

Gambella University
Faculty of Natural and Computational Science
Department of Computer Science

Course Title: Introduction to Emerging Technologies, Cr. Hr: 3Hrs/5ECTS

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Chapter 1: Introduction to Emerging Technologies

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Evolution of Technologies

Emerging technology is a term generally used to describe a new technology, it also refer to the continuing development of existing technology; it can have slightly different meanings when used in different areas, such as media, business, science, or education. The term commonly refers to technologies that are currently developing, or that are expected to be available within the next five to ten years, and is usually reserved for technologies that are creating or expected to create significant social or economic effects.

Role of Data for Emerging Technologies

Data determines the future of science, technology, the economy, and possibly everything in our world today and tomorrow. Data have not only triggered tremendous hype and buzz but more importantly, presents enormous challenges that in turn bring incredible innovation and economic opportunities.

This reshaping and paradigm-shifting are driven not just by data itself but all other aspects that could be created, transformed, and/or adjusted by understanding, exploring, and utilizing data.

Enabling devices and network (Programmable devices)

In the world of digital electronic systems, there are four basic kinds of devices: memory, microprocessors, logic, and networks. **Memory devices** store random information such as the contents of a spreadsheet or database. **Microprocessors** execute software instructions to perform a wide variety of tasks such as running a word processing program or video game. **Logic devices** provide specific functions, including device-to-device interfacing, data communication, signal processing, data display, timing and control operations, and almost every other function a system must perform. **The network** is a collection of computers, servers, mainframes, network devices, peripherals, or other devices connected to one another to allow the sharing of data. An excellent example of a network is the Internet, which connects millions of people all over the world.

Programmable devices Figure usually refer to chips that incorporate field programmable logic devices (FPGAs), complex programmable logic devices (CPLD) and programmable logic devices (PLD). There are also devices that are the analog equivalent of these called field-programmable analog arrays.



Programmable devices

List of some Programmable devices

- Achronix Speedster SPD60
- Actel's
- Altera Stratix IV GT and Arria II GX
- Atmel's AT91CAP7L
- Cypress Semiconductor's programmable system-on-chip (PSoC) family
- Lattice Semiconductor's ECP3
- Lime Microsystems' LMS6002
- Silicon Blue Technologies
- Xilinx Virtex 6 and Spartan 6
- Xmos Semiconductor L series

A full range of network-related equipment referred to as Service Enabling Devices (SEDs), which can include:

Traditional channel service unit (CSU) and data service unit (DSU)

- Modems
- Routers
- Switches
- Conferencing equipment
- Network appliances (NIDs and SIDs)
- Hosting equipment and servers

Human to Machine Interaction

Human-machine interaction (HMI) refers to the communication and interaction between a human and a machine via a user interface. Nowadays, natural user interfaces such as gestures have gained increasing attention as they allow humans to control machines through natural and intuitive behaviors.

What is interaction in human-computer interaction?

HCI (human-computer interaction) is the study of how people interact with computers and to what extent computers is not developed for successful interaction with human beings. As its name implies, HCI consists of three parts: the user, the computer itself, and the ways they work together.

How do users interact with computers?

The user interacts directly with hardware for the human input and output such as displays, e.g. through a graphical user interface. The user interacts with the computer over this software interface using the given input and output (I/O) hardware.

How important is human-computer interaction?

The goal of HCI is to improve the interaction between users and computers by making computers more user-friendly and receptive to the user's needs. The main advantages of HCI are simplicity, ease of deployment & operations and cost savings for smaller set-ups. They also reduce solution design time and integration complexity.

Disciplines Contributing to Human-Computer Interaction (HCI)

Cognitive psychology: Limitations, information processing, performance prediction, cooperative working, and capabilities.

Computer science: Including graphics, technology, prototyping tools, user interface management systems.

- Linguistics.
- Engineering and design.
- Artificial intelligence.
- Human factors.

Future Trends in Emerging Technologies

- 5G Networks
- Artificial Intelligence (AI)
- Autonomous Devices
- Blockchain
- Augmented Analytics
- Digital Twins
- Enhanced Edge Computing and
- Immersive Experiences in Smart Spaces

Some emerging technologies that will shape the future of you and your business.

The future is now or so they say. So-called emerging technologies are taking over our minds more and more each day. These are very high-level emerging technologies it could be shaping the future of you and your business.

Chatbots -- **Chatbots** are developed to understand and communicate with users using a variety of automation **technologies** including Artificial Intelligence (AI), Natural Language Processing (NLP), or a Rules Engine.

Virtual/Augmented reality --

Blockchain -- A **Blockchain** is basically a decentralized, distributed ledger of all the transactions or events which takes place only after involving multiple parties. **Blockchain** is one of the **emerging technologies** in today's world and a lot of revolution and research has just began regarding this distributed **technology**.

Ephemeral Apps and Artificial Intelligence.

Autonomous things/**devices**/machines can be in any shapes (robots, drones, vehicles) and can handle tasks without human intervention. These AI-powered **devices** collect data from a particular situation and spontaneously learn and improve from experiences.

Chapter 2: Data Science

An Overview of Data Science.

What are Data and Information.

Data Processing Cycle.

Data types and their representation.

Data types from Computer programming perspective

Introduction

To learn more about data science, data vs. information, data types and representation, data value chain, and basic concepts of big data.

An Overview of Data Science

Data science is a multi-disciplinary field that uses scientific methods, processes, algorithms, and systems to extract knowledge and insights from structured, semi-structured and unstructured data. Data science is much more than simply analyzing data. It offers a range of roles and requires a range of skills.

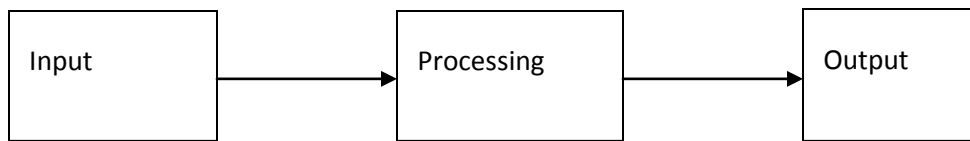
What are data and information?

Data can be defined as a representation of facts, concepts, or instructions in a formalized manner, which should be suitable for communication, interpretation, or processing, by human or electronic machines. It can be described as unprocessed facts and figures. It is represented with the help of characters such as alphabets (A-Z, a-z), digits (0-9) or special characters (+, -, /, *, <, >, =, etc.).

Whereas **information** is the processed data on which decisions and actions are based. It is data that has been processed into a form that is meaningful to the recipient and is of real or perceived value in the current or the prospective action or decision of recipient. Furthermore, information is interpreted data; created from organized, structured, and processed data in a particular context.

Data Processing Cycle

Data processing is the re-structuring or re-ordering of data by people or machines to increase their usefulness and add values for a particular purpose. Data processing consists of the following basic steps - input, processing, and output. These three steps constitute the data processing cycle.



Data Processing Cycle

Input – in this step, the input data is prepared in some convenient form for processing. The form will depend on the processing machine. For example, when electronic computers are used, the input data can be recorded on any one of the several types of storage medium, such as hard disk, CD, flash disk and so on.

Processing – in this step, the input data is changed to produce data in a more useful form. For example, interest can be calculated on deposit to a bank, or a summary of sales for the month can be calculated from the sales orders.

Output – at this stage, the result of the proceeding processing step is collected. The particular form of the output data depends on the use of the data. For example, output data may be payroll for employees.

Data types and their representation

Data types can be described from diverse perspectives. In computer science and computer programming, for instance, a data type is simply an attribute of data that tells the compiler or interpreter how the programmer intends to use the data.

Data types from Computer programming perspective

Almost all programming languages explicitly include the notion of data type, though different languages may use different terminology. Common data types include:

Integers(int)- is used to store whole numbers, mathematically known as integers

Booleans(bool)- is used to represent restricted to one of two values: true or false

Characters(char)- is used to store a single character

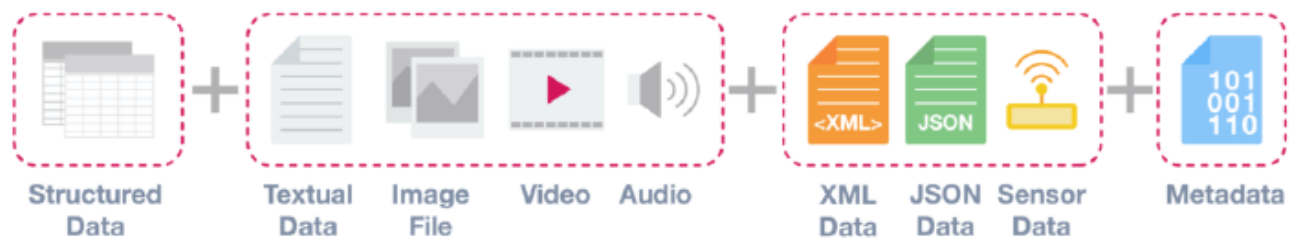
Floating-point numbers(float)- is used to store real numbers

Alphanumeric strings(string)- used to store a combination of characters and numbers

A data type makes the values that expression, such as a variable or a function, might take. This data type defines the operations that can be done on the data, the meaning of the data, and the way values of that type can be stored.

Data types from Data Analytics perspective

From a data analytics point of view, it is important to understand that there are three common types of data types or structures: Structured, Semi-structured, and Unstructured data types. Figure below describes the three types of data and metadata.



Data types from a data analytics perspective

Chapter 3: Artificial Intelligence

What is Artificial Intelligence, Need for Artificial Intelligence

Goals of Artificial Intelligence, What Comprises to Artificial Intelligence

Advantages of Artificial Intelligence, Disadvantages of Artificial Intelligence

Types of AI, How humans think

Applications of AI, Sample AI application.

Introduction

In this chapter, artificial intelligence, history, types, and applications in different sectors are studied. Finally, some tools and platforms, as well as a real sample of AI applications, are discussed.

What is Artificial Intelligence (AI)

Artificial Intelligence is composed of two words Artificial and Intelligence.

Artificial defines "man-made," and intelligence defines "thinking power", or “the ability to learn and solve problems” hence Artificial Intelligence means "a man-made thinking power." So, It can define Artificial Intelligence (AI) as the branch of computer science by which intelligent machines can create, can behave like a human, think like humans, and able to make decisions.

Intelligence, as we know, is the ability to acquire and apply knowledge. Knowledge is the information acquired through experience. Experience is the knowledge gained through exposure (training). Summing the terms up, we get artificial intelligence as the “copy of something natural (i.e., human beings) ‘WHO’ is capable of acquiring and applying the information it has gained through exposure.”

Artificial Intelligence exists when a machine can have human-based skills such as learning, reasoning, and solving problems with Artificial Intelligence do not need to preprogram a machine to do some work, despite that user can create a machine with programmed algorithms which can work with own intelligence.

Intelligence is composed of:

Reasoning

Learning

Problem Solving

Perception

Linguistic Intelligence

An AI system is composed of an agent and its environment. An agent (e.g., human or robot) is anything that can perceive its environment through sensors and acts upon that environment through effectors.

High-profile examples of AI include autonomous vehicles (such as drones and self-driving cars), medical diagnosis, creating art (such as poetry), proving mathematical theorems, playing games (such as Chess), search engines (such as Google search), online assistants (such as Siri),

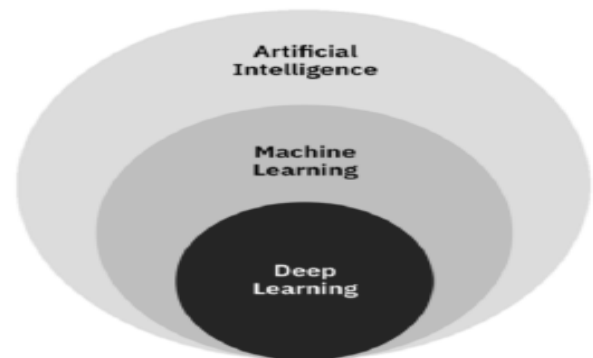
Image recognition in photographs, spam filtering, prediction of judicial decisions and targeting online advertisements

AI deals with the area of developing computing systems that are capable of performing tasks that humans are very good at, for example recognizing objects, recognizing and making sense of speech, and decision making in a constrained environment.

The advent of Big Data, driven by the arrival of the internet, smart mobile and social media has enabled AI algorithms, in particular from Machine Learning and Deep Learning.

Machine learning is the study of computer algorithms that improve automatically through experience. The term machine learning was introduced by Arthur Samuel in 1959.

Neural networks are biologically inspired networks that extract features from the data in a hierarchical fashion. The field of neural networks with several hidden layers is called deep learning.



Need for Artificial Intelligence

1. To create expert systems that exhibit intelligent behavior with the capability to learn, demonstrate, explain and advice its users.
2. Helping machines find solutions to complex problems like humans do and applying them as algorithms in a computer-friendly manner.

Goals of Artificial Intelligence

Following are the main goals of Artificial Intelligence:

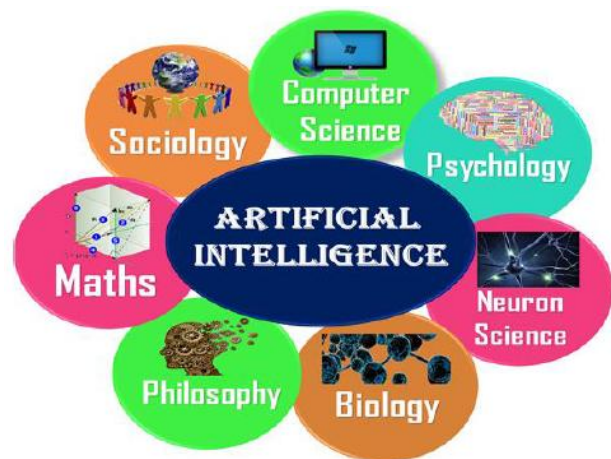
1. Replicate human intelligence
2. Solve Knowledge-intensive tasks
3. An intelligent connection of perception and action
4. Building a machine which can perform tasks that requires human intelligence such as:
 - Proving a theorem
 - Playing chess
 - Plan some surgical operation
 - Driving a car in traffic
5. Creating some system which can exhibit intelligent behavior, learn new things by itself, demonstrate, explain, and can advise to its user.

What Comprises to Artificial Intelligence?

Artificial Intelligence is not just a part of computer science even it's so vast and requires lots of other factors that can contribute to it. To create the AI-first we should know that how intelligence is composed, so Intelligence is an intangible part of our brain which is a combination of Reasoning, learning, problem-solving, perception, language understanding, etc

To achieve the above factors for a machine or software Artificial Intelligence requires the following disciplines

- Mathematics
- Biology
- Psychology
- Sociology
- Computer Science
- Neurons Study
- Statistics



Advantages of Artificial Intelligence

Following are some main advantages of Artificial Intelligence:

High Accuracy with fewer errors: AI machines or systems are prone to fewer errors and high accuracy as it takes decisions as per pre-experience or information.

High-Speed: AI systems can be of very high-speed and fast-decision making, because of that AI systems can beat a chess champion in the Chess game.

High reliability: AI machines are highly reliable and can perform the same action multiple times with high accuracy.

Useful for risky areas: AI machines can be helpful in situations such as defusing a bomb, exploring the ocean floor, where to employ a human can be risky.

Digital Assistant: AI can be very useful to provide digital assistant to users such as AI technology is currently used by various E-commerce websites to show the products as per customer requirements.

Useful as a public utility: AI can be very useful for public utilities such as a self-driving car which can make our journey safer and hassle-free, facial recognition for security purposes, Natural language processing (for search engines, for spelling checker, for assistant like Siri, for translation like google translate), etc.

Disadvantages of Artificial Intelligence

High Cost: The hardware and software requirement of AI is very costly as it requires lots of maintenance to meet current world requirements.

Can't think out of the box: Even we are making smarter machines with AI, but still they cannot work out of the box, as the robot will only do that work for which they are trained, or programmed.

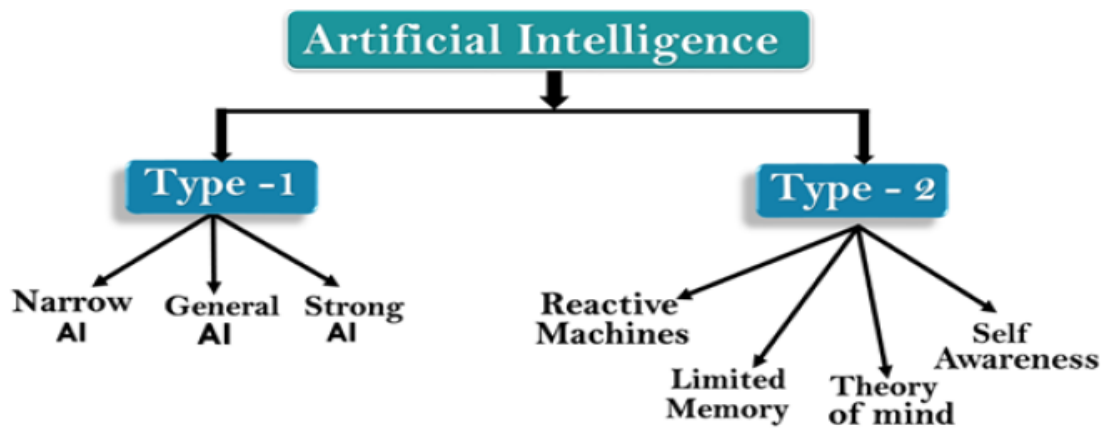
No feelings and emotions: AI machines can be an outstanding performer, but still it does not have the feeling so it cannot make any kind of emotional attachment with humans, and may sometime be harmful for users if the proper care is not taken.

Increase dependence on machines: With the increment of technology, people are getting more dependent on devices and hence they are losing their mental capabilities.

No Original Creativity: As humans are so creative and can imagine some new ideas but still AI machines cannot beat this power of human intelligence and cannot be creative and imaginative.

Types of AI

Artificial Intelligence can be divided into various types, there are mainly two types of the main categorization which are based on capabilities and based on functionality of AI, as shown in figure, and Following is the flow diagram which explains the types of AI.



Types of Artificial Intelligence

Based on Capabilities

Weak AI or Narrow AI:

Narrow AI is a type of AI which is able to perform a dedicated task with intelligence. The most common and currently available AI is Narrow AI in the world of Artificial Intelligence. Narrow AI cannot perform beyond its field or limitations, as it is only trained for one specific task. Hence it is also termed as weak AI. Narrow AI can fail in unpredictable ways if it goes beyond its limits.

Apple Siri is a good example of Narrow AI, but it operates with a limited pre-defined range of functions.

IBM's Watson supercomputer also comes under Narrow AI, as it uses an Expert system approach combined with Machine learning and natural language processing.

Some Examples of Narrow AI are Google translate, playing chess, purchasing suggestions on e-commerce sites, self-driving cars, speech recognition, and image recognition.

General AI: General AI is a type of intelligence that could perform any intellectual task with efficiency like a human.

The idea behind the general AI to make such a system that could be smarter and think like a human on its own.

Currently, there is no such system exists which could come under general AI and can perform any task as perfect as a human. It may arrive within the next 10 or 20 years but it has challenges relating to hardware, the energy consumption required in today's powerful machines, and the need to solve for catastrophic memory loss that affects even the most advanced deep learning algorithms of today.

The worldwide researchers are now focused on developing machines with General AI. As systems with general AI are still under research, and it will take lots of effort and time to develop such systems.

Super AI: Super AI is a level of Intelligence of Systems at which machines could surpass human intelligence, and can perform any task better than a human with cognitive properties. This refers to aspects like general wisdom, problem solving and creativity. It is an outcome of general AI.

Some key characteristics of strong AI include capability include the ability to think, to reason solve the puzzle, make judgments, plan, learn, and communicate on its own.

Super AI is still a hypothetical concept of Artificial Intelligence. The development of such systems in real is still a world-changing task.

Based on the functionality

Reactive Machines: Purely reactive machines are the most basic types of Artificial Intelligence. Such AI systems do not store memories or past experiences for future actions. These machines only focus on current scenarios and react on it as per possible best action.

IBM's Deep Blue system is an example of reactive machines.

Google's AlphaGo is also an example of reactive machines.

Limited Memory: Limited memory machines can store past experiences or some data for a short period of time.

These machines can use stored data for a limited time period only. Self-driving cars are one of the best examples of Limited Memory systems. These cars can store the recent speed of nearby cars, the distance of other cars, speed limits, and other information to navigate the road.

Theory of Mind: Theory of Mind AI should understand human emotions, people, beliefs, and be able to interact socially like humans.

This type of AI machines is still not developed, but researchers are making lots of efforts and improvement for developing such AI machines

Self-Awareness: Self-awareness AI is the future of Artificial Intelligence. These machines will be super intelligent and will have their own consciousness, sentiments, and self-awareness.

These machines will be smarter than the human mind. Self-Awareness AI does not exist in reality still and it is a hypothetical concept.

How Humans think

The goal of many researchers is to create strong and general AI that learns like a human and can solve general problems as the human brain does. Achieving this goal might require many more years.

How does a human being think? Intelligence or the cognitive process is composed of three main stages:

Observe and input the information or data in the brain.

Interpret and evaluate the input that is received from the surrounding environment.

Make decisions as a reaction towards what received as input and interpreted and evaluated.

AI researchers are simulating the same stages in building AI systems or models. This process represents the main three layers or components of AI systems.

Applications of AI: Artificial Intelligence has various applications in today's society. It is becoming essential for today's time because it can solve complex problems in an efficient way in multiple industries, such as Healthcare, entertainment, finance, education, etc. AI is making our daily life more comfortable and faster.

AI in Agriculture: Agriculture is an area that requires various resources, labor, money, and time for the best result. Now a day's agriculture is becoming digital, and AI is emerging in this field. Agriculture is applying AI as agriculture robotics, soil and crop monitoring, predictive analysis. AI in agriculture can be very helpful for farmers

AI in Healthcare: In the last, five to ten years, AI becoming more advantageous for the healthcare industry and going to have a significant impact on this industry.

Healthcare Industries are applying AI to make a better and faster diagnosis than humans. AI can help doctors with diagnoses and can inform when patients are worsening so that medical help can reach the patient before hospitalization

AI in Education: AI can automate grading so that the tutor can have more time to teach. AI chatbot can communicate with students as a teaching assistant.

AI in the future can be work as a personal virtual tutor for students, which will be accessible easily at any time and any place.

AI in Gaming: AI can be used for gaming purposes. The AI machines can play strategic games like chess, where the machine needs to think of a large number of possible places.

AI in Finance and E-commerce: AI and finance industries are the best matches for each other. The finance industry is implementing automation, chatbot, adaptive intelligence, algorithm trading, and machine learning into financial processes.

AI is providing a competitive edge to the e-commerce industry, and it is becoming more demanding in the e-commerce business. AI is helping shoppers to discover associated products with recommended size, color, or even brand.

AI in Data Security: The security of data is crucial for every company and cyber-attacks are growing very rapidly in the digital world. AI can be used to make data more safe and secure. Some examples such as AEG bot, AI2 Platform, are used to determine software bugs and cyber-attacks in a better way.

AI in Social Media: Social Media sites such as Facebook, Twitter, and Snapchat contain billions of user profiles, which need to be stored and managed in a very efficient way. AI can organize and manage massive amounts of data. AI can analyze lots of data to identify the latest trends, hashtags, and requirements of different users.

AI in Travel &Transport: AI is becoming highly demanding for travel industries. AI is capable of doing various travel related works such as from making travel arrangements to suggesting the hotels, flights, and best routes to the customers. Travel industries are using AI-powered chatbots which can make human-like interaction with customers for a better and fast response.

AI in the Automotive Industry: Some Automotive industries are using AI to provide virtual assistants to their use for better performance. Such as Tesla has introduced TeslaBot, an intelligent virtual assistant.

Various Industries are currently working for developing self-driven cars which can make your journey more safe and secure.

AI in Robotics: Artificial Intelligence has a remarkable role in Robotics. Usually, general robots are programmed such that they can perform some repetitive task, but with the help of AI, we can create intelligent robots which can perform tasks with their own experiences without pre-programmed.

Humanoid Robots are the best examples for AI in robotics, recently the intelligent Humanoid robot named Erica and Sophia has been developed which can talk and behave like humans.

AI in Entertainment: We are currently using some AI-based applications in our daily life with some entertainment services such as Netflix or Amazon. With the help of AI algorithms, these services show the recommendations for programs or shows.

Sample AI application

Commuting

- Google's AI-Powered Predictions

- Ridesharing Apps Like Uber and Lyft

- Commercial Flights Use an AI Autopilot

Email

- Spam Filters
- Smart Email Categorization

Social Networking

- Facebook - When you upload photos to Facebook, the service automatically highlights faces and suggests friends tag.

Pinterest - Pinterest uses computer vision, an application of AI where computers are taught to “see,” in order to automatically identify objects in images (or “pins”) and then recommend visually similar pins. Other applications of machine learning at Pinterest includes spam prevention, search, and discovery, ad performance and monetization, and email marketing.

Instagram - Instagram, which Facebook acquired in 2012, uses machine learning to identify the contextual meaning of emoji, which have been steadily replacing slang (for instance, a laughing emoji could replace “lol”)

Snapchat - Snapchat introduced facial filters, called Lenses, in 2015. These filters track facial movements, allowing users to add animated effects or digital masks that adjust when their faces moved.

Online Shopping: Search - Amazon searches (“ironing board”, “pizza stone”, “Android charger”, etc.) quickly return a list of the most relevant products related to the search.

Recommendations - User see recommendations for products user’s interested in as “customers who viewed this item also viewed” and “customers who bought this item also bought”, as well as via personalized recommendations on the home page, bottom of item pages, and through email. Amazon uses artificial neural networks to generate these product recommendations.

Mobile Use: Voice-to-Text - A standard feature on smartphones today is voice-to-text. By pressing a button or saying a particular phrase (“Ok Google”, for example), User can start speaking and phone converts the audio into text.

Smart Personal Assistants - Now that voice-to-text technology is accurate enough to rely on for basic conversation, it has become the control interface for a new generation of smart personal assistants.

Siri and Google Now (now succeeded by the more sophisticated Google Assistant), which could perform internet searches, set reminders, and integrate with your calendar.

Amazon expanded upon this model with the announcement of complementary hardware and software components:

Alexa, an AI-powered personal assistant that accepts voice commands to create to-do lists, order items online, set reminders, and answer questions (via internet searches)

Echo (and later, Dot) smart speakers that allow you to integrate Alexa into your living room and use voice commands to ask natural language questions, play music, order pizza, hail an Uber, and integrate with smart home devices.

Microsoft has followed suit with Cortana, its own AI assistant that comes pre-loaded on Windows computers and Microsoft smartphones

Chapter 4: Internet of Things (IoT)

Overview of IoT

What is IoT

Advantages of IoT

Disadvantages of IoT

Introduction

Learn about the overview of the Internet of Things (IoT), how it works, IoT tools and platforms, and sample applications of IoT.

Overview of IoT

The most important features of IoT include artificial intelligence, connectivity, sensors, active engagement, and small device use. A brief review of these features is given below

Artificial Intelligence – IoT essentially makes virtually anything “smart”, meaning it enhances every aspect of life with the power of data collection, artificial intelligence algorithms, and networks. This can mean something as simple as enhancing refrigerator and cabinets to detect when milk and favorite cereal run low, and to then place an order with preferred grocer.

Connectivity – New enabling technologies for networking and specifically IoT networking, mean networks are no longer exclusively tied to major providers. Networks can exist on a much smaller and cheaper scale while still being practical. IoT creates these small networks between its system devices.

Sensors – IoT loses its distinction without sensors. They act as defining instruments that transform IoT from a standard passive network of devices into an active system capable of real-world integration.

Active Engagement – Much of today's interaction with connected technology happens through passive engagement. IoT introduces a new paradigm for active content, product, or service engagement.

Small Devices – Devices, as predicted, have become smaller, cheaper, and more powerful over time. IoT exploits purpose-built small devices to deliver its precision, scalability, and versatility.

What is IoT?

The description of the Internet of Things is related to different definitions used by several groups for promoting the particular concept in the whole world.

- According to the Internet Architecture Board's (IAB) definition, IoT is the networking of smart objects, meaning a huge number of devices intelligently communicating in the presence of internet protocol that cannot be directly operated by human beings but exist as components in buildings, vehicles or the environment.
- According to the Internet Engineering Task Force (IETF) organization's definition, IoT is the networking of smart objects in which smart objects have some constraints such as limited bandwidth, power, and processing accessibility for achieving interoperability among smart objects.
- According to the IEEE Communications category magazine's definition, IoT is a framework of all things that have a representation in the presence of the internet in such a way that new applications and services enable the interaction in the physical and virtual world in the form of Machine-to-Machine (M2M) communication in the cloud.
- According to the Oxford dictionary's definition, IoT is the interaction of everyday object's computing devices through the Internet that enables the sending and receiving of useful data.

The term Internet of Things (IoT) according to the 2020 conceptual framework is expressed through a simple formula such as:

$$IoT = Services + Data + Networks + Sensors$$

Generally, The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data.

IoT is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. IoT is a network of devices that can sense, accumulate and transfer data over the internet without any human intervention.

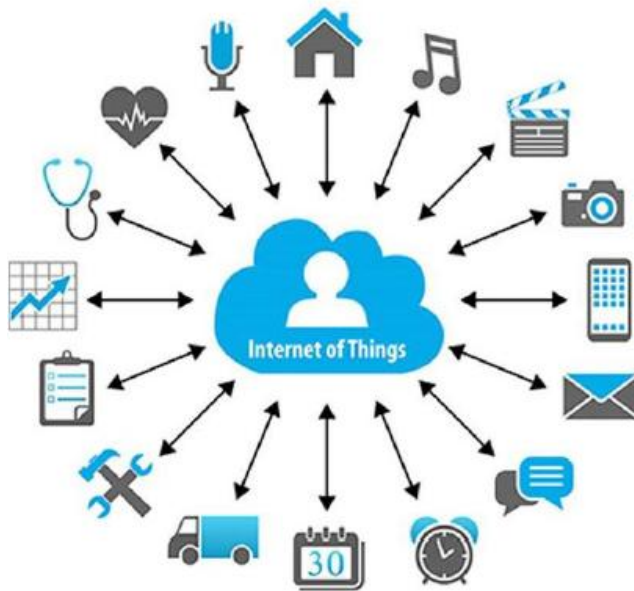
Simply stated, the Internet of Things consists of any device with an on/off switch connected to the Internet. This includes almost anything you can think of, ranging from cellphones to building maintenance to the jet engine of an airplane.

Medical devices, such as a heart monitor implant or a biochip transponder in a farm animal, can transfer data over a network and are members of the IoT. If it has an off/on the switch, then it can, theoretically, be part of the system.

The IoT consists of a gigantic network of internet-connected "things" and devices. Ring, a doorbell that links to smartphone, provides an excellent example of a recent addition to the Internet of Things. Ring signals when the doorbell is pressed and lets user see who it is and to speak with them.

The internet of things (IoT) has found its application in several areas such as connected industry, smart-city, smart-home, smart-energy, connected car, smart agriculture, connected building and campus, health care, logistics, among other domains.

Figure. IoT -systems allow users to achieve deeper automation, analysis, and integration within a system. They improve the reach of these areas and their accuracy.



IoT utilizes existing and emerging technology for sensing, networking, and robotics. IoT exploits recent advances in software, falling hardware prices, and modern attitudes towards technology. Its new and advanced elements bring major changes in the delivery of products, goods, and services; and the social, economic, and political impact of those changes.

History of IoT

The Internet of Things, as a concept, wasn't officially named until 1999. One of the first examples of an Internet of Things is from the early 1980s and was a Coca Cola machine, located at the Carnegie Mellon University. Local programmers would connect by the Internet to the refrigerated appliance, and check to see if there was a drink available and if it was cold, before making the trip.

By the year 2013, the Internet of Things had evolved into a system using multiple technologies, ranging from the Internet to wireless communication and from micro-electromechanical systems (MEMS) to embedded systems. The traditional fields of automation (including the automation of buildings and homes), wireless sensor networks, GPS, control systems, and others, all support the IoT.

IoT – Advantages

The advantages of IoT span across every area of lifestyle and business. Here is a list of some of the advantages that IoT has to offer:

Improved Customer Engagement – Current analytics suffer from blind-spots and significant flaws in accuracy; and as noted, engagement remains passive. IoT completely transforms this to achieve richer and more effective engagement with audiences.

Technology Optimization – The same technologies and data which improve the customer experience also improve device use, and aid in more potent improvements to technology. IoT unlocks a world of critical functional and field data.

Reduced Waste – IoT makes areas of improvement clear. Current analytics give us superficial insight, but IoT provides real-world information leading to the more effective management of resources.

Enhanced Data Collection – Modern data collection suffers from its limitations and its design for passive use. IoT breaks it out of those spaces and places it exactly where humans really want to go to analyze our world. It allows an accurate picture of everything.

IoT – Disadvantages

Here is a list of some of the disadvantages of IoT. These are:

→ As the number of connected devices increases and more information is shared between devices, the potential that a hacker could steal confidential information also increases.

→ If there's a bug in the system, it's likely that every connected device will become corrupted. Since there's no international standard of compatibility for IoT, it's difficult for devices from different manufacturers to communicate with each other.

→ Enterprises may eventually have to deal with massive numbers, maybe even millions of IoT devices and collecting and managing the data from all those devices will be challenging.

Challenges of IoT

Though IoT delivers an impressive set of advantages, it also presents a significant set of challenges. Here is a list of some of its major issues:

Security – IoT creates an ecosystem of constantly connected devices communicating over networks. The system offers little control despite any security measures. This leaves users exposed to various kinds of attackers.

Privacy – The sophistication of IoT provides substantial personal data in extreme detail without the user's active participation.

Complexity – Some find IoT systems complicated in terms of design, deployment, and maintenance given their use of multiple technologies and a large set of new enabling technologies.

Flexibility – Many are concerned about the flexibility of an IoT system to integrate easily with another. They worry about finding themselves with several conflicting or locking systems.

Compliance – IoT, like any other technology in the realm of business, must comply with regulations. Its complexity makes the issue of compliance seem incredibly challenging when many consider standard software compliance a battle.

Applications of IoT

The versatile nature of IoT makes it an attractive option for so many businesses, organizations, and government branches, that it doesn't make sense to ignore it. Here's a sample of various industries, and how IoT can be best applied.

Agriculture - For indoor planting, IoT makes monitoring and management of micro-climate conditions a reality, which in turn increases production. For outside planting, devices using IoT technology can sense soil moisture and nutrients, in conjunction with weather data, better control smart irrigation and fertilizer systems. If the sprinkler systems dispense water only when needed, for example, this prevents wasting a precious resource.

Consumer Use - For private citizens, IoT devices in the form of wearables and smart homes make life easier. Wearables cover accessories such as Fitbit, smartphones, Apple watches, health monitors, to name a few. These devices improve entertainment, network connectivity, health, and fitness. Smart homes take care of things like activating environmental controls so that your house is at peak comfort when you come home. Dinner that requires either an oven or a crockpot can be started remotely, so the food is ready when you arrive. Security is made more accessible as well, with the consumer having the ability to control appliances and lights remotely, as well as activating a smart lock to allow the appropriate people to enter the house even if they don't have a key.

Healthcare - First and foremost, wearable IoT devices let hospitals monitor their patients' health at home, thereby reducing hospital stays while still providing up to the minute real-time information that could save lives. In hospitals, smart beds keep the staff informed as to the availability, thereby cutting wait time for free space. Putting IoT sensors on critical equipment means fewer breakdowns and increased reliability, which can mean the difference between life and death. Elderly care becomes significantly more comfortable with IoT. In addition to the above-mentioned real-time home monitoring, sensors can also determine if a patient has fallen or is suffering a heart attack.

Insurance - Even the insurance industry can benefit from the IoT revolution. Insurance companies can offer their policyholders discounts for IoT wearables such as Fitbit. By employing fitness tracking, the insurer can offer customized policies and encourage healthier habits, which in the long run benefits everyone, insurer, and customer alike.

Manufacturing - The world of manufacturing and industrial automation is another big winner in the IoT sweepstakes. RFID and GPS technology can help a manufacturer track a product from its start on the factory floor to its placement in the destination store, the whole supply chain from start to finish.

These sensors can gather information on travel time, product condition, and environmental conditions that the product was subjected to. Sensors attached to factory equipment can help identify bottlenecks in the production line, thereby reducing lost time and waste. Other sensors mounted on those same machines can also track the performance of the machine, predicting when the unit will require maintenance, thereby preventing costly breakdowns.

Retail - IoT technology has a lot to offer the world of retail. Online and in-store shopping sales figures can control warehouse automation and robotics, information gleaned from IoT sensors. Much of this relies on RFIDs, which are already in heavy use worldwide. Mall locations are iffy things; business tends to fluctuate, and the advent of online shopping has driven down the demand for brick and mortar establishments. However, IoT can help analyze mall traffic so that stores located in malls can make the necessary adjustments that enhance the customer's shopping experience while reducing overhead. Speaking of customer engagement, IoT helps retailers target customers based on past purchases.

Equipped with the information provided through IoT, a retailer could craft a personalized promotion for their loyal customers, thereby eliminating the need for costly mass-marketing promotions that don't stand as much of a chance of success. Much of these promotions can be conducted through the customers' smartphones, especially if they have an app for the appropriate store.

Transportation - By this time, most people have heard about the progress being made with self-driving cars. But that's just one bit of the vast potential in the field of transportation. The GPS, which if you think of it is another example of IoT, is being utilized to help transportation companies plot faster and more efficient routes for trucks hauling freight, thereby speeding up delivery times. There's already significant progress made in navigation, once again alluding to a phone or car's GPS. But city planners can also use that data to help determine traffic patterns, parking space demand, and road construction and maintenance.

Utilities - IoT sensors can be employed to monitor environmental conditions such as humidity, temperature, and lighting. The information provided by IoT sensors can aid in the creation of algorithms that regulate energy usage and make the appropriate adjustments, eliminating the human equation (and let's face it, who of us hasn't forgotten to switch off lights in a room or turn down the thermostat?). With IoT-driven environmental control, businesses and private residences can experience significant energy savings, which in the long run, benefits everyone, including the environment! On a larger scale, data gathered by the Internet of Things can be used to help run municipal power grids more efficiently, analyzing factors such as usage. In addition, the sensors can help pinpoint outages faster, thereby increasing the response time of repair crews and decreasing blackout times.

IoT Based Smart Home

Smart Home initiative allows subscribers to remotely manage and monitor different home devices from anywhere via smartphones or over the web with no physical distance limitations.

With the ongoing development of mass-deployed broadband internet connectivity and wireless technology, the concept of a Smart Home has become a reality where all devices are integrated and interconnected via the wireless network. These "smart" devices have the potential to share information with each other given the permanent availability to access the broadband internet connection.

Remote Control Appliances: Switching on and off remotely appliances to avoid accidents and save energy.

Weather: Displays outdoor weather conditions such as humidity, temperature, pressure, wind speed and rain levels with the ability to transmit data over long distances.

Smart Home Appliances: Refrigerators with LCD screen telling what's inside, food that's about to expire, ingredients you need to buy and with all the information available on a smartphone app. Washing machines allowing you to monitor the laundry remotely, and. The kitchen ranges with the interface to a Smartphone app allowing remotely adjustable temperature control and monitoring the oven's self-cleaning feature.

Safety Monitoring: cameras, and home alarm systems making people feel safe in their daily life at home.

Intrusion Detection Systems: Detection of window and door openings and violations to prevent intruders.

Energy and Water Use: Energy and water supply consumption monitoring to obtain advice on how to save cost and resources, & many more.

IoT Based Smart City

In cities, the development of smart grids, data analytics, and autonomous vehicles will provide an intelligent platform to deliver innovations in energy management, traffic management, and security, sharing the benefits of this technology throughout society

Structural Health: Monitoring of vibrations and material conditions in buildings, bridges and historical monuments.

Lightning: intelligent and weather adaptive lighting in street lights.

Safety: Digital video monitoring, fire control management, public announcement systems.

Transportation: Smart Roads and Intelligent High-ways with warning messages and diversions according to climate conditions and unexpected events like accidents or traffic jams.

Smart Parking: Real-time monitoring of parking spaces available in the city making residents able to identify and reserve the closest available spaces,

Waste Management: Detection of rubbish levels in containers to optimize the trash collection routes. Garbage cans and recycle bins with RFID tags allow the sanitation staff to see when garbage has been put out

Chapter 5: Augmented Reality (AR)

Overview of Augmented Reality

Virtual reality (VR)

Applications of AR System, AR in education, AR in Medicine, AR in Entertainment.

Introduction

We will take a closer look at the overview of augmented reality, the difference between virtual reality (VR), augmented reality (AR) and mixed reality (MR), architecture of AR systems, and its application of AR systems such as in education, medicine, entertainment, etc. are discussed.

Overview of augmented reality

The fundamental idea of AR is to combine, or mix, the view of the real environment with additional, virtual content that is presented through computer graphics. Its convincing effect is achieved by ensuring that the virtual content is aligned and registered with the real objects. As a person moves in an environment and their perspective view of real objects changes, the virtual content should also be presented from the same perspective.

Augmented reality (AR) is a form of emerging technology that allows users to overlay computer-generated content in the real world. AR refers to a live view of a physical real-world environment whose elements are merged with augmented computer-generated images creating a mixed reality.

Through this augmented vision, a user can digitally interact with and adjust information about their surrounding environment.

Augmented Reality (AR) as a real-time direct or indirect view of a physical real-world environment that has been enhanced/augmented by adding virtual computer-generated information to it.

Augmented reality is the integration of digital information with the user's environment in real-time. Unlike virtual reality, which creates a totally artificial environment, augmented reality uses the existing environment and overlays new information on top of it. A live direct or indirect view of a physical, real-world environment whose elements are augmented by computer-generated sensory input such as sound, video, graphics or GPS data

Virtual reality (VR), Augmented Reality (AR) vs Mixed reality (MR)

With constant development in computer vision and the exponential advancement of computer processing power, virtual reality (VR), augmented reality (AR), and mixed reality (MR) technology is becoming more and more prominent. With some overlap in the applications and functions of these emerging technologies, sometimes these terms get confused or are used incorrectly.

Virtual Reality (VR)

VR is fully immersive, which tricks the senses into thinking user in a different environment or world apart from the real world. Using a head-mounted display (HMD) or headset, you'll experience a computer-generated world of imaginary and sounds in which you can manipulate objects and move around using haptic controllers while tethered to a console or PC. It is also called a computer-simulated reality. It refers to computer technologies using reality headsets to generate realistic sounds, images and other sensations that replicate a real environment or create an imaginary world. Advanced VR environment will engage all five senses (taste, sight, smell, touch, sound), but it is important to say that this is not always possible See Figure.

Using VR devices such as HTC Vive, Oculus Rift or Google Cardboard, users can be transported into a number of real-world and imagined environments.

The most advanced VR experiences even provide freedom of movement – users can move in a digital environment and hear sounds. Moreover, special hand controllers can be used to enhance VR experiences.



Immersive Technology

Most VR headsets are connected to a computer (Oculus Rift) or a gaming console (PlayStation VR) but there are standalone devices (Google Cardboard is among the most popular) as well. Most standalone VR headsets work in combination with smartphones – you insert a smartphone, wear a headset, and immerse in the virtual reality see Figure.



VR Case that Inserts a Smartphone

Augmented Reality (AR)

In augmented reality, users see and interact with the real world while digital content is added to it. If you own a modern smartphone, you can easily download an AR app and try this technology.

There's a different way to experience augmented reality, though – with special AR headsets, such as Google Glass, where digital content is displayed on a tiny screen in front of a user's eye.

AR adds digital elements to a live view often by using the camera on a smartphone. Examples of augmented reality experiences include Snapchat lenses and the game Pokemon Go. Augmented Reality (AR) is a live, direct or indirect view of a physical, real-world environment whose elements are augmented (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data see Figure.



Direct and Indirect Augmentation of Objects

Mixed Reality (MR)

Mixed Reality (MR), sometimes referred to as hybrid reality, is the merging of real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real-time. It means placing new imagery within a real space in such a way that the new imagery is able to interact, to an extent, with what is real in the physical world we know see Figures.

For example, with MR, you can play a virtual video game, grab your real-world water bottle, and smack an imaginary character from the game with the bottle. Imagination and reality have never been so intermingled.

The key characteristic of MR is that the synthetic content and the real-world content are able to react to each other in real-time.



Mixed Reality in Engineering and Medicine

In mixed reality, you interact with and manipulate both physical and virtual items and environments, using next-generation sensing and imaging technologies. MR allows you to see and immerse yourself in the world around you even as you interact with a virtual environment using your own hands—all without ever removing your headset.



Mixed Reality in Entertainment

It provides the ability to have one foot (or hand) in the real world, and the other in an imaginary place, breaking down basic concepts between real and imaginary, offering an experience that can change the way you game and work today.

One of the most obvious differences among augmented reality, virtual reality, and mixed reality is the hardware requirements and also VR is content which is 100% digital and can be enjoyed in a fully immersive environment, AR overlays digital content on top of the real-world. and MR is a digital overlay that allows interactive virtual elements to integrate and interact with the real-world environment. Numerous augmented reality apps and games can run on almost every smartphone on the market.

On the other hand, virtual reality programs require specialized VR headsets, noise-canceling headphones, cameras to track room space and boundaries, and sometimes even motion capture technology. Some of the biggest names in VR tech today are the Oculus Rift, HTC Vive, and PlayStation VR. For the enjoyment of simple VR videos, there are affordable makeshift VR headsets like the Google Cardboard, which work by running a video in 360 modes on your smartphone and inserting the phone into the headset.

Mixed reality hardware is still emerging and hasn't quite broken into the mainstream consumer market, most likely due to the price. The consumer releases of the Microsoft HoloLens and Magic Leap One retail for over \$2000 USD, which is 3 to 4 times the cost of the PlayStation VR and HTC Vive VR headsets. However, mixed reality applications sometimes require exponentially more processing power and thus require more powerful hardware.

For example, the Microsoft HoloLens includes a built-in microphone array, binaural sound capabilities, a built-in camera for recording, a depth sensor, head-tracking cameras, and an inertial measurement unit which helps track your head movement. On top of the traditional CPU and GPU, Microsoft also created a Holographic Processing Unit to help track where the user is looking and understand command gestures.

Applications of AR Systems

Technology is ever-changing and ever-growing. One of the newest developing technologies is augmented reality (AR), which can be applied to many different disciplines such as education, medicine, entertainment, military, etc. Let us see some of its applications.

AR In education

Augmented reality allows flexibility in use that is attractive to education. AR technology can be utilized through a variety of mediums including desktops, mobile devices, and smartphones. The technology is portable and adaptable to a variety of scenarios. AR can be used to enhance content and instruction within the traditional classroom, supplement instruction in the special education classroom, extend content into the world outside the classroom, and be combined with other technologies to enrich their individual applications. More importantly, the following reasons for using augmented reality in education:

Affordable learning materials - posters, digital illustrations, physical models, prototypes are very expensive and it may not be impossible for schools to find enough money to purchase all the supplementary materials they would like to. Using AR technology allows for avoiding investments in physical materials. Besides, students can get access to learning materials and interact with them anytime.

Interactive lessons - when AR technology is used in classrooms, students can view models on their own smartphones and get a better idea of the concepts they are studying. That increases engagements and reinforces the learning

Higher engagement - when teachers integrate augmented reality into their lectures, they attract the attention of their students and make lessons more effective. When students are interested, it is much easier to make them work more productively.

Higher retention - using the AR app, students can get access to augmented models that represent any real objects from a famous monument or work of art to a molecule. Besides, students can get access to a website with specific information. When learning with AR technology, students use different senses and retain more knowledge for a long time.

Boost intellectual curiosity - augmented reality makes students more excited about learning certain subjects. Modern students were born in a digital era so they will always be excited with innovative technologies that can help them learn new ideas and develop their critical thinking skills.

When using AR technology in the classroom, teachers can create an authentic learning environment for students with different learning styles.

AR In Medicine

Augmented reality is one of the current technologies changing all industries, including healthcare and medical education.

The purpose of any invention and technology is to simplify our life. Augmented reality has the potential to play a big role in improving the healthcare industry. Only a few years since the first implementations of augmented reality in medicine, it has already filled an important place in doctors' and nurses' routine, as well as patients' lives.

This new technology is enhancing medicine and healthcare towards more safety and efficiency. For now, augmented reality has already made significant changes in the following medical areas:

- surgery (minimally invasive surgery);
- education of future doctors;
- diagnostics;
- AR tools may also aid to detect the signs of depression and other mental illnesses by reading from facial expressions, voice tones, and physical gestures.

In medicine, AR has the following applications:

Describing symptoms - It impacts on finding out the accurate diagnosis. The first steps to find the solutions are already made. To increase patients' education, medical app AyeDecide is using augmented reality to show the simulation of the vision, harmed by the different diseases. It helps patients to understand their conditions and describe correctly their symptoms.

Nursing care - About 40% of the first intravenous injections fail, and this ratio is even higher in the case of children and elderly patients. The AccuVein uses augmented reality to cope with this negative statistic. A handheld scanner projects on the skin and shows the patients' veins. It increases the successful finding of the vein from the first try in 3,5 times. That is why this invention got the greatest recognition among the general public and medical staff.

Surgery - In no sphere augmented reality does not have such practical application as in the medicine, especially in surgery, where it literally helps to save lives. Three-dimensional reconstructions of organs or tumors will help surgeons become more efficient at surgery operations. For example, spinal surgery, as usually, is a long and difficult process. But with the use of AR, it can reduce the time, cut the risks and improve the results. The Israeli startup Augmedics had created an augmented reality headset for spine surgeons. This technology overlays a 3D model of the CT-scan on the spine, so, the surgeon gets some kind of "X-ray" vision.

Ultrasounds - Some time ago ultrasound made a small revolution in medicine. Today, it has another one chance to make the same with using augmented reality. Already a few AR software companies developed handy ultrasound scanner, which with the help of smart glasses works as a traditional one.

It is hard to overestimate the usefulness of this technology. Especially when we talk about using it in the developing countries, in military medicine (on the battlefields) and even in the ambulance.

Diabetes management - In 2017, the number of people struggle with diabetes reached up to 425 million adults worldwide. And the amount of diagnosed people is increasing every year. In 2014, Google revealed the plans for creating a smart contact lens (Google Contact Lens), in which the main function will be to measure the glucose levels in the tears. It will help people with this disease to live the life they used to, without permanent worries about sugar level in the blood.

Navigation - The using AR in navigation apps has already become a "traditional" way. By pointing your phone to the city landscape, you get the information about nearby objects of your interest (museums, hotels, shops, metro stations, etc.). The same way AR can be useful to provide information about the nearest hospitals. For example, the EHBO app helps to find the nearest to you AEDs (automated external defibrillators).

Generally, AR provides the following benefits to patients and healthcare workers:

- Reduce the risks associated with minimally invasive surgery.
- Better informed decisions about the right treatment and illness prevention.
- Make procedures more tolerable.
- Better aftercare
- Medical training and education.
- Assistance in medical procedures and routine tasks.

AR In Entertainment

Augmented reality can be used in various “entertainment” industries as entertainment covers quite a number of different industries – music, movies, live shows, games – and all of them can benefit from using augmented reality.

AR in games - the AR games were praised for increasing physical activity in people – you actually have to move around to find your target, for example, Pokémon. At the same time, there are complaints that players could cause various incidents and accidents being too engrossed in the game. In any case, Pokémon GO has rightfully earned its popularity and opened the world of AR games to us.

AR in music - music is not only about listening to favorite tracks and putting together playlists. When we like a piece, we often want to find out more about its background: the performers’ bios, the lyrics of the song, the making of the recording or the music video. Augmented reality can do all that and much more providing complete information on the track or its performer. Augmented reality can enhance live performances by illustrating the story told by a track or displaying the way it was created by the band.

AR on TV - this may seem a bit far-fetched, as television already shows a virtual world, thus adding augmented reality will raise it to the second power. However, some experiments of fusing augmented reality on TV are already being made with the promise of future enhancements.

One way of integrating augmented reality in television is adding supplementary information to what is going on the TV screen – such as match scores, betting options, and the like.

AR in eSports - recently, the industry of eSports has been gaining popularity in all parts of the globe. Competitive online gaming has become as fascinating as real sports, and the technology is following it closely with new solutions and unusual implementations. Augmented reality turns eSports shows into interactive experiences allowing the watchers to become participants.

AR in the theater - in this sector, augmented reality can serve not only for entertainment purposes but also for the purposes of accessibility. The possibility to overlay virtual objects over the real environment can be used, for example, for subtitling in various theater shows. Now, many theaters use LED displays either to provide subtitles for translation or to assist hearing-impaired visitors. However, LED equipment is not available in each theater and even when it is, it can distract the viewers from the show.

Chapter 6: Ethics and Professionalism of Emerging Technologies

Technology and ethics

Professional responsibilities

Digital privacy, Information privacy, Communication Privacy

Treats and challenges

Introduction

Emerging technologies like big data, artificial intelligence, internet of things and augmented reality were discussed. After having a discussion on all of the above emerging technologies, it is time to study their connection with our ethical values as well as social values. In this chapter, the connection of emerging technologies with professional ethics, privacy, accountability, trust was discussed. Finally, the threats and challenges of emerging technologies will be explained.

Technology and ethics

The Internet boom has provided many benefits for society, allowing the creation of new tools and new ways for people to interact. As with many technological advances, however, the Internet has not been without negative aspects. For example, it has created new concerns about privacy, and it has been hampered by spam and viruses. Moreover, even as it serves as a medium for communication across the globe, it threatens to cut off people who lack access to it.

Technology can serve to promote or restrict human rights. The Information Society should foster the use of emerging technologies in such a way as to maximize the benefits that they provide while minimizing the harms. In many cases, this promotion may be less a matter of technological control than of oversight: establishing the proper legal or regulatory system to ensure that technology capable of abuse is not in fact abused and that the benefits of technology are shared among all.

Ethics is particularly important for the accountancy profession, with a code for professional ethics based on five basic principles – integrity, objectivity, competence and due care, confidentiality, and professional behavior. However, the emergence of new technologies raises some new challenges for the profession to address.

Professional responsibilities

1. Strive to achieve high quality in both the processes and products of professional work.
2. Maintain high standards of professional competence, conduct, and ethical practice.
3. Know and respect existing rules pertaining to professional work.
4. Accept and provide appropriate professional review.
5. Give comprehensive and thorough evaluations of computer systems and their impacts, including analysis of possible risks.
6. Perform work only in areas of competence.
7. Foster public awareness and understanding of computing, related technologies, and their consequences.

8. Access computing and communication resources only when authorized or when compelled by the public good.
9. Design and implement systems that are robustly and usably secure.

Professional leadership principles

1. Ensure that the public good is the central concern during all professional computing work.
2. Articulate, encourage acceptance of and evaluate fulfillment of social responsibilities by members of the organization or group.
3. Manage personnel and resources to enhance the quality of working life.
4. Articulate, apply, and support policies and processes that reflect the principles of the Code.
5. Create opportunities for members of the organization or group to grow as professionals.
6. Use care when modifying or retiring systems. Interface changes, the removal of features, and even software updates have an impact on the productivity of users and the quality of their work.
7. Recognize and take special care of systems that become integrated into the infrastructure of society.

Digital privacy

Digital Privacy is the protection of personally identifiable or business identifiable information that is collected from respondents through information collection activities or from other sources.

It is a collective definition that encompasses three sub-related categories; information privacy, communication privacy, and individual privacy. It is often used in contexts that promote advocacy on behalf of individual and consumer privacy rights in digital spheres, and is typically used in opposition to the business practices of many e-marketers/ businesses/ companies to collect and use such information and data.

Some digital privacy principles

Data Minimization: collect the minimal amount of information necessary from individuals and businesses consistent with the Department's mission and legal requirements.

Transparency: Notice covering the purpose of the collection and use of identifiable information will be provided in a clear manner. Information collected will not be used for any other purpose unless authorized or mandated by law.

Accuracy: Information collected will be maintained in a sufficiently accurate, timely, and complete manner to ensure that the interests of the individuals and businesses are protected.

Security: Adequate physical and IT security measures will be implemented to ensure that the collection, use, and maintenance of identifiable information are properly safeguarded and the information is promptly destroyed in accordance with approved records control schedules.

Information Privacy

In the context of digital privacy, information privacy is the notion that individuals should have the freedom, or right, to determine how their digital information, mainly that pertaining to personally identifiable information, is collected and used.

Every country has various laws that dictate how information may be collected and used by companies. Some of those laws are written to give agency to the preferences of individuals/consumers in how their data is used. In other places, like in the United States, privacy law is argued by some to be less developed in this regard. For example, some legislation, or lack of, allows companies to self-regulate their collection and dissemination practices of consumer information.

Communication Privacy

In the context of digital privacy, communication privacy is the notion that individuals should have the freedom, or right, to communicate information digitally with the expectation that their communications are secure; meaning that messages and communications will only be accessible to the sender's original intended recipient. However, communications can be intercepted or delivered to other recipients without the sender's knowledge, in a multitude of ways.

Communications can be intercepted directly through various hacking methods; this is expanded upon further below. Communications can also be delivered to recipients unknowingly to the sender due to false assumptions made regarding the platform or medium which was used to send information. An example of this is a failure to read a company's privacy policy regarding communications on their platform could lead one to assume their communication is protected when it is in fact not. Additionally, companies frequently have been known to lack transparency in how they use information, this can be both intentional and unintentional. Discussion of communication privacy necessarily requires consideration of technological methods of protecting information/communication in digital mediums, the effectiveness, and ineffectiveness of such methods/systems, and the development/advancement of new and current technologies.

Individual Privacy

In the context of digital privacy, individual privacy is the notion that individuals have a right to exist freely on the internet, in that they can choose what types of information they are exposed to, and more importantly that unwanted information should not interrupt them.

An example of a digital breach of individual privacy would be an internet user receiving unwanted ads and emails/spam, or a computer virus that forces the user to take actions they otherwise wouldn't. In such cases the individual, during that moment, doesn't exist digitally without interruption from unwanted information; thus, their individual privacy has been infringed or broke upon.

Treats and challenges

Ethical and regulatory challenges

With Technology moving at a fast pace it is always been a challenge for Security. As security professionals, we need to keep pace with ever-changing technology and be aware of the AI, IoT, Big Data, Machine Learning, etc. It is no more Guards, guns & gates it is more than that & we need to play a major role for a security professional to support business or rather we should be able to understand the language of business and talk to the leaders in their language. With Growing needs Cyber & Data Security is getting prominence that requires security practitioners to focus on the business need for securing data, understanding security and risk from a business perspective by extensively interacting with the business community in understanding their requirements or what they want.

Emerging technologies are already impacting how we live and work. They're also changing how we approach, plan, and integrate security operations. Certainly, we are living in an era where innovation, agility, and imagination are all essential in order to keep pace with the exponential technological transformation taking place. For security, both physical and cyber, the equation is the same catalyzing many new potential applications for emerging technologies.

Emerging technologies are making an impact include:

1. Counter-terrorism and law enforcement informatics via predictive analytics and artificial intelligence.
2. Real-time horizon scanning and data mining for threats and information sharing.
3. Automated cybersecurity and information assurance.
4. Enhanced Surveillance (chemical and bio-detection sensors, cameras, drones, facial recognition, license plate readers).
5. Simulation and augmented reality technologies for training and modeling.
6. Safety and security equipment (including bullet and bomb proof) made with lighter and stronger materials.
7. Advanced forensics enabled by enhanced computing capabilities (including future quantum computing).
8. Situational awareness capabilities via GPS for disaster response and crisis response scenarios.
9. Biometrics: assured identity security screening solutions by bio-signature: (every aspect of user physiology can be used as a bio-signature. Measure unique heart/pulse rates, electrocardiogram sensor, blood oximetry, skin temperature).
10. Robotic Policing (already happening in Dubai!).

Challenges in using Artificial Intelligence

AI is only as good as the data it is exposed to, which is where certain challenges may present themselves. How a business teaches and develops its AI will be the major factor in its usefulness. Humans could be the weak link here, as people are unlikely to want to input masses of data into a system.

Another dilemma that comes along with AI is its potential to replace human workers. As machines become more “intelligent” they could begin to replace experts in higher-level jobs. Alternatively, AI also has the potential to take the burden of laborious and time-consuming tasks from these people, freeing up their time and brainpower for other things e.g. doctors using diagnostic AI to help them diagnose patients will analyze the data presented by the AI and make the ultimate decision. Managing the challenges posed by AI will require careful planning to ensure that the full benefits are realized and risks are mitigated.

Challenges in using Robotics in manufacturing

With automation and robotics moving from production lines out into other areas of work and business, the potential for humans losing jobs is great here too. As automation technologies become more advanced, there will be a greater capability for automation to take over more and more complex jobs.

As robots learn to teach each other and themselves, there is the potential for much greater productivity but this also raises ethical and cybersecurity concerns.

Challenges in using the Internet of Things

As more and more connected devices (such as smart watches and fitness trackers) join the Internet of Things (IoT) the amount of data being generated is increasing. Companies will have to plan carefully how this will affect the customer-facing application and how to best utilize the masses of data being produced. There are also severe security implications of mass connectivity that need to be addressed.

Challenges in Big Data

Almost all the technologies mentioned above have some relation to Big Data. The huge amount of data being generated on a daily basis has the potential to provide businesses with better insight into their customers as well as their own business operations.

Although data can be incredibly useful for spotting trends and analyzing impacts, surfacing all this data to humans in a way that they can understand can be challenging. AI will play a role here.

Treats

New and emerging technologies pose significant opportunities for businesses if they utilize them well and understand their true value early on. They also pose risks and questions not only to business but to society as a whole. Planning for how to deal with these emerging technologies and where value can be derived while assessing potential risks before they become a fully-fledged reality is essential for businesses that want to thrive in the world of AI, Big Data and IoT.

Some risks of emerging technology are

Driverless car: while a compelling option for future fleet cars, companies could crash and burn from claims related to bodily injury and property damage.

Wearables: Google glass, Fitbit and other wearables can expose companies to the invasion of privacy claims that may not be covered by general liability or personal injury claims that weren't foreseen.

Drones: Turbulence is in the offing for manufacturers and organizations that fail to protect themselves for property damage and bodily injury, as well as errors and omissions.

Internet of things: The proliferation of sensors and cross-platform integration creates potential exposure from privacy invasion, bodily injury and property damage that may connect an organization to huge liabilities.

Chapter 7: Other Emerging Technologies

Cybersecurity (Cybersecurity measures, Types of Cybersecurity threats, Benefits of cybersecurity), Cybersecurity vendors.

Cybersecurity

It is the protection of computer systems from the theft of or damage to their hardware, software, or electronic data, as well as from the disruption or misdirection of the services they provide.

The field is becoming more important due to increased reliance on computer systems, the Internet and wireless network standards such as Bluetooth and Wi-Fi, and due to the growth of smart devices, including smart-phones, televisions, and the various devices that constitute the Internet of Things. Due to its complexity, both in terms of politics and technology, Cybersecurity is also one of the major challenges in the contemporary world.

Cybersecurity is often confused with information security but it focuses on protecting computer systems from unauthorized access or being otherwise damaged or made inaccessible. Information security is a broader category that looks to protect all information assets, whether in hard copy or in digital form.

The term cybercrime is used to describe an unlawful activity in which computer or computing devices such as smartphones, tablets, Personal Digital Assistants (PDAs), etc. which are stand-alone or a part of a network are used as a tool or/and target of criminal activity. It is often committed by the people of destructive and criminal mindset either for revenge, greed or adventure. Combating this is a multi-disciplinary affair that spans hardware and software through to policy and people all of it aimed at both preventing cybercrimes occurring in the first place, and minimizing its impact when it does.

CyberSecurity measures

The following are some security measures to be taken to prevent cybercrimes.

Staff awareness training: Human error is the leading cause of data breaches, so it need to equip staff with the knowledge to deal with the threats they face. Training courses will show staff how security threats affect them and help them apply best-practice advice to real-world situations.

Application security: Web application vulnerabilities are a common point of intrusion for cybercriminals. As applications play an increasingly critical role in business, it is vital to focus on web application security.

Network security: Network security is the process of protecting the usability and integrity of the network and data. This is achieved by conducting a network penetration test, which scans the network for vulnerabilities and security issues.

Leadership commitment: Leadership commitment is the key to cyber resilience. Without it, it is very difficult to establish or enforce effective processes. Top management must be prepared to invest in appropriate cybersecurity resources, such as awareness training.

Password management: Almost half of the UK population uses ‘password’, ‘123456’ or ‘qwerty’ as their password. User should implement a password management policy that provides guidance to ensure staff create strong passwords and keep them secure.

Types of CyberSecurity threats

Ransomware: It is a type of malicious software. It is designed to extort money by blocking access to files or the computer system until the ransom is paid. Paying the ransom does not guarantee that the files will be recovered or the system restored.

Malware: it is a type of software designed to gain unauthorized access or to cause damage to a computer.

Social engineering: it is a tactic that adversaries use to trick into revealing sensitive information. They can solicit a monetary payment or gain access to the confidential data. Social engineering can be combined with any of the threats listed above to make more likely to click on links, download malware, or trust a malicious source.

Phishing: it is the practice of sending fraudulent emails that resemble emails from reputable sources. The aim is to steal sensitive data like credit card numbers and login information. It's the most common type of cyber-attack. It can help protect through education or a technology solution that filters malicious emails.

Benefits of CyberSecurity

Benefits of utilizing Cybersecurity include:

- Business protection against malware, ransomware, phishing, and social engineering, Protection for data and networks.
- Prevention of unauthorized users.
- Improves recovery time after a breach.
- Protection for end-users.
- Improved confidence in the product for both developers and customers.

CyberSecurity vendors

Vendors in Cybersecurity fields will typically use endpoint, network and advanced threat protection security as well as data loss prevention. Three commonly known cybersecurity vendors include Cisco, McAfee, and Trend Micro.

Asimo

Asimo is one of the world's most advanced humanoid robots, able to learn independently, walk on two legs and climb stairs. For a robot, two-legged ambulation in a real-world environment is a complex AI feat in its own right.

Honda Motor Corporation's **Asimo**, with its humanoid appearance and ability to walk and climb stairs, has been dubbed the world's most advanced robot.

ASIMO is a humanoid robot created by Honda in 2000. Since then it has been continually developed and has become one of the world's most advanced social robots.

Perhaps the **most** recognizable face of humanoids is that of Sophia, a social humanoid developed by Hong Kong based Hanson Robotics. In 2020, the AI-powered four-year-old **robot** is going to continue her role **as a robotic** ambassador, helping to advance research into robotics and **human-robot** interactions.

World's smartest **robot Sophia** draws **Holly** and Phillip's portraits. It's time for **Holly** and Phil to **meet Sophia**, one of the most intelligent robots in the world. Using **artificial intelligence**, **Sophia** can communicate with people and even use facial expressions to convey emotions - looking eerily human as she does so.

Google Assistant is the **smartest AI** assistant. Microsoft's Cortana is surprisingly good, coming in second. Alexa is learning faster than any other assistant.