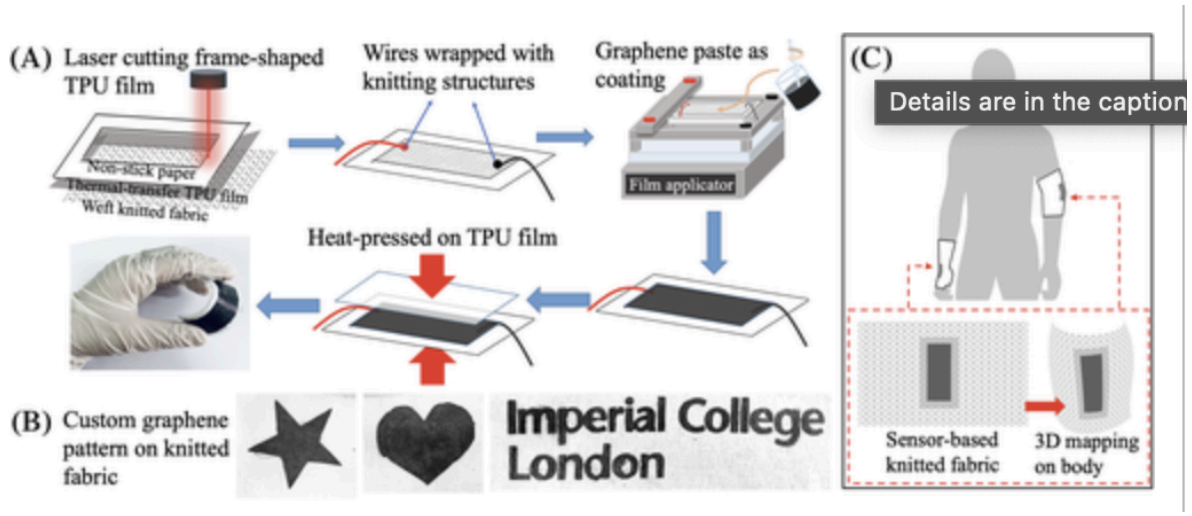
Energising Electronics:

Nanotechnology is revolutionising the electronics industry through the introduction of novel materials like graphene and carbon nanotubes, which possess exceptional electrical properties absent in traditional electronics. Graphene, composed of a single layer of carbon atoms arranged in a honeycomb lattice, exhibits remarkable conductivity and strength, rendering it ideal for flexible electronics applications.



Similarly, carbon nanotubes, cylindrical structures made of carbon atoms, offer unique electrical properties, as discussed in the National Institutes of Health article. While further research is needed, carbon nanotubes hold promise for various electronic applications, signifying a significant advancement in the field.

Harnessing the potential of these nanomaterials paves the way for a new era of electronic devices with exciting features. This includes supercharged processing speeds driven by faster movement of electrical current within devices, improved energy efficiency through enhanced transistor performance, and the realisation of flexible electronics concepts.



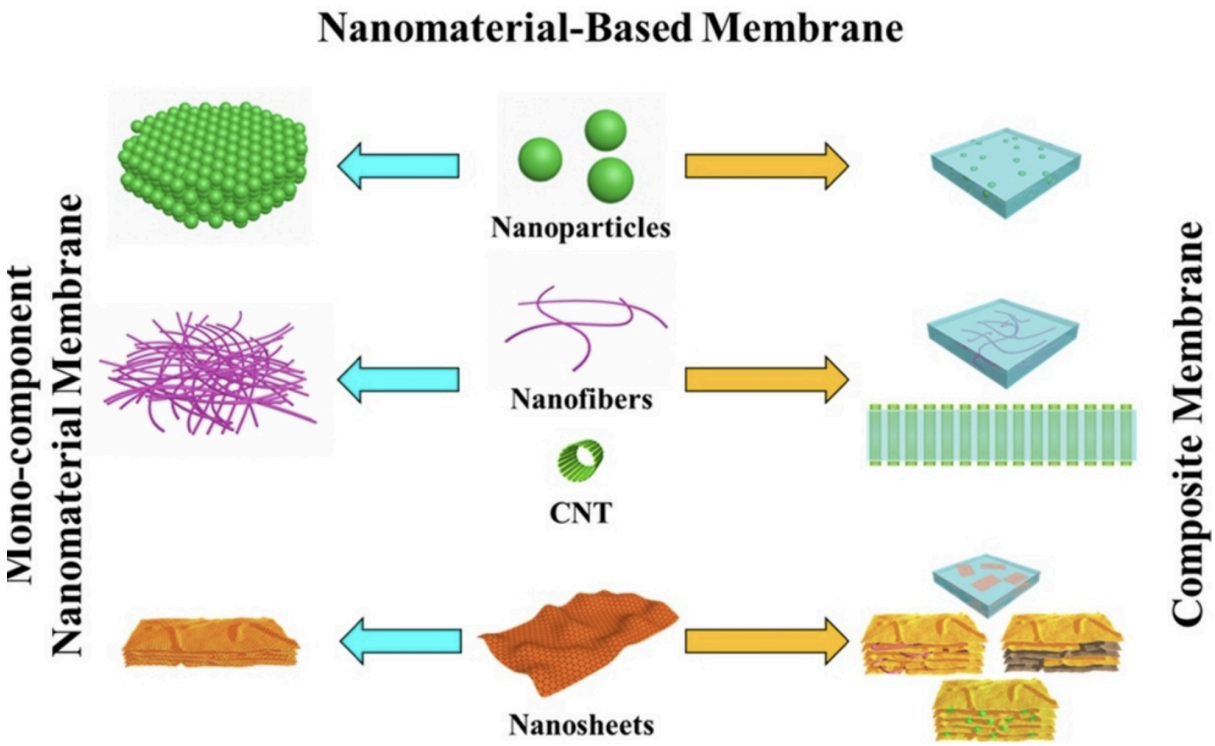
Graphene's flexibility opens doors for creating bendable screens and other futuristic tech concepts, while carbon nanotubes present opportunities for developing faster, smaller transistors and super-strong composites. Moreover, both materials hold promise in fields such as targeted drug delivery and environmental remediation. As research in nanotechnology progresses, the future of electronics appears promising, with the potential for faster, more efficient, and even bendable devices poised to revolutionise daily life.

Sources : 1. https://onlinelibrary.wiley.com/doi/full/10.1002/pat.5856
2. https://www.ncbi.nlm.nih.gov/books/NBK220680/

Addressing Environmental Challenges:

Nanotechnology is becoming more widely acknowledged as a critical weapon that goes beyond electronics and healthcare to address environmental crises. Innovative nanomaterial development provides previously unseen answers to urgent environmental problems, such as pollution remediation and water purification. In order to meet the growing demand for sustainable energy, nanocatalysts, for example, show promise in improving the efficiency of renewable energy sources like fuel cells and solar panels.

Additionally, real-time monitoring of environmental pollutants is made possible by sensors based on nanomaterials, which gives stakeholders the information they need to make decisions that will protect the environment. Specialised nanoparticles are designed to target and remove pollutants from water sources, including lead and arsenic. This offers a promising solution for supplying clean drinking water to areas where water is scarce or contaminated.



Similar to this, nanoparticles are essential for pollution remediation because they can specifically target and break down dangerous organic compounds in soil and water, providing a more effective and focused method of cleaning up the environment. With regard to protecting the environment and guaranteeing a sustainable future, these developments highlight the revolutionary potential of nanotechnology.

Sources : 1. https://www.sciencedirect.com/science/article/abs/pii/S2352940716302827

In conclusion, nanotechnology is at the vanguard of technological advancement and has the potential to drastically alter our world in ways that were previously unthinkable. It is crucial that we approach these developments with a sense of responsibility and conservation as we continue to solve the mysteries of the nanoscale. This will help to ensure that the advantages of nanotechnology are shared fairly and that any hazards are carefully managed. We can open the door to a future full of limitless possibilities and infinite opportunities by using nanotechnology to advance humankind.

How has Technology Impacted Healthcare

– By Rain Cheng

Technology has become an integral part of modern biology and medicine, changing the way researchers study biological systems and healthcare professionals diagnose and treat diseases. The rapid advancements in technology have enabled the integration of data-driven approaches, precision medicine, and personalised healthcare. This essay aims to explore the impact of technology in biology and medicine, focusing on genomics, bioinformatics, medical imaging, and telemedicine.

Genomics and Bioinformatics:

The field of genomics has been significantly influenced by technological advancements, particularly in high-throughput sequencing and genome editing techniques. The Human Genome Project, completed in 2003, marked a milestone in genomics research, providing a reference sequence for the entire human genome (Collins et al., 2003). Subsequent developments in next-generation sequencing (NGS) technologies have enabled the rapid and cost-effective sequencing of entire genomes, leading to the identification of genetic variations associated with diseases and drug responses (Goodwin et al., 2016).

Bioinformatics, the interdisciplinary field that combines biology and computer science, plays a crucial role in analysing and interpreting large-scale genomic data. Tools such as the Genome Analysis Toolkit (GATK) have enabled researchers to identify genetic variants, understand their functional impact, and unravel the genetic basis of complex diseases (McKenna et al., 2010).

Medical Imaging:

Advancements in medical imaging technologies have revolutionised the diagnosis and monitoring of diseases. Modalities such as magnetic resonance imaging (MRI), computed tomography (CT), and positron emission tomography (PET) have improved the visualisation of anatomical structures and physiological processes with high resolution and contrast. For instance, PET-CT imaging combines functional and anatomical information, allowing for precise localization of tumours and accurate staging of cancer (Cherry & Gambhir, 2001).

Telemedicine:

The integration of technology in healthcare delivery has led to the emergence of telemedicine, enabling remote patient consultations, monitoring, and tele-surgeries. Telemedicine has become particularly valuable in improving access to healthcare services, especially in rural and underserved areas. The use of telehealth platforms and mobile health

applications has facilitated virtual patient-physician interactions, home-based monitoring of chronic conditions, and real-time transmission of medical data (Bashshur et al., 2016).

In conclusion, the integration of technology in biology and medicine has led to significant advancements in genomics, bioinformatics, medical imaging, and telemedicine. These technological innovations have improved our understanding of genetic mechanisms, enhanced disease diagnosis and monitoring, and expanded access to healthcare services. As technology continues to evolve, it is imperative to harness its potential for personalised medicine, population health management, and global healthcare equity.

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The Advancement of Technology and Space Exploration

– By Shayna Mukherjee

Technology is used in almost every aspect of space exploration, such as the development of lightweight materials, machinery supporting research, better telescopes, the increasing capabilities for smaller telescopes, rovers, the technology used in rockets, space stations and so much more!

It even goes the other way round: a large amount of the technology that make our lives more comfortable and efficient have been discovered through space exploration, such as communication tools, advancement in weather forecasting, solar panels, implantable heart monitors, water-purification systems, improved computing systems, advanced robotics, health, medicine, engineering, transportation and software.

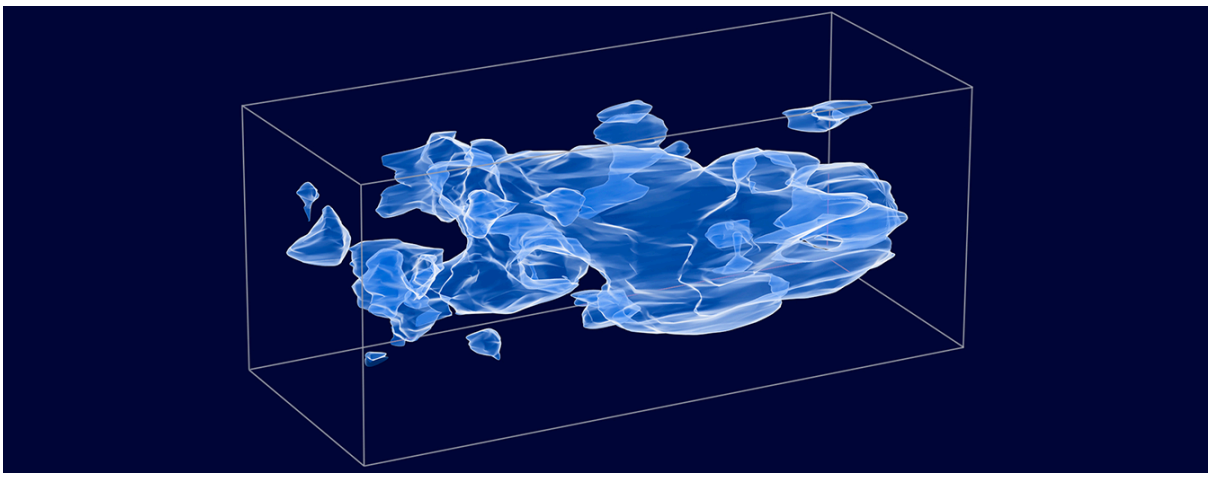
An example of how advanced technology supports research is the development of telescopes. In this article, I have described how a few of the telescopes around the world have shaped how we see space.

The Hubble Space Telescope

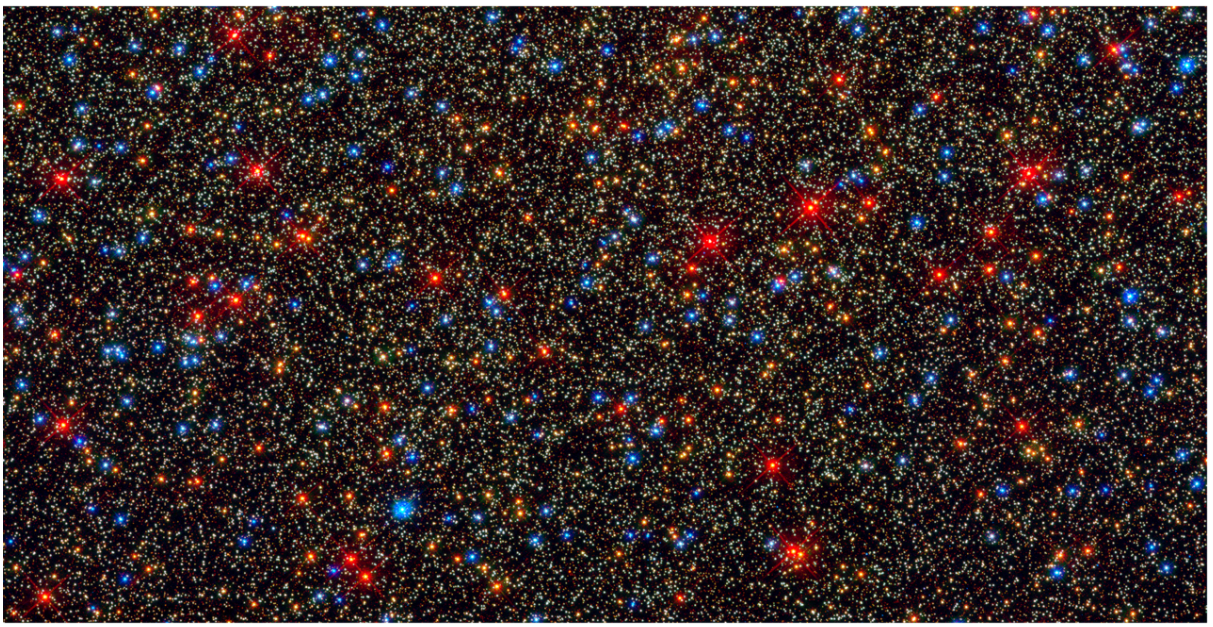
Since its launch on the 24th of April, 1990, the Hubble Space Telescope has dazzled the world with its breathtaking images, and helped scientists to discover a deeper understanding of the universe and how it works. In fact, it has taken over 1.6 million observations!

The Hubble Space Telescope has hugely contributed to science, such as by -
helping pinpoint the age of the universe (13.8 billion years), discovering the moons - Nix and Hydra (Pluto's moons), helping determine the rate of the universe's expansion,, discovering how almost every galaxy has a supermassive black hole in its centre and creating a 3D map of what is known as dark matter.

Here are some of the amazing things the Hubble Telescope has produced -



- 3D map of the distribution of dark matter in the universe.



- An image of about 10,000 of the 10,000,000 in the Omega Centauri star cluster

- A stunning image of the nebula NGC 6302, also known as the ‘Butterfly Nebula’.

- This is the famous picture of the magnificent Eagle Nebula, known as ‘The Pillars Of Creation’, taken by Hubble in 1995. How truly spectacular!

There are so many more astonishing and astounding images taken by the Hubble Space Telescope, proving what remarkable things technology can do.

The James Webb Space Telescope

The James Webb Space Telescope is another wondrous telescope, designed to observe deeper into the history of our universe, such as searching for the first stars and galaxies created after the Big Bang, better understanding how planets, stars and galaxies are born and how they evolve. The Webb Mission is to study every phase in the history of the

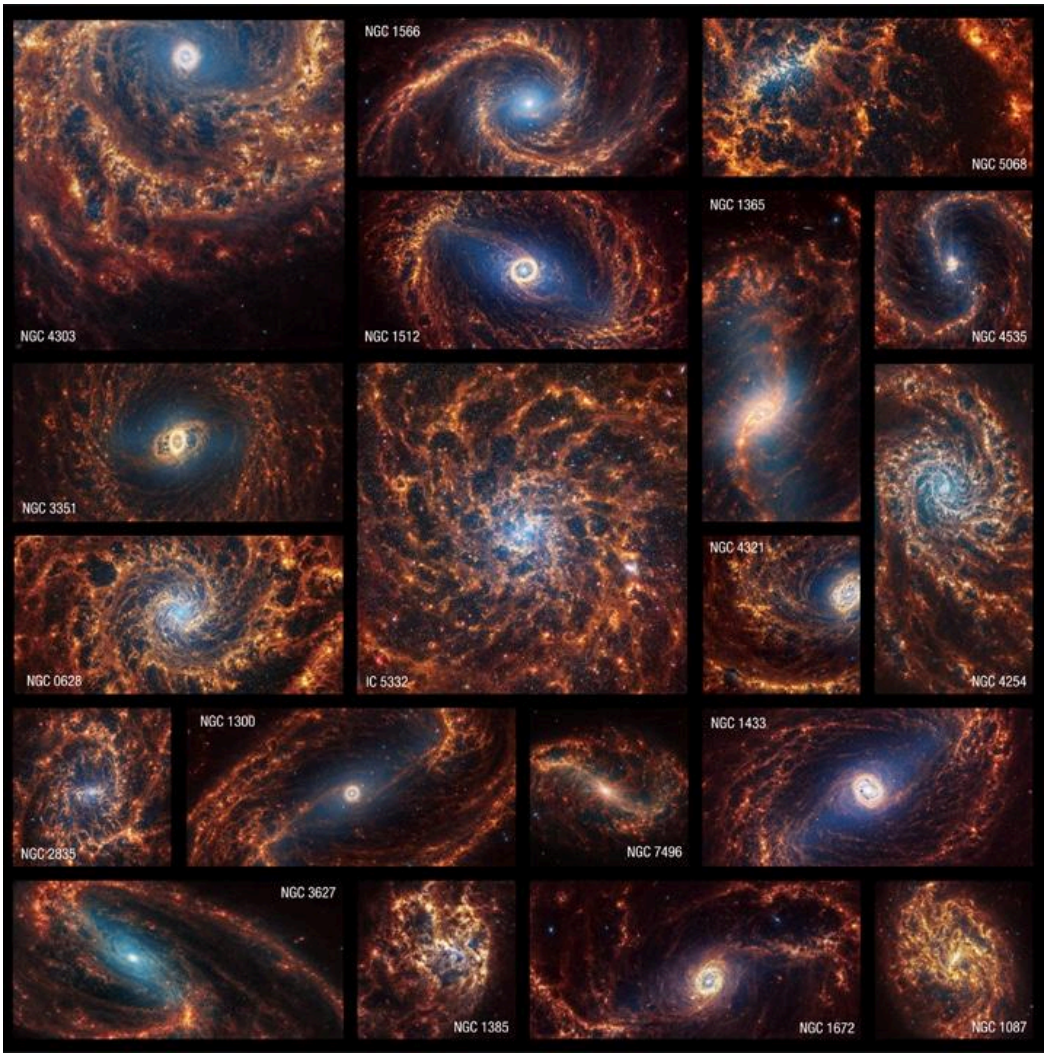
universe. The telescope is one of the most powerful telescopes in the world, capturing truly amazing things out there in space.

Here are some images the telescope has discovered -

- The Southern Ring Nebula (NIRCam Image). It is a bright star at the centre of NGC 3132, prominent when viewed by the Webb Telescope in near-infrared light.

- Another version of the ‘Pillars Of Creation’, this time taken by the James Webb Telescope

The Hubble Telescope and Webb Telescope images of the same Eagle Nebula show different aspects of the region. In Hubble’s observations, forming stars are inside dense envelopes of dust and gas, blocking their visible light from reaching the telescope. In Webb’s near-infrared observations, infrared light shines through all but the densest dust, revealing tons of stars inside and all around.



- This image is a collection of 19 spiral galaxies observed by Webb, in near-infrared and mid-infrared light.

The Webb telescope specialises in detecting near-infrared and mid-infrared wavelengths, and holds key understandings of galactic evolution, atmospheric compositions, the early universe and stellar birth. Webb will soon explore the first ever galaxies from the early universe, the life cycles of different types of stars and properties of planetary systems (such as our own Solar System).

The telescope has many specialised instruments, which have different ranges of wavelength they can measure, such as -

- NIRCam (Near-Infrared Camera): 0.6-5 microns.
- NIRSpec (Near-Infrared Spectrograph): 0.6-5.3 micrometres.
- MIRI (Mid-Infrared Instrument): 4.9-27.9 microns.
- NIRISS (Near-Infrared Imager and Slitless Spectrograph: 0.6-5 microns.

The observation of infrared light is crucial to supporting our understanding of the universe, as it allows us to see details in the universe and determine things about distant objects. With its longer wavelengths, it can also perforate dense clouds, which's dust usually blocks most light which is detectable by visible light telescopes like the Hubble Space Telescope.

W.M Keck Observatory

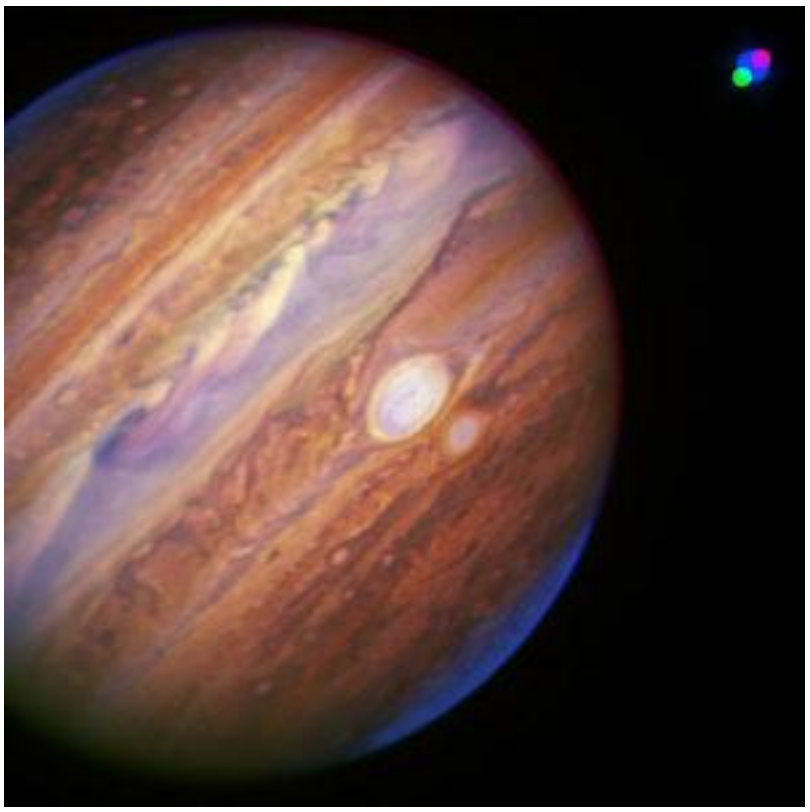
Keck Observatory is known for its contribution to the discovery of exoplanets, the study of how planets, stars and galaxies form, the nature of black holes and the chemical composition and evolution of our universe. It is located at the summit of Mauna Kea in Hawaii.

Keck Observatory can observe the universe with precision and power. The twin telescopes are one of the world's largest, and most scientifically productive infrared and optical telescopes. Both telescopes have 10 metre wide mirrors, and advanced detectors that can combine light from both telescopes.

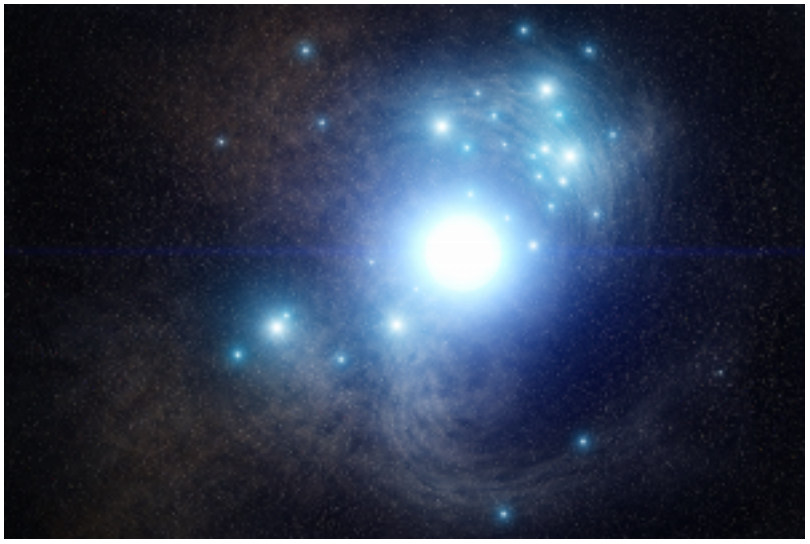
Some of its major findings and discoveries are -

- The first Earth-sized and rocky exoplanet found: Kepler-78b
- Gliese 581g, an Earth-sized, Goldilocks exoplanet that orbits squarely in the middle of its star's 'habitable zone' where liquid water could exist on the planet's surface.
- The habitability of Europa, showing that hydrogen peroxide is abundant across much of the surface of it. Some scientists believe that if the hydrogen peroxide would mix into the subsurface ocean that lies beneath Europa's icy crust, it could provide an energy source for life.

Here are some of the images taken by the twin telescopes of Keck Observatory -



- An image of Jupiter’s Red Spot Jr. as it zips past Jupiter’s Great Red Spot: captured by Keck Telescope.



- A supernova observed by Keck.

There are so many more telescopes observing and capturing wondrous things for us humans to understand, and not to forget rovers, satellites, space probes and more that we have created.

It is phenomenal how humans have developed technology to deepen the understanding of outer space, and how our curiosity makes us continue to strive for answers.

Sites -

- hubblesite.org (all the images about the Hubble Space Telescope)
- webbtelescope.org (Southern Ring Nebula, the 19 galaxies images from the James Webb Space Telescope, and information about the telescope)
- nasa.gov (‘Pillars Of Creation by the James Webb Telescope and majority of the information in this article)
- keckobservatory.org (information about the W.M Keck Observatory and all the images about it)

Organ Care Technology & Bioprinting

– By Sophia Duan

Around the world, statistically there are currently over 103,223 men, women, and children on the national transplant waiting list. In this article, we will be covering the topic of organ care technology and bioprinting.

To begin with, what is bioprinting? Bioprinting is an amazing process in which people use 3D technology to construct living tissue models. Currently, this remarkable technology is used in a vast range of research areas, such as tissue engineering and the development of new drugs.

Specifically, 3D bioprinting is a manufacturing process in which bioinks–made out of natural or synthetic materials such as polymer or hydrogels–are used to print cell structures which are used to mimic the certain behaviours of natural tissues.

Picture of a heart being printed [1]

So far, researchers have bioprinted a miniature human heart that can beat on its own. Based on this research, these artificial hearts will be used to study the human body in a more insightful detail along with how cardiac diseases occur or how hearts can react to new drugs.

Furthermore, in 2019 researchers at the Rensselaer Polytechnic Institute developed fully vascularized skin patches which means that they can carry and transport blood throughout your body. Due to this research, healing wounds at an accelerated rate will become possible soon.

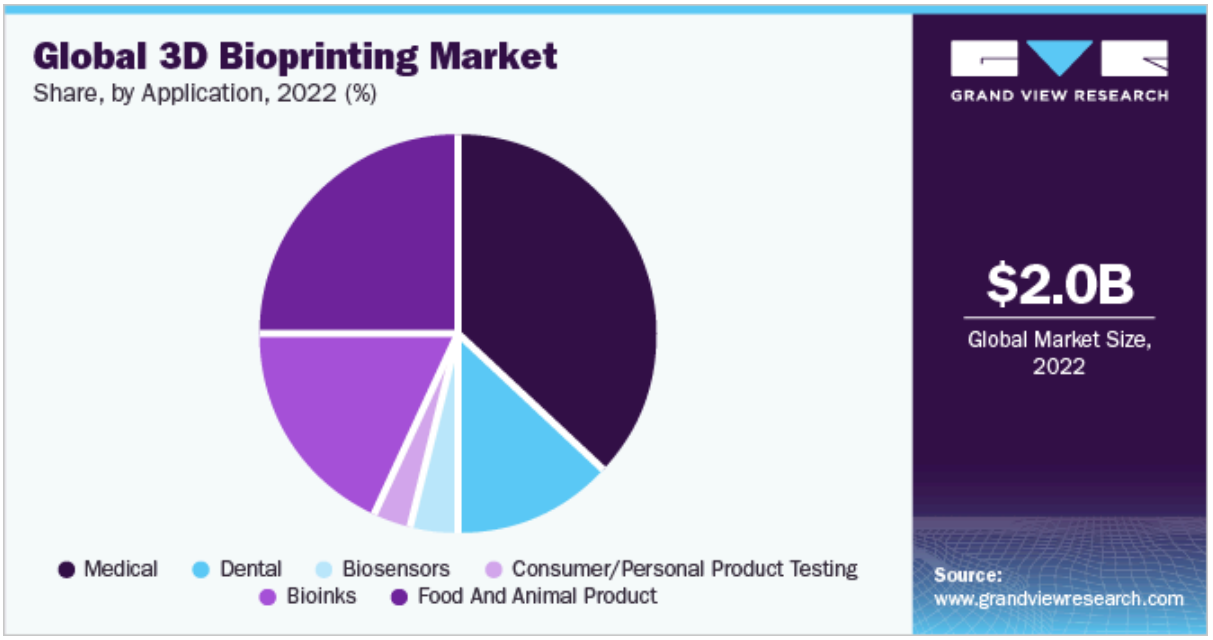
From what we can see so far, bioprinting is an innovative piece of technology that can enhance the future of people who need organ transplants. We will now cover the advantages and disadvantages of 3D biotechnology.

Firstly, bioprinting can be used as a scalable technology. Being able to mass produce organs could drastically change the difference of life and death for people waiting on the transplant list, in which 17 people die according to the Health Resources and Services Administration. Also, as the procedure of bioprinting becomes more precise it will lower the probability of human errors.

Secondly, bioprinting can create highly specific organs tailor-made for each patient, thus decreasing the likelihood of the body rejecting the organ. Based on this technology, many lives can be saved.

Thirdly, bioprinting reduces the usage of animal testing. Currently, around the world, it's estimated that 115 million animals are used in laboratory experiments every year. Once this technology is developed fully, not only will humans be saved but so will the lives of animals.

However, bioprinting is a costly piece of technology. To illustrate, Here is a graph provided by Grand View Research.



[2]

From this graph, we can see that the global market size of bioprinting costs $2.0B.
In addition to this, 3D bioprinting consumes lots of energy to create large quantities. Therefore, it is more suitable for small-quantity production.

Along with this, 3D bioprinting releases extremely volatile organic compounds which can cause severe health problems such as organ damage and throat irritation.

All in all, I believe that bioprinting is an influential piece of technology that will be used tremendously in the future. With the proper medical supervision we can limit any possible health problems that may arise and as it becomes more accessible to communities worldwide many lives can be saved.

Image references:

1) FutureBridge. Bioprinting in Personalized Healthcare | Life Sciences | FutureBridge. n.d. Bioprinting: Creating New Milestones in Personalized Healthcare. https://www.futurebridge.com/industry/perspectives-life-sciences/bioprinting.
2) Grand View Research. 3D Bioprinting Market Size & Share Analysis Report, 2030. n.d. Grand View Research. https://www.grandviewresearch.com/industry-analysis/3d-bioprinting-market

The Hidden Pioneers: Women Shaping the World of Technology

– By Tanishkka Iswaran

In today's world, technology is connected to every aspect of our lives, shaping how we view the world around us. We often celebrate the contributions of iconic figures like Steve Jobs, Mark Zuckerberg, Elon Musk, and Bill Gates, who have unequivocally revolutionised the tech industry. However, amidst these familiar names, there's one often overlooked pioneer who laid the foundation for modern computing: Ada Lovelace.

Born in London, England, on December 10, 1815, Ada Lovelace was not only a mathematician but also an astounding writer. Collaborating with Charles Babbage, she envisioned the Analytical Engine, a fully program-controlled mechanical digital computer—a groundbreaking idea far ahead of its time. Lovelace's insights went beyond mere calculations; she realised the computing machines are far more capable of what they are used for in her time, as she believed them to be able to execute complex instructions, programs to complete tasks, essentially birthing the concept of computer programming.

Although the Analytical Engine remained a theoretical construct, Lovelace's foresight laid the foundation for the digital age we live in today. Ada’s intellect was often compared to esteemed scientists like Albert Einstein and Stephen Hawkings as she had the IQ of 160 the exact same as Albert and Hawkings. Ada surpassed the constraints and rules of her society on what women should be, propelling the world towards a future where technology is used almost everyday!

Fast forward to the 1960s, a significant period of time for space exploration, and we encounter another group of unrecognised scientists, programmers and mathematicians: the women programmers at NASA. Behind the historic Apollo 11 mission that sent Neil Armstrong to the moon, there were meticulous calculations and blood,sweat and tears from women like Margaret Hamilton, Mary Jackson, Katherine Johnson, and Dorothy Vaughan. Their contributions are acknowledged in the movie "Hidden Figures’ created in 2016 after almost 55 years after the real event, it showcases the indispensable role of women in advancing technology and space exploration. Katherine Johnson was even awarded the Presidential Medal of Freedom from President Obama to appreciate all the hard work she had done for the missions in NASA.

Yet, despite these remarkable achievements, the landscape of the tech industry has evolved, and not necessarily for the better. What was once an industry dominated by women has now become predominantly male. This shift has led to the marginalisation of women in tech, inducing unfit and degrading stereotypes, hindering diversity and innovation.

It's important to recognize that women have always been at the forefront of technology, from Ada Lovelace to the women of NASA and beyond. Their stories serve as a reminder that gender should never dictate one's potential in this field. We must challenge these existing narratives and create a more inclusive environment that empowers women to get involved in technology.

To the women reading this, remember: there are no limits in the world of technology. With the right mindset, determination, and support, we can defy expectations and reshape the industry for the better. If history has taught us anything, it's that innovation knows no gender. It's time to rewrite the narrative and pave the way for a future where everyone, regardless of gender, can contribute to the ever changing world of technology.

After all, in the realm of programming, it's not about the "man board" or the "father board"—it's about the motherboard, where diversity and inclusivity are the keys to unlocking endless possibilities.

The Impact AI Plays Into the Fashion Industry

– By Yumin KIM

From finance, education, to even entertainment, several industries are reshaped by AIs. These days, Artificial Intelligence (AI) are not just “assistants” of humans, but “creators” that guide humanity’s journey towards innovation and progress. They have such a profound impact on our lives, to the extent where I used ChatGPT to figure out what I should write about for this following piece of writing. However, I was completely unaware that AIs have such a significant impact in the fashion industry, from designing to improvements in consumer experiences. In fact, 73 percent of fashion executives reported that they predict AI as an essential for their business. Therefore, this essay will explore the role of AI in the current fashion industry and the positive and negative impacts AIs have on the industry.

Many major fashion companies, including Heliot Emil, Zara, and H&M, are using AIs to bring positive impacts in their companies. The following are some of the benefits of implementing AIs in the fashion industry, discovered by several fashion and AI experts:

- Creative Design Suggestions Based on Fashion Trends: AIs, including generative design algorithms and computer-aided design (CAD) software, have the ability to create their own innovative and unique fashion designs. Therefore, the designers would receive numerous assistance on generating and introducing creative, experimental, and new design variations to the industry. As AIs also have the ability to analyse target market and fashion trends through social media, it is expected that suggestions from AIs would fulfil the demands of the customers.
- Management in Supply Chain Through Sales Prediction: As fashion trends change rapidly in correlation to changes in seasons and customer preferences, AIs’ ability to predict sales patterns allow companies to manage their supply chain. This means that the fashion industry would have the right amount of stock to meet the changing customer demand, therefore reducing carrying costs and risks of stockouts. This would also lead to a reduced amount of waste, which is a significant problem in the current fashion industry.
- Improved Customer Experience: AIs analyses individuals’ preferences and provide personalised recommendation through algorithms, increasing customer satisfaction on the shopping experience. In addition, AI provides virtual try-on experiences to give an idea of how the clothing would look on the customers before making a purchase. This makes shopping much more convenient for customers.

However, some critics also argue that implementing AIs in the fashion industry would bring several significant challenges and risks. Here are some potential risks of AIs working on the fashion industry:

- Unemployment Due to Job Displacement: Job displacement is a common problem for every industry with AI implementation. The automation of tasks, including trend analysis, customer service, and even design could lead to job displacement for workers in the fashion industry, increasing global unemployment.
- Loss of Creativity Due to Dependence on Technology: Over dependence on AIs could lead to loss of human creativity and intuition in the design process. This would lead to a significant reduction in artistic expression and uniqueness in fashion design.
- Risks of Potential Errors: AIs are not perfectly developed yet, and have potential for errors in data analysis and designs.

As it is clear that the integration of AI into the fashion industry has both advantages and disadvantages, it is crucial for the policy makers and leaders of the fashion industry to find the right balance between societal values and benefits the AIs bring into the industry. AI integration would definitely help with maintaining consumer demands, making the fashion companies globally competitive. Nonetheless, the integration of AI should be done harmoniously with human creativity, craftsmanship, and other possible risks.

Acknowledgements:

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