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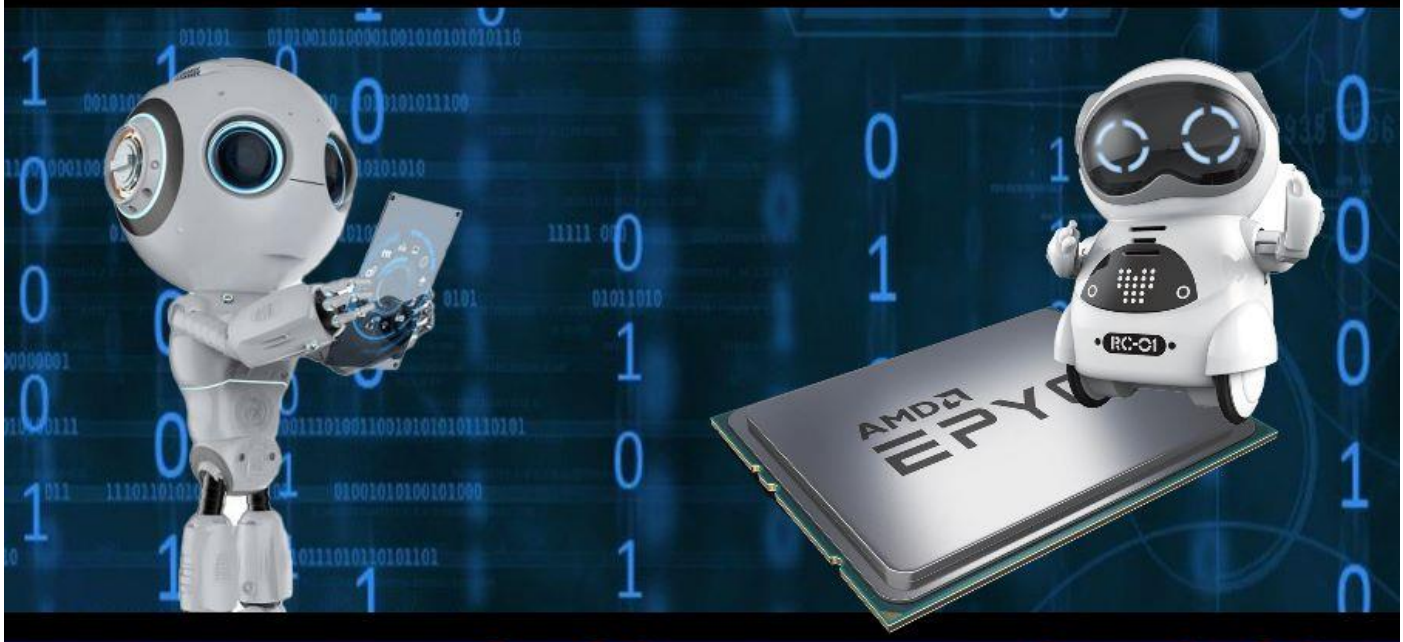

DEPARTMENT OF COMPUTER TECHNOLOGY AND INFORMATION TECHNOLOGY

KONGU ARTS AND SCIENCE COLLEGE
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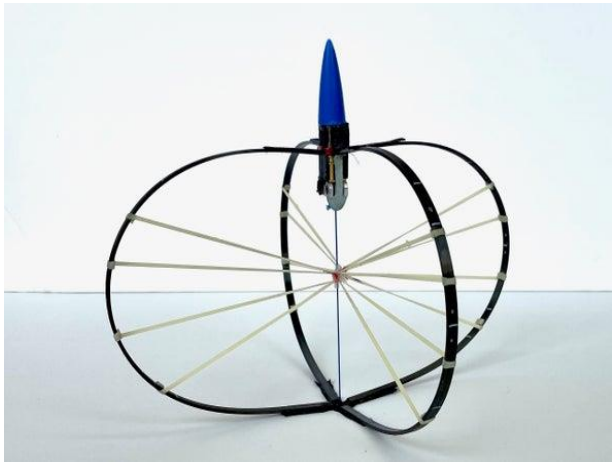
LEAPING ROBOTS

When engineers want to design robots capable of navigating complex real-world environments, they often turn to the animal kingdom. Such biomimicry has produced bots that run like dogs or cheetahs or hop like birds taking off in flight. But now researchers at the University of California, Santa Barbara, have reached new heights by ignoring the constraints of biological models. Their 30-centimeter-tall jumper can spring more than 30 meters into the airroughly the elevation of a 10-story building and 100 times its own height.



This gravity-defying performance is several heads and shoulders above the distance any living creature can reach. “The best animal jumper is likely [a squirrel-sized primate called] the galago, which has been measured jumping around 2.3 meters high from a standstill,” says Elliot W. Hawkes, a mechanical engineer at U.C. Santa Barbara and lead author of a study detailing the superjumper project. He adds that the device also stands out in the mechanical field, where combustion has previously launched jumpers to heights of eight meters and compressed gas has driven them to reach 10 meters. “It jumps much higher than most of the rest of the jumping robots in the world do if not all of them that I’m aware of,” says Sarah Bergbreiter, a mechanical engineer at Carnegie Mellon University, who was not involved in the new study but wrote an accompanying commentary about it.

The team designing the new leaper relied on elastic power. In this kind of jumping system, a part called an actuator moves and stores energy in a spring, which is released by a latch to propel an object into the air. This basic mechanism is similar to the one members of the animal kingdom use. For example, a grasshopper’s leg muscle serves as an actuator: when it contracts, it bends back a spring like part of its knee joint to create tension, which is released to propel the insect’s jumps.

But for the new project, human engineering introduced some crucial innovations. For any elastic-based jumper, attainable height is determined by the amount of energy the spring can store and this, in turn, depends on two factors. The first is how much work an actuator can provide. In animals, muscles have only one contraction with which they can stretch their “spring.” But for the actuator in the new mechanical jumper, the engineers used a motor which could turn multiple times before each jump and thus keep storing more energy.

The second factor in an elastic jumper's prowess is the spring's ability to hold as much energy as possible without packing on too much extra weight. To maximize the new bot's energy density, the team created a 30-gram device whose whole body acts as the spring. It consists of rubber bands and carbon fiber slats, which have a much higher energy density than biological tissues. When the actuator (a light rotary motor) turns, it winds up a string that constricts the spring: it puts the rubber bands under tension and compresses the carbon fiber, bending each slat into a curved configuration like an archer's bow.

A robot that can hurl itself over buildings could efficiently navigate some common environments that currently hinder wheeled, walking or even flying designs. "Jumping, in some sense, is a wonderful way of getting around because you can jump over obstacles that might be in your path," Bergbreiter notes, "whereas you don't have a lot of the complexity that comes from trying to fly over those obstacles or navigate around those obstacles with legs."

Hawkes is especially eager to develop jumping bots for space exploration; he points out that his device could soar to even more impressive distances in an airless, low-gravity environment. "On the moon, our device could theoretically jump forward half of a kilometer while going 125 meters high in a single leap," he says. "For instance, it could hop onto the side of an inaccessible cliff or leap into the bottom of a crater, take samples and return to a wheeled rover." Hawkes is working with NASA to further develop the device. But before it shoots for the moon, the jumper will have to undergo more development. The current prototype has no ability to navigate autonomously, for instance. It also relies on a battery to power its motor and takes a couple of minutes to reload its spring between each jump. And importantly, it cannot control the height of its leap. Still, Hawkes hopes to have a more sophisticated version ready for takeoff in five years.

Even without leaving the planet, however, the new device can help scientists by demonstrating the limits of biomimicry. Many jumping robots are designed, in part, to help researchers study how beings from fleas to humans hurl their bodies into the air. As a result, they incorporate the limitations of those animals but this project helps show that they do not have to and that ignoring certain rules comes with big advantages. "Biological systems work under different constraints than engineered systems, meaning that an ideal solution in biology is not always ideal in engineering," Hawkes explains. "It is imperative to consider how a given engineered system has similar and different constraints than a model biological system and design accordingly rather than simply copying a solution found in nature." The success of this approach suggests it could be adapted to build

other agile machines for a variety of applications.

P.S. MOHANKUMAR

III B.Sc. (Computer Technology)

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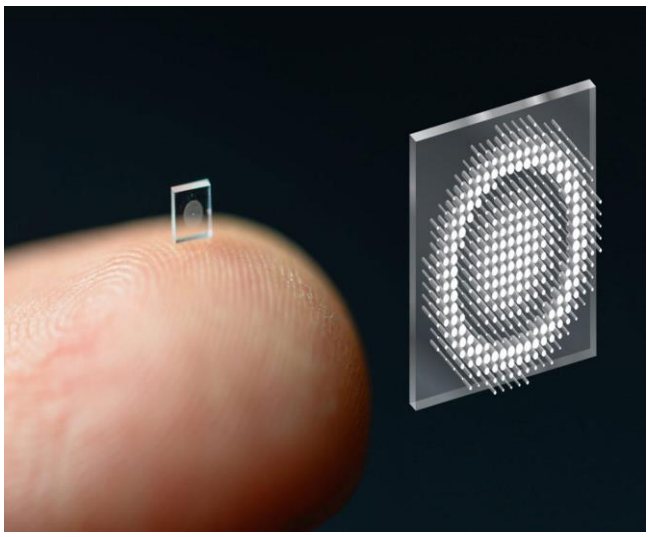
CRUMB-SIZED CAMERA USES ARTIFICIAL INTELLIGENCE TO GET BIG RESULTS

The new miniaturized camera lens sits on the tip of a finger (left). It bends light with 1.6 million tiny metal rods instead of curved glass. The pattern formed by the rods is visible in a magnified image of the lens (right). Researchers have developed a tiny camera that takes amazingly clear photos. Just don't sneeze while it's in your hand. At the size of a coarse grain of salt, you may never find it again.



Smaller cameras could mean lighter smartphones and new James Bond–style gadgets. But that's not all. Cameras on this scale could swim through the body, hitch a ride on an insect, scope out your brain or monitor hostile environments. And those are just a few of the possibilities. How do you pack that much picture-taking power into something the size of a crumb? It takes a "radically different approach" to making a camera lens, says Felix Heide. He's a computer scientist at Princeton University in New Jersey. His lab developed the camera with colleagues from the University of Washington in Seattle.

Cameras have two main parts: a lens and a sensor. The lens bends incoming light onto the sensor, where the image is recorded. Over the last few decades, sensors have gotten smaller and smaller. But lenses are another story. "Lenses haven't been miniaturized at all," Heide says. Most are designed little different today than they were in the 1800s. Lenses are traditionally made by stacking curved pieces of glass or plastic. A curved surface bends light passing through. How the light bends depends on the curvature? A lens can be a single piece of glass. To bend light in more ways, you can stack several of them together.

Heide's team took a totally different approach. They made a lens from a metasurface. These surfaces are super thin, human-made materials patterned with tiny structures. The structures are so small they're measured in billionths of a meter (nanometers). Similar but slightly thicker materials are called metamaterials. With the right design,

metasurfaces can become miniature lenses or mirrors.

That means they can squeeze into tiny spaces and reveal things people haven't seen before. Another plus? They can be made for pennies. That's because you can make them using the process developed for producing computer chips. When TikTok or Snapchat recognizes your face in a photo and applies a filter, that's AI at work. The more you use these features, the better their machine learning gets at identifying you. That's because these programs learn from their mistakes.

With a similar approach, Heide's team tackled two key challenges for metasurface cameras: lens design and image quality. To get a high-quality image they needed a metasurface with more than 1.5 million metal structures. But how should the structures be arranged to get the best picture? It would take far too much time and computing power to explore every possibility.

Luckily, there's a shortcut. The team wrote a computer program that simulated light traveling through a lens and the picture it created. Then the program tweaked the lens design and ran the simulation again. It compared the new picture to the previous one and judged which was better. As the program cycled through different possibilities, it learned a bit each time about how best to tweak the design and get the best picture.

But even a perfect lens design won't deliver crisp, clear pictures unless you tackle another challenge. No metasurface lens can perfectly focus all the light rays passing through. That introduces blurriness. To deal with this, the team wrote a second computer program. This one looked at images of a simulated scene. The images were blurry in different ways. By cycling through the images and comparing them to the original scene, the program learned to correct for each type of blurriness. The result: An image-processing program that made pictures sharp and in full focus.

A lens just 0.5 cubic millimeters (a 300-millionth of a cubic inch) in size now rivals the quality of a traditional camera lens 550,000 times that volume. Just like its much bulkier predecessor, the new camera's pictures are crisp, colorful and capture a wide field of view. You could even take a selfie with it. For now, however, the team is being extra careful and keeping it away from noses.

S. DINESH

II B.Sc. (Computer Technology)

FULL STACK WEB DEVELOPMENT

Full-stack web development is an evergreen technology. Even in 2023, it is still in great demand. Business organizations & startups need full-stack web developers to

manage their websites. The main duties of a full-stack developer are developing and constructing APIs, making sure that applications adhere to performance and quality requirements, and implementing data security. In India, a Full-Stack Developer makes an average yearly pay of Rs. 7 lakhs, and in the US around 120,000$.

Salesforce

Nobody should have any doubts about the fact that Salesforce is the best customer relationship management (CRM) tool available. According to Forbes, Salesforce now holds a market share of more than 19% in the CRM industry. The online business journal also disclosed that Salesforce increased its revenue by over 23% in 2018, outpacing competing for CRM solutions. The demand for Salesforce as a CRM has increased manifolds in this decade leading to a similar rise in the demand for Salesforce Professionals.

Let us discuss the salary of Salesforce Admin professionals. Now for the sake of simplicity, we will split the salary range based on experience level and skill acquired. The 3 categories are Entry level, mid-level, and senior.

- The pay scale for entry-level is between Rs. 3,00,000 to 3,15,000.
- Mid-level experts receive an average salary of Rs. 8,00,000 to 8,20,000, however, this might vary depending on several circumstances.
- The Salesforce Senior Administrator makes between Rs. 14,50,000 and Rs. 17,50,000 while serving as the team's leader.

The highly sought-after Salesforce Developer profile has once again been placed among the top 10 best-paying technical professions in the world. The annual salary range for a Salesforce Developer in India is between Rs. 5,00,000 and Rs. 25,00,000. This approximate number can differ from person to person. The compensation of a Salesforce Developer is determined by several criteria, including geography and experience, just like that of a Salesforce Administrator.

M.HARINI
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ACCELERATING DIGITAL TRANSFORMATION

Whether we like it or not, the world is rapidly moving into a technological era, and seemingly at an increasing pace. These days, complex processes that take numerous hours can be automated and made possible more quickly. It has become imperative for businesses to jump on the trend of digital transformation or get left behind. Before we delve into the concept of digital transformation, let's define what it is.

Digital transformation means incorporating digital technology into a business. This is essentially changing how businesses are being operated and ultimately, how value is added for customers. In the past, digital transformation was a long process that often took months to achieve for companies due to the many complexities involved. However, nowadays, the shift can be made in a matter of weeks or even days. This is the acceleration aspect of digital transformation.

As technology rapidly develops, businesses adopt new methods and processes to remain relevant. Sometimes this change must be made quickly so that the business does not miss out on the benefits. Organizations must continually adapt, experiment with new technologies and challenge the status quo, otherwise they may risk becoming extinct.

In the early years of digitalization, businesses that were able to accelerate digital transformation often had an edge over other businesses. It meant that their processes became more cost effective and user friendly than their competitors' processes. Leaders at companies that had not adopted the new norms realized they were falling behind. While their digitalized competitors were overcoming challenges by accelerating, they were faced with threats of new changes in the game.

These days, many aspects of business are rapidly changing, including consumer behaviour. The pandemic has ignited the whole situation, and business leaders across various industries have realized the importance of accelerating their digital transformation. In fact, according to a report by Cisco, over 70% of small businesses are accelerating digital transformations. The ultimate explanation as to why digital transformation must be accelerated is that to survive in today's harsh economy, a business must move fast and adapt to changes, or else it may struggle with being relevant, and competitors may take the lead in the market. If businesses are able to accelerate digital services, they may find they are able to experience huge growth within a short period.

Benefits of accelerated digital transformation

While digital transformation has numerous advantages on its own, accelerating this transformation can bring an even bigger advantage for the business. Here are some benefits of accelerating digital transformation:

Emergency preparation: As the world learned from the Covid-19 pandemic, anything can happen at any point in time to disrupt normal workflow. Mandatory lockdowns and closure of workplaces, among other things, can force an immediate shutdown of work, so it helps to already have a system in place to fill in the gap.

Better products with enhanced services: Most people want to achieve the best results with the minimum effort, and that is

exactly the benefit that an accelerated digital transformation can get you. With digital transformation, a business can have access to many products, which can ultimately help to manage customers more efficiently and bring in a better profit.

Greater efficiency and scalability: Manual processes are the ways of old in this new digitized world. Moreover, they can be unreliable as there may be more potential for mistakes, which can increase risk and overall cost. Digitized processes, however, can reduce those risks and increase efficiency.

Cost savings: An accelerated system can help increase productivity, which can ultimately save costs. The more time spent on digitalizing a system, the more cost is involved. When a system is cost-effective, it can ultimately serve as a great way to save money.

To accelerate the transformation of your business into a digital one, it is important to first identify your goals for this transformation. Are you trying to go digital to boost sales, get tasks done faster or interact better with clients? Setting an objective for why you are accelerating will help you work toward your goals faster.

When digitalizing your business, prioritize your customers. As great as accelerated digital transformation is, avoid doing it to the detriment of your customers. Ensure that client information is not mixed up or lost as you make the transformation and that the move does not affect the client relationship. You should also ensure that you have the right storage for the shift. You do not want to be stuck in the middle of the whole transformation with some clients experiencing your transformation while others are not. Not only can this cause confusion, it can also cost you time and resources.

Several factors can hinder accelerated digital transformation, from management issues to changing customer needs and budget constraints. An effective way to scale through these issues is to have a clear idea of what digital transformation is to your business and what you hope to achieve from it. This way, you'll be able to tailor your budget toward the things you need to achieve. It can also be easier to coordinate staff and establish a unanimous voice with management when the objective is clear from the onset. Develop an effective strategy before you even get started. Do not rush to jump on new technologies promoted by vendors; instead, take the time to explore each new technology introduced to you and weigh out the pros and cons. You may need to change a few business rules and adjust your workflow in order to make accommodations for the change.

Digital transformation has become inevitable for all businesses, but I think the real question should be how fast it is implemented. Organizations that jump on the train early enough will be able to partake in its many

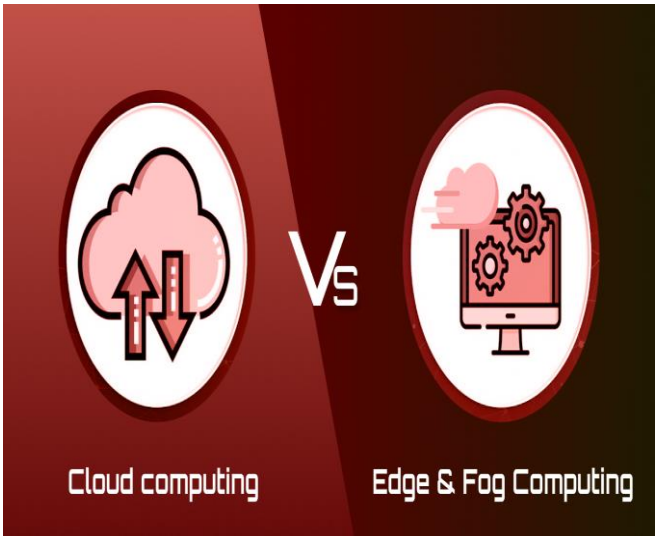
benefits and have an edge over their competitors who are still undergoing the change process. This is the major reason why a company must evolve or find itself extinct.

S.KAVIYA

III B.Sc. (Computer Technology)

AN ALTERNATIVES TO CLOUD COMPUTING- EDGE & FOG COMPUTING

Edge computing is an innovative way of deploying and using technology that allows data to be processed on-premises near the customer. This is opposed to the cloud, where data is processed and stored by a remote entity. Fog computing is another term for edge computing, and it refers to the ability to use multiple devices to access data. These technologies are being used more and more in order to improve the user experience and reduce the cost of doing business and allow faster and more efficient processing of data by eliminating the need for data to travel through the cloud. They are also being used in order to improve security and add redundancy.



For example, if a company has a data centre located near their customers, they can use edge & fog computing in order to improve the speed and accuracy of their services. As they can be seen as an alternative to cloud computing.

Some of the benefits of edge & fog computing include:

- **Increased agility** - Edge & fog computing can help businesses to be more agile by allowing them to access resources from multiple networks in a quicker and more efficient manner. This can be particularly valuable for companies that require quick access to sensitive data or those that need to quickly deploy new applications.
- **Reduced costs** - Edge & fog computing can help businesses to reduce costs by allowing them to use resources from multiple networks without having to build or maintain separate infrastructure. This can be especially beneficial for companies that have large data

sets or those that need to quickly deploy new applications.

- **Increased productivity** - Edge & fog Computing can also help businesses to increase their productivity by reducing the time it takes to access resources and services. This can be particularly valuable for companies that have large data sets or those that need to quickly deploy new applications.

KAVIYA S

III B.Sc. (Computer Technology)

CYBER SECURITY: TYPES OF THREATS AND VULNERABILITIES IN CYBER SECURITY

Cyber threats are growing more sophisticated all the time, so it's important to have a sound cyber security strategy in place. This includes understanding the different types of threats and vulnerabilities that exist, as well as implementing effective measures to protect your computer systems.

Today's world is increasingly connected, which makes cyberattacks even easier and more widespread. Attackers use various methods such as phishing emails or malicious websites to gain access to personal information or provide malware infections. In some cases, criminals can even conduct ransomware attacks in order not only to collect monetary compensation but also to prevent users from accessing their computers until they pay a ransom. So how do you stay safe online? We have compiled our best Cyber Security blogs for you, which will walk you through cybersecurity threats to prevention methods.

Cybersecurity is not a one size fits all process. Each organization implements cybersecurity practices and rules depending on its size, its importance, its industry, its data, and many other factors. For instance, Microsoft won't have the same cybersecurity practices as a startup or a smaller company would have. This is perhaps because hackers tend to target tech giants or other giant companies. After all, they know they will have access to crucial, confidential, and protected data that's very valuable.

Hacking attacks on the automobile industry have been growing in recent years due to severe security breaches. There is potential to hack into a number of systems so that hackers could steer and brake a vehicle, and many more. In this blog, you'll find tips on how you can keep your vehicles protected.

Smartphones have become more and more pervasive throughout the world. As cyber threats have grown in their scope, the need for the best protection has never been greater. Make sure your mobile devices are encrypted, have all of the latest security updates applied as soon as they come out, use screen lock codes or complex passwords for added protection, and

be wary of filling out any forms on your phone that request sensitive login information.

Many companies are switching to get internet-based applications in order to save money and speed up performance. The same goes for cloud services, which open up an organization's IT stack to network security problems. In the early '90s, a Norwegian engineer named Bjartnaes broke into and changed data records at his former workplace, a nuclear power plant, it's scary to think that they are not immune from such vulnerabilities. This article will first quantify the severity of the cloud vulnerability problem, and then we will move on to methods we can use for the prevention of such vulnerability.

Cybersecurity is an important issue that needs to be addressed on a global scale. The first step is recognizing potential risks and staying informed about current events related to cybersecurity. You should also carefully monitor your privacy settings and update your software regularly with the latest security patches (and antivirus definitions). Last but not least, install an active firewall on your home network devices to block unauthorized accesses from outside sources.

AAKASH G

III B.Sc. (Information Technology)

NATURAL LANGUAGE GENERATION

Machines process and communicate in a different way than the human brain. Natural language generation is a trendy technology that converts structured data into the native language. The machines are programmed with algorithms to convert the data into a desirable format for the user. Natural language is a subset of artificial intelligence that helps content developers to automate content and deliver in the desired format. The content developers can use the automated content to promote on various social media platforms, and other media platforms to reach the targeted audience. Human intervention will significantly reduce as data will be converted into desired formats. The data can be visualized in the form of charts, graphs, etc.

Natural Language Generation (NLG) simply means producing text from computer data. It acts as a translator and converts the computerized data into natural language representation. In this, a conclusion or text is generated on the basis of collected data and input provided by the user. It is the natural language processing task of generating natural language from a machine representation system. Natural Language Generation in a way acts contrary to Natural language understanding. In natural language understanding the system needs to disambiguate the input sentence to produce the machine representation language, whereas in Natural Language Generation the system

needs to make decisions about how to put a concept into words.

The process to generate text can be as simple as keeping a list of readymade text that is copied and pasted. Consequences can either be satisfactory in simple applications such as horoscope machines or generators of personalized business letters. But in a sophisticated NLG system, it is required to include stages of planning and merging of information generates text that looks natural and does not become repetitive.

Example of a simple NLG system is the Pollen Forecast for Scotland system that could essentially be a template. NLG system takes as input six numbers, which predicts the pollen levels in different parts of Scotland. From these numbers, a short textual summary of pollen levels is generated by the system as its output.

The typical stages of natural language generation are:

Content determination: Deciding the main content to be represented in a sentence or the information to mention in the text. For instance, in the pollen example above, deciding whether to explicitly mention that pollen level is 7 in the south-east.

Document structuring: Deciding the structure or organization of the conveyed information. For example, deciding to describe the areas with high pollen levels first, instead of the areas with low pollen levels.

Aggregation: Putting of similar sentences together to improve understanding and readability. For instance, merging the two sentences Grass pollen levels for Friday have increased from the moderate to high levels of yesterday and Grass pollen levels will be around 6 to 7 across most parts of the country into the single sentence Grass pollen levels for Friday have increased from the moderate to high levels of yesterday with values of around 6 to 7 across most parts of the country.

Lexical choice: Using appropriate words that convey the meaning clearly. For example, deciding whether medium or moderate should be used when describing a pollen level of 4.

Referring expression generation: Creating such referral expressions that help in identification of a particular object and region. For example, deciding to use in the Northern Isles and far northeast of mainland Scotland to refer to a certain region in Scotland. This task also includes making decisions about pronouns and other types of anaphora.

Task-based evaluation: It includes human-based evaluation, who assess how well it helps him perform a task. For example, a system which generates summaries of medical data can be evaluated by giving these summaries to doctors and assessing whether the summaries help doctors make better decisions.

Human ratings: It assess the generated text on the basis of ratings given by a person on the quality and usefulness of the text.

Metrics: It compares generated texts to texts written by professionals.

Another example includes Content generation systems that assist human writers and makes the writing process more efficient and effective. A content generation tool based on web mining using search engines APIs has been built. The tool imitates the cut-and-paste writing scenario where a writer forms its content from various search results.

So far, the most successful NLG applications have been Data-to-Text systems, which generate textual summaries of databases and data sets; these systems usually perform data analysis as well as text generation. In particular, several systems have been built that produce textual weather forecasts from weather data.

BHARATHKUMAR K

II B.Sc. (Information Technology)

GOOGLE GLASS

When it comes to transcending reality and transporting science fiction material into reality, the field of technology succeeds in ways that are numerous and ingenious. Perhaps the one company which has spearheaded this conversion more than others is Google. Sebastian Thrun, the inventor of the Glass defines it as a way of outsourcing the human brain. The reason why he sets so peculiar a definition is that Google Glass literally, digitalizes a person's personal experience. The Glass is an optically mounted headgear in the shape of an eyeglass. It has three main components.

The bar of the eyeglass – conventionally, the sidebar of a spectacle – is the touchpad. The touchpad can be used by the user to engage with the device in a timeline of events.

The optical part of the Glass is the 'display' – is used to display information as if on a screen. Supplementing these is the camera embedded in the Glass which can be used to take pictures and record videos.

When it was initially developed at Google by X, it created ripples in the world. It was heralded as proof that the technology of the world was potent enough to bridge the gap between a highly advanced future and a sluggish present. Many also pointed out the correlation between the Glass and other optical headgears referenced heavily in popular media and popular culture via stories. It is no wonder that when the project was first announced, around 8,000 people agreed to pay the hefty sum of $1,500 to be allowed access to the Glass in its beta version.

Much like a smartphone, the Glass can be voice-operated and can recognize the user's voice. Applications for the Glass are similarly made by third-party developers, some of them using the specially designed Mirror API rolled out by Google. The Glass can be controlled via one's smartphone through the MyGlass app.

But the real reason why the gap is truly revolutionary is that it can mitigate the ailments of society in a very unique way. It was once used by WWF for documenting the sustenance and existence of many species in the wild and the circumstances in which they live. This was useful in locations that are remote and inaccessible. It can help autistic patients in engaging with the outside world in a way better than the other conventional modes of technology. Furthermore, the John Hopkins Centre experimentally used the Glass to scan the image of a person's retina and extrapolate corresponding data that had the potential to help in medical research.

The far-reaching implications of Google Glass are what make it so unique and different from the other avenues of technology. The brains behind the project indubitably illuminate the ingenious power of Google both as an information technology giant and as a propagator of human efforts. Indeed, the gaps between a utopian, bright future and a static present are being eroded faster than one can be comprehended and before late, we might soon find ourselves living in futures that resemble those of Sci-Fi stories.

KRISHNA PRABU V B

I B.Sc. (Computer Technology)

BRAIN MACHINE INTERFACE (BMI)

A **Brain Machine Interface (BMI)** is a device that enables a direct communications path between the brain and the machine to be controlled. Researchers began their research on BCI's in the 1970's at the University of California, Los Angeles (UCLA) under a grant from the National Science Foundation, followed by a contract from DARPA.

The papers published after the research also mark the first appearance of the expression brain machine interface in scientific literature. It is also called as:

- Neural-control interface (NCI)
- Mind-machine interface (MMI)
- Direct neural interface (DNI)

- Brain–computer interface (BCI)

There are several ways to measure Brain-Machine Interface out of which the two most prominent are mentioned below –

Electroencephalograph (EEG): One of the biggest difficulty faced by researchers in brain-computer interface in the present scenario is the complex mechanics of the interface itself. A group of electrodes which is a device known as an electroencephalograph (EEG) attached to the scalp is the easiest and invasive method. It is used for reading brain signals. However, significant portion of the signal emanated from our brain gets distorted as the skull blocks the electrical signals. Regardless of whatever location you place the electrodes, the basic mechanism is the same i.e. the electrodes measure minute differences in the voltage between neurons and then signal is then amplified and filtered.

Magnetic Resonance Image (MRI): An MRI machine is a complicated and massive device. Even though the images produced by the MRI are of high-resolution, we cannot use it as a part of permanent or semi-permanent. Researchers used this to get standard for certain brain activity or to depict where in the brain electrodes should be placed to measure a specific function.

Top 5 Brain Machine Interface Projects:

Brain controlled wheelchair: Move with your Brain-This project can be developed for physically impaired people in their movement, all the system need is user's concentration. Users are allowed to navigate in a familiar indoor environment within a reasonable time with the help of Wheelchair.

Brain Controlled Robotic ARM: Brainwave sensor can catch your brain signals whenever you blink your eyes, when you concentrate, meditate and can be used in various applications. Brain Controlled Robotic Arm is one of the Applications of it. The Robotic Arm is moved with EEG sensor based on a parameter collected by it.

Brain Keyboard (You can type with your Eye blink): Many paralyzed people try to communicate with the surroundings but cannot. They can do it with this Brain keyboard and communicate with their surroundings. EEG sensor reads the eye blink and accordingly, text gets displayed on the text box.

Helicopter Controlled by Brain: Yes, you can fly your helicopter with your Brainwaves. The helicopter can fly according to your level of concentration, and meditation so when you concentrate it flies up and when you relax it will be back, isn't it interesting.

HARINI M

I B.Sc. (Computer Technology)

EVOLUTION OF FOLDABLE SMARTPHONES

Foldable smartphones are technology which was a dream for everybody. The whole concept of foldable screens was unrealistic until last year. The phones we use today are made of hard glass or gorilla glass as we call it which cannot bend at all. So to make the phone foldable, they had to come up with new material for the screen which will be flexible but it shouldn't break in half.

The first-ever foldable phone was launched on the 31st October 2018. It was from a company called Royale and they called the phone the Royole Flexpai. This was the company that beat all the other smartphone companies in folding technology. However, the phone had multiple malfunctions even though it ran the latest snapdragon processor at that time. The phone had a lot of false touches, wasn't pocket-friendly, hardly practical and the user interface was terrible.

A few months later, both Samsung and Huawei released their foldable phones named as the Galaxy Fold and the Mate X respectively. Both these phones were better than the Flexpai in every aspect. Huawei never distributed these phones but Samsung sent these to a few reviewers for alpha testing before releasing them for the public. The Galaxy Fold looked a lot better when compared to the Mate X. The Galaxy fold looked more like a practical phone than the Mate X. However, none of the phones could make it through alpha testing. The Mate X had a problem on the screen after multiple folds. The Galaxy had a similar problem apart from the breaking of the hinge.

Both these phones were never made available for the public and even if they did, a very less number of phones would have been sold as they were really very expensive. Samsung was working on the folding technology for the past 7 years and Huawei was working on just the foldable hinge for 3 years. The phones were foldable so obviously there had to be moving parts. More the moving parts mean more maintenance and better quality of parts so that they won't damage easily. Foldable phones won't be cheap and it was pretty obvious. The Mate X was announced for a whopping $2600 (Rs. 1,82,000) [approx] and the Galaxy Fold was announced at $1980 (Rs. 1,38,600) [approx].

Samsung asked all the reviewers to return the phones as they had to make a lot of changes in them and after 2 months, the Samsung Galaxy fold is finally available for sale in the US. Huawei said that they are

looking to release the phone in a few months but no official date has been declared. Even though foldable phones don't seem practical for everyday use, it was a huge success for Samsung and Huawei as they were able to come up with an actual foldable phone this year.

LOGESH P

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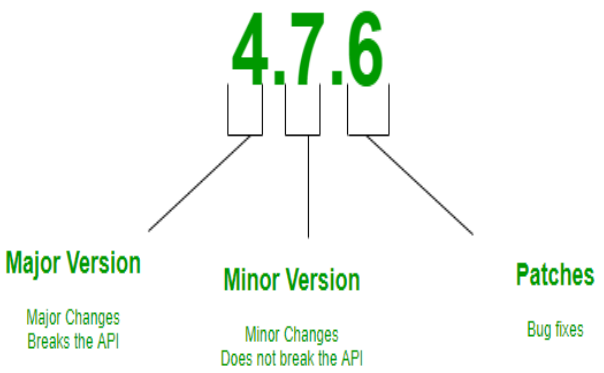
SEMANTIC VERSIONING (SemVer)

Semantic versioning (also known as SemVer) is a versioning system that has been on the rise over the last few years. It has always been a problem for software developers, release managers and consumers. Having a universal way of versioning the software development projects is the best way to track what is going on with the software as new plugins, addons, libraries and extensions are being built almost every day. This problem can be solved by Semantic Versioning. In brief, it's a way for numbering the software releases. So, SemVer is in the form of Major.Minor.Patch.



Semantic Versioning is a 3-component number in the format of X.Y.Z, where:

- **X** stands for a **major version**. The leftmost number denotes a major version. When you increase the major version number, you increase it by one but you reset both patch version and minor versions to zero. If the current version is 2.6.9 then the next upgrade for a major version will be 3.0.0. Increase the value of X when breaking the existing API.
- **Y** stands for a **minor version**. It is used for the release of new functionality in the system. When you increase the minor version, you increase it by one but you must reset the patch version to zero. If the current version is 2.6.9 then the next upgrade for a minor version will be 2.7.0. Increase the value of Y when implementing new features in a backward-compatible way.
- **Z** stands for a **Patch Versions:** Versions for patches are used for bug fixes. There are no functionality changes in the patch version upgrades. If the current version is 2.6.9 then the next version for a patch upgrade will be

2.6.10. There is no limit to these numbers. Increase the value of Z when fixing bugs.

Valid identifiers are in the set **[A-Za-z0-9]** and cannot be empty. Pre-release metadata is identified by appending a hyphen to the end of the SemVer sequence. Thus a pre-release for version 1.0.0 could be 1.0.0-alpha.1. Then if another build is needed, it would become 1.0.0-alpha.2, and so on. Note that names cannot contain leading zeros, but hyphens are allowed in names for pre-release identifiers.

Advantages of SemVer:

- To keep track of every transition in the software development phase.
- Versioning can do the job of explaining the developers about what type of changes have taken place and the possible updates that should take place in the software.
- It helps to keep things clean and meaningful.
- It helps other people who might be using your project as a dependency.

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WORKING OF BRAIN-MACHINE INTERFACE (BMI)

As the influence of modern computers grows alongside with our understanding of the human brain, we are moving closer to make some pretty spectacular science fiction into reality. For example, just imagine transmitting signals directly to someone's brain that would allow them to see, hear or feel specific sensory inputs, how much spectacular that would be. This means you have the potential of manipulating the machine or the computer with your own brain just by giving sensory inputs.

Development of a Brain-machine interface (BCI) could be the most important technological breakthrough in decades not just for the convenience of disabled people. Our brains are filled with neurons, individual nerve cells connected to one another through dendrites and axons. Each time we think, move, feel and remember something, our neurons are at work. Brain-Machine Interface research is an area of high public awareness. Videos on YouTube, as well as reported news in the media, indicates intense curiosity and

interest in a field that hopefully one day soon will dramatically improve the lives of many disabled persons affected by a number of different diseases.

LAVANYA N

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THE POWER OF 5G WISDOM WIRELESS COMMUNICATION

A new era opens in the history of technology to serve the century of speed, in which new digital age communication is expected to experience a high data rate that is unimaginable to achieve by existing communication networks. According to statistics, by 2024, 5G networks will cover 40% of the world population and handles 25% of all mobile traffic data.

The first wireless transmission; it's nothing but the transmission of Morse codes using radio waves. But the turning point in wireless communication is the invention of the handheld device that can communicate wirelessly. This invention led to the evolution of technology. Let's look into the mobile wireless technology generation:

- 1G - First Generation Mobile Communication System.
- 2G - Second Generation Communication System.
- 3G - Third Generation Communication System.
- 4G - Fourth Generation Communication System.
- 5G - Fifth Generation Communication System.

1G-First Generation Mobile Communication System

The first generation communication system (1G) uses an analog system, which is put into operation in Japan by Nippon Telephone and Telegraph, during the year 1978. This analog system uses a frequency range between 800MHz and 900 MHz, and a bandwidth of 10 MHz. 1G system provides voice-only service, and its access technique is Frequency Division Multiple Access (FDMA). But the inevitable disadvantages of the 1G system are:

- Multiplexed traffic
- Inability to operate among different countries
- Less security

2G - Second Generation Communication System

The second-generation communication system is a digital cellular system that can be defined as a standard global system for mobile communication (GSM). Digital system communication is one of the key features of the 2G system; it allows the spectrum to be used much more efficiently and also reduce the bandwidth for voice communication. One of the disadvantages is that it can only handle a maximum of 9.6 kbps, which is not good for internet related services.

Then 2.5 G and 2.7G were introduced. The 2.5G system uses General Packet Radio Services (GPRS) Standard and it supports an array of features Wireless Application Protocol, Multimedia Message Service, Short Message Service, Mobile Games, and so on. Whereas 2.7G uses EDGE - Enhanced Data Rate for GSM Evolution; it provides a higher data rate compared to 2.5 G.

3G- Third Generation Communication System

The third generation communication system (3G) provides high-speed internet access, 384 kbps in burst mode. The services provided by 3G are video calls, broadband wireless data, mobile television, GPS, video broadcast service, and so on. However, some disadvantages of the 3G system are:

- Need higher bandwidth to support a higher data rate
- Costly infrastructure
- Spectrum license is expensive

4G - Fourth Generation Communication System

The fourth-generation communication system provides high-speed internet access of 100 Mbps and hence, it can provide quality video and audio streaming. Two main standards of 4G are:

- Worldwide Interoperability for microwave
- WiMax and LongTerm Evolution (LTE)

Some technical challenges respect to the 4G system are:

- High data rates-OFDM, Distortion, MC-CDMA
- Turbo, LDPC
- MIMO devices
- Cognitive Radio
- Smart antenna system

Overview of 5G

5G is termed as the fifth generation technology standard that ensures faster communication and ubiquitous connectivity. The 5th generation communication network is based on WISDOM (Wireless Innovative System for Dynamically Operating Mega Communication) that provides enhanced capabilities such as enhanced mobile broadband (eMBB), Ultra-Reliable Low Latency Communication (URLLC), and

massive machine-type communication (MMTC). Let's discuss this in detail.

Enhanced Mobile Broadband (eMBB)

Enhanced Mobile brand provides faster data transfer across a wide coverage area. Hence, eMBB can ensure a higher user experience for data-rich applications and compelling digital media. It provides 5G users with fluid and flexible technology-dependent services. Some of them are:

- Ultra-High Display.
- 360-degree video streaming.
- Immersive VR and AR applications.
- High-end features in wearable mobile devices.
- Mobile Cloud.
- Smart Navigation.
- Real-time interactive games, and so on.

From the above features, it is clear, eMBB is not just for providing multimedia content, but it also provides a higher user experience for cloud-based applications as well; it defines new standards for smart office applications such as virtual meetings with 360-degree video, real-time translation, and so on.

Ultra-Reliable Low Latency Communication (URLLC)

URLLC ensures ultra-reliable and low latency communication, which can be used for mission-critical applications — remote surgery, remote patient diagnosis, intelligent transportation system, smart grids, and so on. Not only it provides uninterrupted and robust data exchange, but it also ensures end-to-end security and reliability.

It is a challenging task for the 5G network to achieve URLLC; 5G requires modifications in the existing telecom infrastructure since the QoS requirement (air interface latency and system reliability) for URLLC varies among applications. Let's consider the scenario of air interface latency, it depends on the channel quality and dedicated bandwidth that varies based on the applications. On the other side, achieving reliability is also a challenging task, since different mobile applications rely on different retransmission methods.

Massive Machine Type Communication (MMTC)

Massive Machine Type Communication (MMTC) is a communication paradigm where machine type devices send information to other machines with less or zero human interventions. This M2M data sharing can be characterized as automation data generation, actuation among intelligent machines, and so on. And, it defines a new standard for a diverse set of connected devices that encompass the Internet Of Things (IoT).

MMTC is different from existing communication models since it contains a set of power-constrained devices and also exhibits different traffic patterns. The various device types and different traffic patterns can help to achieve diverse requirements such as industry 4.0, IoT, connected cars, more effective security surveillance, POS, and so on.

In short, eMBB offers a wide coverage area; URLLC ensures ultra-reliable and low latency communication, and MMTC offers efficient and secure wireless connectivity and networking for billions of M2M devices. These applications all together define 5G.

WISDOM (Wireless Innovative System for Dynamically Operating Mega Communication)

WISDOM is an important concept that explains 5G. In simple terms, we can define a 5G system as a combination of 4G and WISDOM technology. WISDOM can offer frequencies up to Terahertz and data rate up to Tera bps. Here, it accomplishes Tera bps by using millimeter waves. Let's have a look at the following section.

- WISDOM Objectives
- Five Independent Vectors
- Pillars of WISDOM
- WISDOM Architecture
- WISDOM Benefits
- WISDOM Challenges

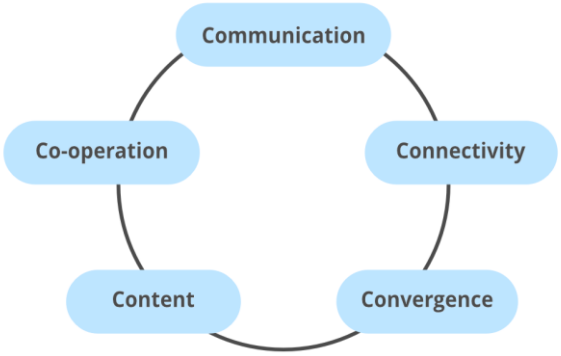
WISDOM Objectives

The main objective of WISDOM is to provide a wireless infrastructure for human-centric mega communication, which helps to interconnect different sectors by bridging their communication gap with higher capacity and performance. This can be made possible by:

- Designing an air interface that provides 3 to 5 times more channel efficiency.
- Creating novel cross-layer and cross-network domain optimization.
- Developing a converged WISDOM system.
- Utilizing smaller size cells and virtual cells with optimized dynamic spectrum management.

Five Independent Vectors

The five independent vectors are shown in the below figure:



There are five independent vectors that contribute to the concept of WISDOM. They are-

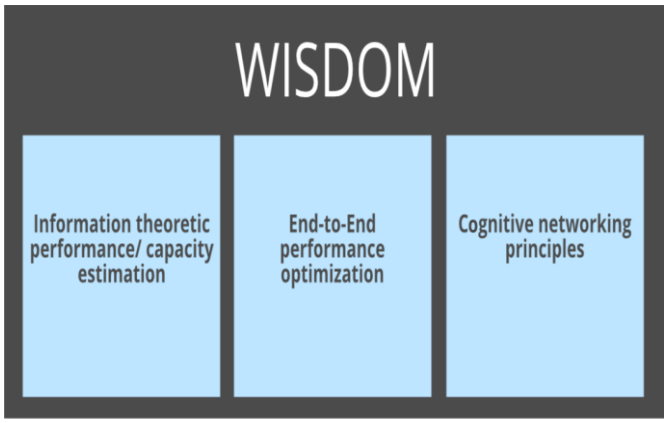
- Communication.
- Connectivity.
- Convergence.
- Content.
- Co-operation.

It can meet the present generation demands by ensuring quick data transfer, single IP for worldwide connectivity, distant business correspondence, and so on.

Pillars of WISDOM

The main goal of WISDOM is to interconnect different sectors by bridging their

communication gap with higher capacity and performance. It also aims at providing a rich digital experience for the end-users. The WISDOM pillars play a significant role to meet this demand.



The top design of WISDOM is designed based on 3 founding pillars. They are as follows:

- Information-theoretic performance/ capacity estimation: Here, information from different types of network paradigms are considered to determine the efficiency and capacity of the design process.
- End-to-End performance optimization: This performance optimization offers high reliable communication links, which is much efficient than one based on classical layered design. To achieve this optimization, it uses a novel transport protocol, which is compatible with the wired part (optical fiber) of the network.
- Cognitive networking principles: These principles make it possible to consider a wide range of usage scenarios irrespective of their complexity. It also plays a significant role in the minimization of the spectrum and energy needs. The self-organizing/self-healing wireless access networks in the converged WISDOM architecture is based on cognitive networking principles.

WISDOM Architecture

WISDOM Architecture has three main components.

Person to Machine (P2M): The P2M component in WISDOM architecture makes it possible for humans to interact and connect with machines in unbelievable ways. It can overcome today's challenges

— such as bandwidth demand, heterogeneity and integration of new systems, and different network paradigms

—offer a seamless person to machine communication experience. It makes use of mm-wave and Sub-THz point-to-point MIMO and offers a low bitrate up to 1 Tbit/s. Some applications of P2M components are IoT, Wireless Sensor Networks (WSN), MANET, and more.

Short-range (WPAN & WLAN): WISDOM short-range component has multiple directional antennas that transmit to the same terminal. This technique helps to create spatial diversity and attenuate Line of Sight (LoS) blocking. It facilitates both Wireless Personal Area Networks (WPAN) and Wireless Local Area Network (WLAN). This component uses communication methodologies such as mm-wave, Multi-Radio, Multihop, Indoor, and Wireless Mesh Networks and offers sustainable 10 Gbit/s and Bursty 1 Terabit/sec

links. Some applications are smart houses, child monitoring, Immersive augmented reality and gaming, smart helmets, smart cars, Green Information Communication Technology (GICT), personalized medicines, smart robotics, tactile internet, RFID, and more.

Cellular and WMAN range: This component offers the next-generation cellular networks that consist of a network of radio cells. It helps to design a converged architecture and network solution that facilitates human-centric mega communications over the network of the future. Through this component, WISDOM focuses on interfacing network nodes that use different technology, with the support of some novel solutions. It considers a new communication system based on the transmission, signaling, and modulation techniques. It makes use of MIMO and Virtual MIMO links in the mm-wave bands and different types of beamforming for generating highly directional links at high frequencies. This WISDOM component offers sustainable symmetric 300 Mbps links (1 Gbit/s peak) and full mobility.

WISDOM Benefits

A wide array of technology can benefit from WISDOM. They are as follows:

- Multimedia Communication: Wisdom technology focuses on the areas of Machine-to-Machine (M2M) and Peer-to-Peer(P2P), and thereby can ensure efficiency for home networking, smart cities, and techno-social systems.
- Cognitive Communications: Cognitive communication includes a wide array of services such as educational, office, emergency, commercial, intelligent transportation system, and so on.
- Personalized Medicine: This area includes bioinformatics, body sensors, multi-sensor networks, data protection, and so on.
- Positioning and Localization: Positioning and Localization include navigation systems, ubiquitous and cooperative localization, geo-tagging, robotics, and so on.
- Future Networks: WISDOM can standardize the future network process such as physical security, cooperative communication, IoT, and so on.
- Dynamically operating mega communication: Another advantage of WISDOM is its ability to switch the communication network dynamically, based on the change in geolocation. Let's point to its key features:
    - Promising frequency spectrum.
    - Novel enabling technologies.
    - Reduced OPEX cost.
    - Less coverage and electricity cost.
    - Scalable and Flexible technology options.

WISDOM provides a faster data rate across a wide coverage area; it ensures this

coverage by forming a Global Information Multimedia Communication (GIMCV).

GIMCV (Global Information Multimedia Communication)

WISDOM provides a wide coverage area by forming a Global Information Multimedia Communication. It ranges from cities to states, then to countries and the world. Before getting into GIMCV, let's look into cellular networks. A cellular network consists of cells, and each cell represents a geographical area. Here, a cell site or base transceiver station provides network coverage for each cell. A cell can use multiple frequencies, range from f1 to f6, under the condition that the adjacent cells should not use the same frequency (co-channel interference). If we look at the cellular network hierarchy, it consists of macrocells (range up to 35 km), microcells (up to 2kms), picocells (range up to 200 meters), and femtocells (10 meters).

Global Information Multimedia Communication (GIMCV) comprises national and international zones, represented as macrocells. Each macrocell further divides into microcells (city network), and the microcells consist of picocells (home network). This model can provide an efficient structure for grouping devices in close vicinity.

Requirements of 5G

To achieve the data rate of 1 Tbit/s, WISDOM based 5G need certain requirements. They are as follows:

1. Single ID mobile terminal to achieve seamless network connectivity
2. Requires a distributed antenna system (DAS) and multi-input and massive multi-output (MIMO) antennas
3. Utilization of D2D in WISDOM based 5G
4. Require frequency bands that are not used for existing cellular communication
5. Visible light communication
6. Cognitive radio technology

MANASSHA M.S.K

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5 WAYS TO USE SOCIAL MEDIA IN A RIGHT WAY

Social Media has been around for many years now and it never ceases to grab the attention of the netizens ranging from teenagers to adults. On-demand videos, online meetings, feeds, blogs, comments, likes, polls you name it, social media has come from occasional simple chat to a powerful tool that we never fail to use almost every day.

Although there are many things on the bright side that social media has to offer, the dark side strikes like slow poison. Its addictive nature has left everyone from young teens to adults gazing at it for hours. While teens tend to have too much exposure just for entertainment, adults fall in the pit-trap as well. That being said, we don't have to worry about the dark side that much if we know how to use it the right way so that we can be a bit productive and also get self-satisfaction avoiding over engagement as a result.

Although there are many things on the bright side that social media has to offer, the dark side strikes like slow poison. Its addictive nature has left everyone from young teens to adults gazing at it for hours. While teens tend to have too much exposure just for entertainment, adults fall in the pit-trap as well.

That being said, we don't have to worry about the dark side that much if we know how to use it the right way so that we can be a bit productive and also get self-satisfaction avoiding over engagement as a result.

1. Stress Busting

This is the most common way of using social media, something that all of us have been doing for a long time. It is still effective these days but should be used in moderation. Do it too much and you'll unknowingly do the exact opposite of what you wanted to do which is relieving stress. There are moments when you face a really heavy workload in front of you. After several hours of working you may be really tired and your brain demands something else to refresh itself other than the regular thing that it has been busy with so far. That is when social media may turn out to be just the thing.

A funny episode from a cartoon will not only cheer up your mood but will also help you maintain focus on your actual task. There are many other similar ways such as reading real-life experiences, quotes, new ideas or creative stuff; chatting, and so on. As long as it is not too much spanning several hours and as long as your brain knows that there is a reward now and then it will tag along.

2. Finding Answers

Here is another effective way to use social media. The very base of social media is to answer questions you are interested in. And on that note, no matter which topic you choose to pose a question on, social media is always up with an answer, isn't it? But there are

always those two categories of questions we pose, one including the regular fashion, entertainment, and trends stuff and the other being educational stuff like academics, walkthroughs, tutorials, etc. Both are effective in their ways but the second class is more informative and productive.

Based on the second class of questions as discussed above, we may pose questions to experts on different sites like quora, Stack Overflow, brain, etc to get them answered and gain some new knowledge in the process. There are a variety of other questions answered, mostly based on the how part which has been answered through blogs, articles, or videos.

If we even need a walkthrough to an entire process or need a series of tutorials to accomplish an on-demand task, social media will always be there to help.

3. Education

This is one of the on-demand ways to use social media. A lot of students and teachers alike have been benefitting from this for a long time. By following channels providing educational content you're interested in, e-learning, solving puzzles and tricky problems that are posted now and then and so on, you can be assured that you're learning something interesting frequently.

Whether you are a college student, a homemaker, a professional, or of any other kind social media has online resources available for everyone alike. If you are a student and wish to learn a few topics that you aren't that good at then YouTube may turn out to be just the thing. If you are a business professional or an employee willing to pursue a different career or improve on the existing one with relevant skills, e-learning may be just what the doctor ordered. Even if you're a homemaker willing to learn art, social media still has the tools and resources for you to get started.

4. Marketing Yourself

This is yet another way to make social media work for you. On YouTube, you market yourself by starting a YouTube channel providing video-based content that is specific or even generic audience may be interested in. Many professionals, employees on LinkedIn update the daily official activities that they are a part of and major turn arounds that they've been through. They do that in the form of text, photos, or even videos. Similarly, there are many other useful ways that many people may not be aware of that much. So be sure to do your research.

By building a profile eventually and meeting the target audience one can make a really good impact. So be sure to share your major achievements, honor, skills attained, participation in official events, and other recognizable things for a much larger audience to see. This is far more useful for freshers or even jobseekers generally as

they'll have something else to talk about in their resume besides regular academics and qualifications.

5. Creating Awareness

This is one of the top reasons to use social media. This has been put into play by many educational institutes, MNCs, Organizations, professionals, groups, and so on. Many competitions on a variety of topics, tests, challenges, webinars, conferences, discussions, and so on are notified of their happening to the intended audience on social media like Instagram, LinkedIn, or YouTube. So, you may also tag along if you're a part of an organization wanting more netizens to participate in a certain event.

Creating Awareness is a combination of most of the above ways discussed so far. Education and Marketing turn out to be its major backbones. The reason being that by answering questions and sharing our knowledge we create awareness, by making a larger audience aware of our activities and the ones upcoming we create awareness and market ourselves as a result. That way in most of the education and marketing perspectives the common generic term that comes into play is "creating awareness".

To sum up, overall there are many ways we can make social media work for us and maybe even benefit others in the process. On the contrary, there are other ways to make it a never-ending maze that we just cannot get out of. The trick is to be wise and to be aware of when to start and when to stop and to also be aware of not deviating from our actual goal in the process.

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GOOD CODING PRACTICES FOR BACKEND DEVELOPERS

Clients often underestimate the work of backend developers, especially those who only get impressed by the frontend part and don't know anything about backend coding. Clients can never get the complexity involves in the backend coding part. Ask a developer, and they will let you know that how sometimes it is difficult to join 4-5 tables in a minimal amount of code, what kind of difficulties they face during the implementation of API, how they need to consider all the scenarios when it comes to making the dynamic URL.

Imagine a scenario you're building an e-commerce site and you need to deal with a complex query where you have to calculate the price for a customer who is going to do some shopping from your website. What will happen if you use = instead of ==. Surely the whole result will be different, a customer may get benefits, or he/she may lose a lot of money. A small mistake on the backend side can generate a lot of bugs and it can cost a lot

of money (and of course you will be in trouble in your company when you will have to face your senior engineers…lol).

Backend development involves dealing with a lot of complex stuff. To make an application more efficient, a developer needs to really focus on the logic and code optimization when they are dealing with the backend part of the application. When the team is very small for a project developers do not focus much on good coding practices but when the team and application grow it's good to follow the best coding practices throughout the team.

1. Perfect Your Core Skills

This one is the most important skill to adapt when it comes to working on the backend part of the application. You should have at least working knowledge of server-side languages such as Java, Python, PHP, C#, etc. The stronger you're in these languages the easier it will be for you to develop the application.

Also, you should have a strong foundation in SQL or databases. Backend developers deal with a huge amount of data saved in the database. They run multiple queries on it in their day-to-day job. So it's good to have exposure to some databases such as MySQL, SQL Server, MongoDB, and PostgreSQL as a bare minimum requirement. They all have a similar concept of storing the data in rows and columns but there are some differences in all the databases. It's good to have a working knowledge of these databases before you start building an application.

Another important skill for backend developers is the knowledge of JSON and/or XML APIs. A lot of application requires data retrieval in the form of JSON and the connection to an application programming interface (API). The most popular format for data retrieval in API is JSON format and XML. Knowledge of working on API and these formats will make your journey much easier in backend development.

2. Validate Inputs and Handle Errors

If you're writing the backend code for more than a few months then you might have heard the word "Never trust your users" from senior engineers. Being a backend developer make sure that you never trust the data submitted by a user. A hacker may try to penetrate the system when the application goes live on the server. To ensure the security

of the system it's good to validate the inputs which are coming to your system.

- **API Gateway:** This can be done via policies, mainly generic validation, schema, format.
- **Microservice:** This involves inspecting the existence of entities. You can use the libraries of your development stack for the input validation in microservice.

Once you're done with the validation of inputs and errors, you need to take the responsibility of handling it properly. You need to do it carefully in microservice/mesh architecture because the components are interconnected in these kinds of systems. If one of the services crashes then the whole system might get affected. And in that case, you may have to do a lot of troubleshooting. You should have knowledge of the HTTP error code which gets generated when something wrong happens on the server. To handle these errors return a response without crashing the service. Proper input validation and error handling won't make any issue on the server. It will also reduce the need for troubleshooting for your software

3. Follow Separation of Concerns

- How do you organize your code?
- How do you structure your code?
- What do you do for the maintainability of the code?

One of the good answers to the above question is….using the separation of concern in your code. Being a backend developer if you follow this concept in your software architecture then surely you will save a lot of time and effort that you put into the maintainability of your code. Separation of concern divides your whole computer programs into different sections or different modules for the better organization of the code. This increases the readability of the code and it becomes easier for the other developers to collaborate on the application.

You can follow any design pattern to structure your code. A popular one for web applications is the MVC framework. Implementing this good practice in software architecture is really helpful for the entire team. It reduces the learning curve for the code and increases the overall speed and efficiency of the team during the development of the application.

4. Implement Health Check Endpoints and Logging

Health check simply means monitoring the services of your system. We ensure that the database is working and the services are running smoothly in the entire system. It is helpful in resolving the issues in your software if in case a bug or issue is identified. Services of your software may get terminated if the health checks fail. So let's discuss a few approaches to implement some good health checks in your system.

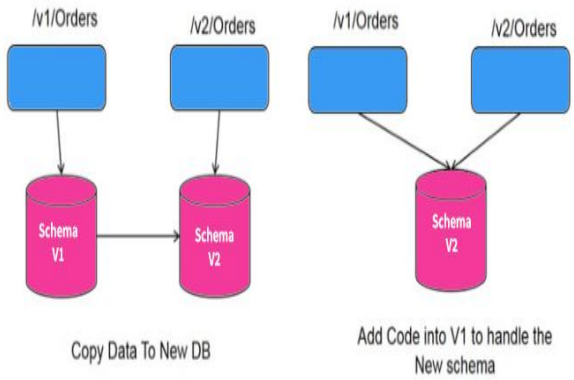
- **TCP health check:** It is a basic health check which ensures that the services are up and running. This health check is done via TCP and it doesn't monitor the service level health. Most of the cloud platforms have their own solution to implement this health check.
- **Service level health check:** Service level health checks are the advanced level of health checks. It validates the intended output and ensures that the services are running smoothly.
- **Logging:** Here we are concerned with the logs actions such as database queries, requests, and responses into a centralized log sink. You can use some logging libraries or log management tools for this purpose.

5. Implement Versioning for Your Services

With time your application needs frequent changes. To handle those changes efficiently you need to implement and test the application while the current version is still running in your system. Let's discuss the two ways to version your service.

- **URL:** For example "/users/v2.1/{id}"
- **Header:** included in the header as "X-Version:2.1."

Below is an example of a URL versioning approach.



6. Automate Repetitive Task

Scripts are always the same but humans are not…Being a backend developer you might have experienced some repetitive tasks in your day-to-day job. Learn to automate it. Don't waste your time doing the same thing again and again. Automating the things will make your life easier and you won't have to type the same command over and over again.

7. Write Test Cases and Documentation

Before you jump into the actual coding part if you write the test cases then surely it will help you in planning and visualizing the end product. You won't have to make frequent changes in your codebase and that increases the efficiency of your work. Also, test cases will help you to identify the downstream impact of the changes you made in your codebase especially when the application grows.

Test-Driven Development (TDD): This is one of the good approaches to write test cases before you start doing the actual coding. There are so many benefits of TDD but it also has some downside. It can take up a lot of time. If services are critical then elaborate on the test cases.

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TECHNOLOGY, LIKE ART, IS A SOARING EXERCISE OF THE HUMAN IMAGINATION.

-DANIEL BELL-