Internet of Things-IOT

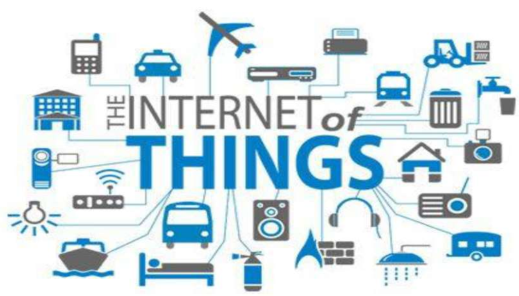
Definition, Characteristics, Architecture, Enabling Technologies, Application & Future Challenges

I Abstract:

The Internet of things refers to a type of network to connect anything with the Internet based on stipulated protocols through information sensing equipment's to conduct information exchange and communications in order to achieve smart recognitions, positioning, tracing, monitoring, and administration.

II. Introduction

The IOT concept was coined by a member of the Radio Frequency Identification (RFID) development community in 1999, and it has recently become more relevant to the practical world largely because of the growth of mobile devices, embedded and ubiquitous communication, cloud computing and data analytics. Imagine a world where billions of objects can sense, communicate and share information, all interconnected over public or private Internet Protocol (IP) networks. These interconnected objects have data regularly collected, analyzed and used to initiate action, providing a wealth of intelligence for planning, management and decision making. This is the world of the Internet of Things (IOT).



Internet of things common definition is defining as: Internet of things (IOT) is a network of physical objects. The internet is not only a network of computers, but it has evolved into a network of device of all type and sizes , vehicles, smart phones, home appliances, toys, cameras, medical instruments and industrial systems, animals, people, buildings, all connected ,all communicating & sharing information based on stipulated protocols in order to achieve smart reorganizations, positioning, tracing, safe & control & even personal real time online monitoring , online upgrade, process control & administration.

Internet of things is an internet of three things:

(1). People to people,

(2) People to machine /things,

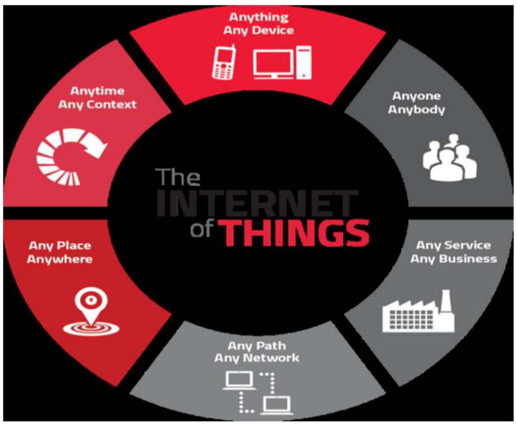
(3) Things /machine to things /machine, Interacting through internet.

presence in the environment of a variety of things/objects that through wireless and wired connections and unique addressing schemes are able to interact with each other and cooperate with other things/objects to create new applications/services and reach common goals. In this context the research and development challenges to create a smart world are enormous. A world where the real, digital and the virtual are converging to create smart environments that make energy, transport, cities and many other areas more intelligent.

ENABLING TECHNOLOGIES FOR IOT :-

Internet of things (IoT) is a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.

With the Internet of Things the communication is extended via Internet to all the things that surround us. The Internet of Things is much more than machine to machine communication, wireless sensor networks, sensor networks , 2G/3G/4G,GSM,GPRS,RFID, WI-FI, GPS, microcontroller, microprocessor etc. These are considered as being the enabling technologies that make "Internet of Things" applications possible.



It can be grouped into three categories: *(1)* ***technologies that enable "things" to acquire contextual information,*** (2) ***technologies that enable "things" to process contextual information****, and* (3) ***technologies to improve security and privacy.*** The first two categories can be jointly understood as functional building blocks required building "intelligence" into "things", which are indeed the features that differentiate the IoT from the usual Internet. The third category is not a functional but rather a de facto requirement, without which the penetration of the IoT would be severely reduced.
The Internet of Things is not a single technology, but it is a mixture of different hardware & software technology. The Internet of Things provides solutions based on the integration of information technology, which refers to hardware and software used to store, retrieve, and process data and communications technology which includes electronic systems used for communication between individuals or groups.

III. CHARACTERISTICS

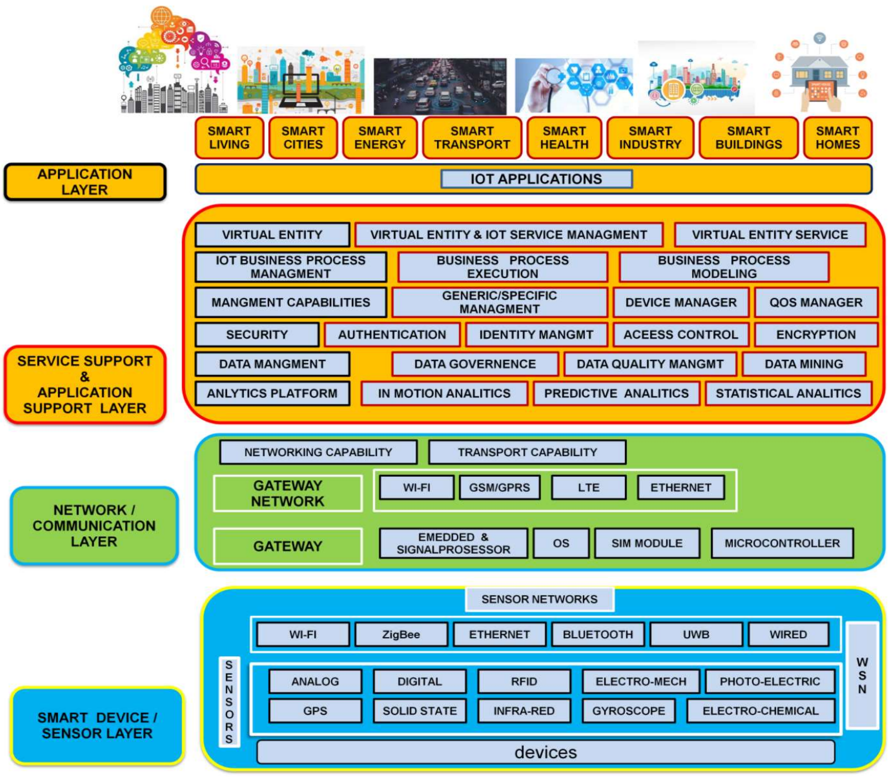
The fundamental characteristics of the IoT are as follows: -
Interconnectivity: With regard to the IoT, anything can be interconnected with the global information and communication infrastructure.
Things-related services: The IoT is capable of providing thing-related services within the constraints of things, such as privacy protection and semantic consistency between physical things and their associated virtual things. In order to provide thing-related services within the constraints of things, both the technologies in physical world and information world will change.
Heterogeneity: The devices in the IoT are heterogeneous as based on different hardware platforms and networks. They can interact with other devices or service platforms through different networks.
Dynamic changes: The state of devices change dynamically, e.g., sleeping and waking up, connected and/or disconnected as well as the context of devices including location and speed. Moreover, the number of devices can change dynamically.
Enormous scale: The number of devices that need to be managed and that communicate with each other will be at least an order of magnitude larger than the devices connected to the current Internet.
Even more critical will be the management of the data generated and their interpretation for application purposes. This relates to semantics of data, as well as efficient data handling.
Safety: As we gain benefits from the IoT, we must not forget about safety. As both the creators and recipients of the IoT, we must design for safety. This includes the safety of our personal data and the safety of our physical well-being. Securing the endpoints, the networks, and the data moving across all of it means creating a security paradigm that will scale.
Connectivity: Connectivity enables network accessibility and compatibility. Accessibility is getting on a network while compatibility provides the common ability to consume and produce data.

IV. IOT ARCHITECTURE

IOT architecture consists of different layers of technologies supporting IOT. It serves to illustrate how various technologies relate to each other and to communicate the scalability, modularity and configuration of IOT deployments in different scenarios.

A. smart device / sensor layer:

The lowest layer is made up of smart objects integrated with sensors. The sensors enable the interconnection of the physical and digital worlds allowing real-time information to be collected and processed. There are various types of sensors for different purposes. The sensors have the capacity to take measurements such as temperature, air quality, speed, humidity, pressure, flow, movement and electricity etc.



In some cases, they may also have a degree of memory, enabling them to record a certain number of measurements. A sensor can measure the physical property and convert it into signal that can be understood by an instrument. Sensors are grouped according to their unique purpose such as environmental sensors, body sensors, home appliance sensors and vehicle telematics sensors, etc.

Most sensors require connectivity to the sensor gateways. This can be in the form of a Local Area Network (LAN) such as Ethernet and Wi-Fi connections or Personal Area Network (PAN) such as ZigBee, Bluetooth and Ultra Wideband (UWB). For sensors that do not require connectivity to sensor aggregators, their connectivity to backend servers/applications can be provided using Wide Area Network (WAN) such as GSM, GPRS and LTE. Sensors that use low power and low data rate connectivity, they typically form networks commonly known as wireless sensor networks (WSNs). WSNs are gaining popularity as they can accommodate far more sensor nodes while retaining adequate battery life and covering large areas.

B. Gateways and Networks

Massive volume of data will be produced by these tiny sensors and this requires a robust and high performance wired or wireless network infrastructure as a transport medium. Current networks, often tied with very different protocols, have been used to support machine-to-machine (M2M) networks and their applications. With demand needed to serve a wider range of IOT services and applications such as high speed transactional services, context-aware applications, etc, multiple networks with various technologies and access protocols are needed to work with each other in a heterogeneous configuration. These networks can be in the form of a private, public or hybrid models and are built to support the communication requirements for latency, bandwidth or security.

C. Management Service Layer

The management service renders the processing of information possible through analytics, security controls, process modeling and management of devices.

One of the important features of the management service layer is the business and process rule engines. IOT brings connection and interaction of objects and systems together providing information in the form of events or contextual data such as temperature of goods, current location and traffic data. Some of these events require filtering or routing to post-processing systems such as capturing of periodic sensory data, while others require response to the immediate situations such as reacting to emergencies on patient’s health conditions. The rule engines support the formulation of decision logics and trigger interactive and automated processes to enable a more responsive IOT system.

D. Application Layer

The IoT application covers “smart” environments/spaces in domains such as: Transportation, Building, City, Lifestyle, Retail, Agriculture, Factory, Supply chain, Emergency, Healthcare, User interaction, Culture and tourism, Environment and Energy.

V. IOT FUNCTIONAL VIEW

The Internet of Things concept refers to uniquely identifiable things with their virtual representations in an Internet-like structure and IoT solutions comprising a number of components such as : (1) Module for interaction with local IoT devices. This module is responsible for acquisition of observations and their forwarding to remote servers for analysis and permanent storage. (2) Module for local analysis and processing of observations acquired by IoT devices. (3) Module for interaction with remote IoT devices, directly over the Internet. This module is responsible for acquisition of observations and their forwarding to remote servers for analysis and permanent storage. (4) Module for application specific data analysis and processing. This module is running on an application server serving all clients. It is taking requests from mobile and web clients and relevant IoT observations as input, executes appropriate data processing algorithms and generates output in terms of knowledge that is later presented to users. (5) User interface (web or mobile): visual representation of measurements in a given context (for example on a map) and interaction with the user, i.e. definition of user queries.

VI. FUTURE TECHNOLOGICAL DEVELOPMENTS FOR IOT.

The development of enabling technologies such as semiconductor electronics, communications, sensors, smart phones, embedded systems, cloud networking, network virtualization and software will be essential to allow physical devices to operate in changing environments & to be connected all the time everywhere.

VIII. FUTURE CHALLANGES FOR IOT

There are key challenges and implications today that need to be addressed before mass adoption of IOT can occur.

A. Privacy and Security

As the IoT become a key element of the Future Internet and the usage of the Internet of Things for large-scale, partially mission-critical systems creates the need to address trust and security functions adequately. New challenges identified for privacy, trust and reliability are: • providing trust and quality-of-information in shared information models to enable re-use across many applications. • Providing secure exchange of data between IoT devices and consumers of their information. • Providing protection mechanisms for vulnerable devices.

B. Cost versus Usability

IOT uses technology to connect physical objects to the Internet. For IOT adoption to grow, the cost of components that are needed to support capabilities such as sensing, tracking and control mechanisms need to be relatively inexpensive in the coming years.

C. Interoperability

In the traditional Internet, interoperability is the most basic core value; the first requirement of Internet connectivity is that “connected” systems be able to “talk the same language” of protocols and encodings. Different industries today use different standards to support their applications. With numerous sources of data and heterogeneous devices, the use of standard interfaces between these diverse entities becomes important. This is especially so for applications that supports cross organizational and various system boundaries. Thus the IOT systems need to handle high degree of interoperability.

D. Data Management

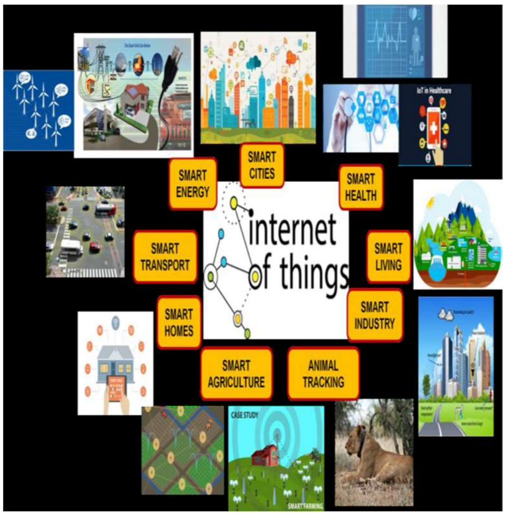
Data management is a crucial aspect in the Internet of Things. When considering a world of objects interconnected and constantly exchanging all types of information, the volume of the generated data and the processes involved in the handling of those data become critical.

E. Device Level Energy Issues

One of the essential challenges in IoT is how to interconnect “things” in an interoperable way while taking into account the energy constraints, knowing that the communication is the most energy consuming task on devices.The IoT application area is very diverse and IoT applications serve different users. Different user categories have different driving needs. From the IoT perspective there are three important user categories: (1) The individual citizens, (2) Community of citizens (citizens of a city, a region, country or society as a whole), (3) The enterprises.

X. Conclusion

Internet of Things is a new revolution of the Internet & it is a key research topic for researcher in embedded, computer science & information technology area due to its very diverse area of application & heterogeneous mixture of various communications and embedded technology in its architecture.



F/NO- 115178462
ASI/T MANOJ

5G Networks

The first commercially launched 5G network was in South Korea. The country's wireless carriers, SK Telecom, KT Corporation, and LG Uplus, rolled out their 5G services in April 2019. 5G is designed to support a 100x increase in traffic capacity and network efficiency. 5G has lower latency than 4G. 5G has significantly lower latency to deliver more instantaneous, real-time access: a 10x decrease in end-to-end latency down to 1ms.

5G is the fifth generation of wireless cellular technology, offering higher upload and download speeds, more consistent connections, and improved capacity than previous networks.

Trend: Development of standalone 5G networks for broader coverage and lower latency

When 5G networks originally rolled out, they were dependent on the 4G core network to provide data transfer and coverage. This allowed for the initial functionality without implementing a whole new infrastructure. Now, with the development of 5G standalone (5G SA) networks, users will have access to greater coverage and will experience lower latency. Utilizing a cloud-based architecture, 5G SA will provide a better user experience and pave the way for technologies such as autonomous vehicle automation and precision robotics.

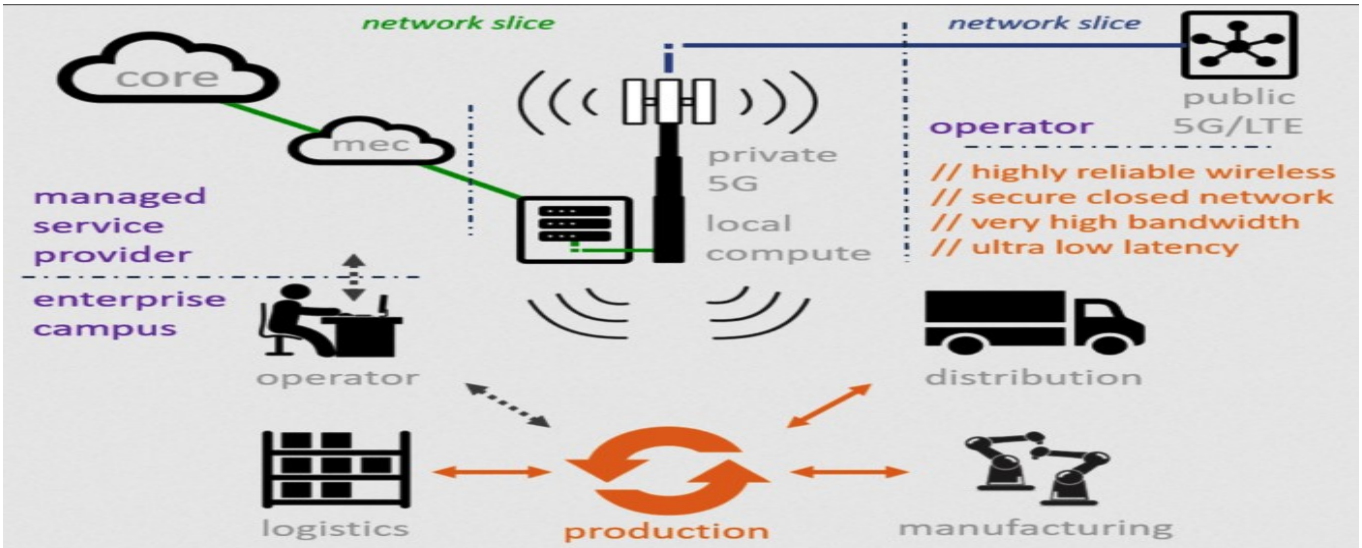
Use Cases

- Reliable remote control of machinery, robotics and other devices
- Secure, controlled and widespread internet access unlimited by geography
- More accurate inventory management across all industries

What are some of the benefits of a private 5G network?

There are several reasons for enterprises to consider running a private 5G network in their facilities. They include:

- Improved network connection
- Longer range compared with WiFi networks
- Improved coverage
- Low latency for manufacturing and smart factory environments
- Complete control over enterprise devices, which can be configured for improved network security



Why is 5G important?

The demand for internet access, combined with the emergence of new technologies such as artificial intelligence, the Internet of Things (IoT), and automation, is driving a massive increase in the amount of data created. Data creation is growing exponentially, with volumes set to increase by several hundred zettabytes over the coming decade. The current mobile infrastructure was not designed for such a high information load and requires upgrading.

At the same time, with its high speed, massive capacity, and low latency, 5G could help to support and scale several applications like cloud-connected traffic control, drone delivery, video chatting, and console-quality gaming on the go. From global payments and emergency response to distance education and mobile workforce, the benefits and applications of 5G are limitless. It has the potential to transform the world of work, the global economy, and people's lives.

How will 5G benefit businesses?

The capabilities of 5G can support innovation and improved customer experiences for business. Here are some areas to look out for.

Autonomous mobility solutions

Previously, fully autonomous cars have not been considered viable because of the length of time it takes for a vehicle to send and receive information. However, the low latency of 5G means we could see self-driving cars become more commonplace, with roads connected with transmitters and sensors that send and receive information to vehicles in 1/1,000 of a second. The reduced time is critical for AI and radar technology to interpret what they see (other cars, pedestrians, stop signs) and control the car accordingly.

Smart factories

5G mobile networks are an opportunity for manufacturers to create hyper-connected smart factories. 5G supports the Internet of Things, meaning factories can wirelessly connect several thousands of smart devices like cameras and sensors to automatically collect data in real-time. The factories can analyze and process this data to make operations more efficient and cost-effective. For example, smart sensor technology can make accurate predictions about equipment lifecycles, inform planning decisions, and predict when machines need maintenance.

How does 5G technology work?

As with previous cellular networks, 5G technology uses cell sites that transmit data through radio waves. Cell sites connect to networks with wireless technology or wired connection. 5G technology works by modifying how data is encoded, significantly increasing the number of usable airwaves for carriers.

OFDM

Orthogonal Frequency Division Multiplexing (OFDM) is an essential part of 5G technology. OFDM is a modulation format that encodes high-band airwaves incompatible with 4G and offers lower latency and improved flexibility compared with LTE networks.

Smaller towers

5G technology also uses smaller transmitters placed on buildings and other infrastructure. 4G and previous cellular technology relied on standalone mobile towers. The ability to run the network from small cell sites will support many devices at superior speeds.

Network slicing

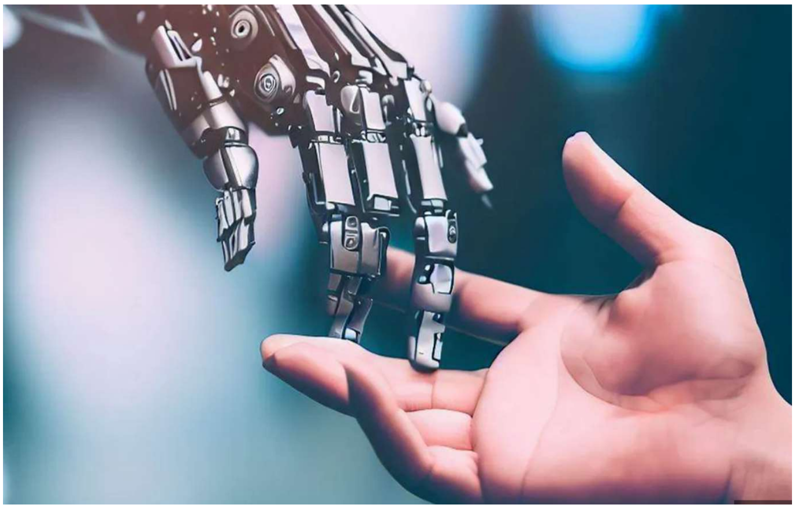
Mobile network operators use 5G technology to deploy multiple independent virtual networks over the same infrastructure. You can customize each network slice for different services and business cases, such as streaming services or enterprise tasks. By forming a collection of 5G network functions for each specific use case or business model, you can support different requirements from all vertical industries. The service separation means users benefit from a more reliable experience and improved efficiency on their devices.

F/NO- 041583624
HC/RO Harinkhede Bhaktraj

The Artificial Intelligence

Introduction

Staying ahead of the curve



We are always on the lookout for new technologies, trending topics, inside stories on the future of technology and innovations globally, etc., aiming to share them with all tech enthusiasts. The first part of the AI Newsletter consisted of the latest trends in the field of artificial intelligence, including transformers, generative models, large language models (LLMs), natural language processing (NLP), and diffusion models. We also discussed the growing ethical concerns surrounding the advancements in AI technology. In our second edition, we will focus on the topics of predictive analytics, automated decision making, big data, and related AI ethics concerns. Our aim is to provide our readers with insights and updates on the latest developments in the field of AI and to continue to share our passion for technology with all tech enthusiasts. *Through these newsletters PwC Albania and Kosovo is not endorsing any of the technologies or solutions mentioned, but rather summarizing and bringing to you trending technologies which are defined by external experts as game-changing technologies.

Predictive Analytics and Automated Decision Making

Predictive analytics and automated decision-making can be greatly aided by large language models. These models can process large amounts of data quickly, and can generate accurate and human-like responses. This can help to reduce the time and energy spent on manual decision-making and can help to ensure that decisions are made with the highest degree of accuracy.

- **Predictive analytics** is the use of data, statistical algorithms, and machine learning techniques to identify the likelihood of future outcomes based on historical data. These techniques can be used to make predictions about a wide range of events, such as customer behavior, equipment failures, and fraud detection.
- **Automated decision making** refers to the use of AI systems to make decisions without human intervention. This can include decision making in areas such as finance, healthcare, and transportation. Automated decision making can provide many benefits, such as improved efficiency, accuracy, and speed of decision making.

However, there are also ethical concerns around the use of predictive analytics and automated decision making, such as bias and discrimination, privacy and security, and accountability and transparency.

Big Data, constructing the world of AI models using descriptive data

Big data refers to the **large and complex data sets** that are generated by various sources such as social media, internet of things devices, and sensor networks. These data sets have the potential to provide valuable insights into a wide range of areas such as customer behavior, market trends, and disease outbreaks.

Big data is **essential for training large transformer models**, and there is a finite amount of data available. Right now it seems that a lot of companies are in need of new data that is descriptive of more aspects of human work, life and interactions.

This is one of the largest problems that will be faced by AI companies and professionals, to build new reliable systems that can work across many professions.

However, a potential approach to mediate in the short term the effects of this issue, may be the **construction of new datasets from existing data sources** and the generation of synthetic datasets in order to create datasets that are large enough to train these models.

Additionally, techniques such as transfer learning can be used to improve the accuracy of these models without the need for large datasets.

Modern Age Ethical Concerns: Artificial Intelligence

Ethical concerns of AI generative models are becoming increasingly important, as these models are being used to create automated decision-making systems and predictive analytics. Issues such as privacy, data bias, and algorithmic transparency are especially pertinent to consider when dealing with large language models such as ChatGPT and Stable Diffusion. As AI technology advances and becomes more prevalent in society, there are a number of ethical concerns that must be taken into account. Some of these concerns include:

- **Bias and discrimination:** AI models can perpetuate and amplify existing biases in the data they are trained on, leading to unfair and discriminatory outcomes.
- **Privacy and security:** AI systems can collect and process large amounts of personal data, raising concerns about how this data is used and protected.
- **Job displacement:** AI systems can automate tasks that were previously done by humans, leading to job losses and economic disruption.
- **Autonomy and accountability:** As AI systems become more autonomous, it can be difficult to determine who is responsible for their actions and decisions.

To address these ethical concerns, it is important for companies and researchers to take a proactive approach to understanding and mitigating the potential negative impacts of AI. This can include implementing fair and transparent AI practices, such as regularly monitoring and testing for bias in AI models, and developing clear and transparent processes for decision making by AI systems. Additionally, there is a need to establish laws and regulations to govern the use and development of AI.

F/NO- 035151119
HC/RO Nirmal Singha

Memorization Strategies

(Memory Strategies)

What is memory?

Memory is the ability to learn, store, and retrieve information. New or increasing problems with any or all of these 3 stages of memory often occur after a traumatic brain injury, stroke, brain tumor, multiple sclerosis, or other kind of injury or illness that affects your nervous system.
Some memory problems may also occur as part of normal aging, when many people have more trouble retrieving new information.

Types of Memory

- **Long-term (remote):** memory for old, well-learned information that has been rehearsed (used) over time, such as the name of a childhood pet, memories of vacations, or where you went to high school. Long-term memory tends to remain after injury or illness.
- **Short-term (recent):** memory for new things that took place a few minutes, hours, or days ago, such as what you had for breakfast or what you did yesterday. Short-term memory tends to be the most affected after injury. People who have had brain injuries may have problems with attention span, storing memories, thinking quickly, and learning easily. These memory problems make it hard to understand and save short-term memories so that they can be rehearsed and stored in long-term memory.
- **Immediate (working):** memory for information that is current, that you usually keep track of mentally, such as a phone number you look up, directions someone just gave you, or keeping track of numbers in your head when you add or subtract.
- **Prospective:** the ability to remember to do something in the future, such as taking a medicine, going to an appointment, or following through on an assignment or project.

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Strategies to Help Improve Your Memory

Your speech therapist can help you with strategies to help you remember new information. There are 2 main types of strategies to help your memory: internal reminders and external reminders.

Internal Reminders

- **Rehearsal:** retelling yourself information you just learned, or restating it out loud in your own words.
- **Repetition:** saying the same information over and over, either silently or out loud.
- **Clarification:** asking others to repeat or rephrase information.
- **Chunking:** grouping items to reduce the number of items to remember, such as grouping 7-digit phone numbers into 2 chunks, one with 3 numbers and the other with 4 numbers.
- **Rhyming:** making a rhyme out of important information.
- **Acronyms or alphabet cueing:** creating a letter for each word you want to remember, or vice versa. One example is using the sentence "Every Good Boy Does Fine" to remember that the notes E, G, B, D, and F are on the lines of a treble staff in music.
- **Imagery (also called visualization):** creating pictures of the information in your mind.
- **Association:** linking old information or habits with the new, such as taking your medicine at the same time that you brush your teeth.
- **Personal meaning:** making the new information meaningful or emotionally important to you in some way.

External Reminders

- Using a paper or electronic calendar or day planner.
- Using written reminders such as to-do lists, shopping lists, and project outlines.
- Recording new information with a voice recorder.
- Using a medicine organizing tool, such as a MediSet.
- Creating specific, permanent places for important items. One example is putting your keys, wallet, and cell phone in the same place every time you get home.

F/NO- 991600028
SI/DM Amrik Singh

Acknowledgement

We are highly thankful for reading out this compilation and hope it will be useful for you in day to day professional and personal life. We would like to hear your interest areas, suggestions from you to make this newsletter more informative and interesting. Your views will definitely help us to create this newsletter as an effective medium to reach you with latest development in the fields of communication and technology.

R&D Team

CTC T&IT CRPF, Ranchi, Jharkhand

ctcit@crpf.gov.in