THE ROLE OF INTELLIGENCE IN IOT NETWORKS

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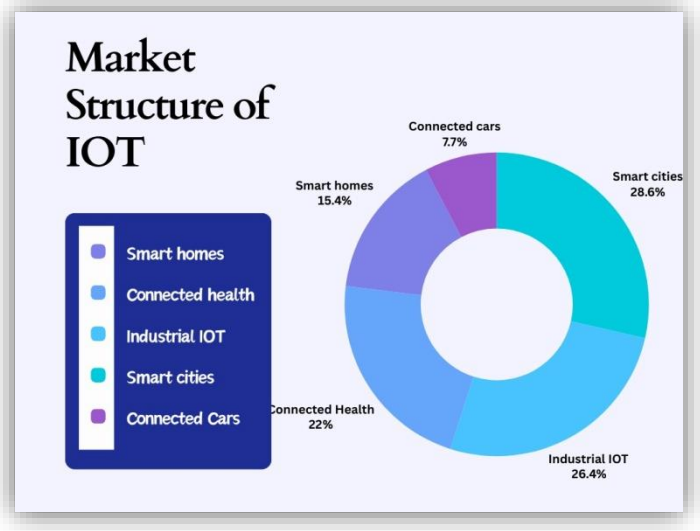
ABSTRACT
The IoT evolved from the merging of progress in wireless communication, sensor tech, and data analytics. This abstract covers the evolution, current state, and future of IoT technology. As these technologies have matured, IoT has spread across many sectors. These include manufacturing, healthcare, agriculture, transportation, smart cities, and consumer electronics. The Internet of Things (IoT) is a big change. It changes how devices, objects, and systems interact. They create vast networks of connected devices. These devices gather, exchange, and analyze data in real-time. Also, 5G networks will speed up IoT growth. They will do this by offering faster speeds, lower latency, and better connectivity. This meeting is set to unlock new automation chances. It will enable predictive analytics, autonomous systems, and personalized experiences. It will revolutionize industries and societies profoundly. Looking ahead, IoT has promise for more integration with new tech. These techs include artificial intelligence, edge computing, blockchain, and quantum computing. IoT devices have sensors and actuators. They collect data from the physical world and send it to cloud platforms for processing and analysis.

INTRODUCTION
Computer science is a branch of engineering. It focuses on studying computers and their systems. It covers the study of computation. This includes algorithms and data structures. It also covers programming languages, software engineering, and computing theory. This field always changes. Innovation and technology drive it. It plays a key role in shaping the modern world. CSE IoT combines CSE with IoT. It adds IoT to traditional CSE. IoT refers to connected devices. They have sensors, software, and connectivity for data exchange. The Internet of Things has quickly changed the 21st century. It has improved decision-making and brought new consumer services, like pay-as-you-use models.



The Internet of Things (IoT) is the network of physical objects, or "things." They have sensors, software, and other tech to connect and share data with other devices and systems over the Internet. The Internet of Things encompasses electronics, communication, and computer science engineering. People called "Internet of Things" a misnomer. This is because devices don't need the public internet. They just need a network and to have their own addresses. The field has evolved with the merging of many technologies. These include ubiquitous computing, cheap sensors, and powerful embedded systems. They also include machine learning. Older fields, such as embedded systems, wireless sensor networks, and control systems, now connect to the Internet of Things. They do so alone and together. These fields also include automation, such as home and building automation. Peter T. Lewis first introduced the concept of IoT in 1985. He defined it as the fusion of people, processes, and tech with linked devices and sensors. Sensors collect live data from inside and outside. They come from things ranging from mobile phones to microwave ovens. Actuators, in turn, respond to data or commands, enabling automation and remote control of physical devices. The Internet of Things is an emerging topic of technical, social, and economic importance.

REVIEW OF LITERATURE

The term "Internet of Things" is new. But, the idea of connecting computers and networks to check and manage devices has a long history. It spans decades. The idea of the Internet of Things (IoT) comes from early talks about networked devices. It also comes from talks about machine-to-machine communication.

Md Eshrat E. Alahi et al (2023) As the worldwide populace develops, and urbanization turns out to be more predominant, urban areas frequently battle to give advantageous, secure, and economical ways of life because of the absence of vital brilliant advancements. Luckily, the Web of Things (IoT) has arisen as an answer for this test by interfacing actual items utilizing hardware, sensors, programming, and correspondence organizations. This has changed shrewd city frameworks, presenting different advancements that upgrade manageability, efficiency, and solace for metropolitan occupants. By utilizing Man-made brainpower (simulated intelligence) to examine the huge measure of IoT information accessible, new open doors are arising to plan and oversee modern savvy urban communities.

Kah Phooi Seng et al (2022) The advances and assembly in sensor, data handling, and correspondence innovations have molded the Web of Things of today. The fast increment of information and administration necessities brings new difficulties for Web of Thing. Arising advances and shrewd methods can assume a convincing part in provoking the improvement of clever models and administrations in Web of Things to shape the man-made reasoning Web of Things. In this article, we give a presentation and survey ongoing advancements of computerized reasoning Web of Things, the different man-made brainpower Web of Things computational systems and feature the difficulties and open doors for powerful arrangement of computerized reasoning Web of Things innovation to resolve complex issues for different applications.

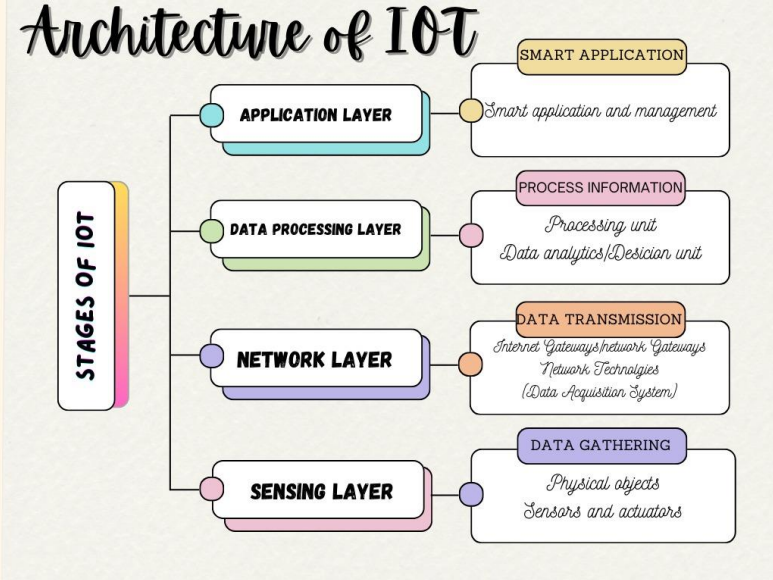
N. Javaid, Arshad Sher et al (2018) The prerequisite of high information rates, low idleness, effective utilization of range, and concurrence of various organization advancements are significant contemplations in Web of Things (IoT)- based fifth era (5G) networks. To accomplish the above necessities, the consolidation of man-made consciousness (simulated intelligence) is expected to go with effective choices in light of the gigantic information

produced by the enormous number of IoT gadgets. Simulated intelligence techniques investigate the information to extricate examples and get a handle on the information to recommend activity to the end gadgets.

What is IoT or the Internet of Things? –History & Evolution of IoT

The Internet of Things (IoT) is the network of physical objects or "things". They have electronics, software, sensors, and connectivity. These enable objects to exchange data with the maker, operator, and/or other connected devices. Today, common IoT devices include smart watches, home appliances, and vehicles. One can trace back the origins and evolution of IoT to the 1980s. At that time, we added barcodes and RFID tags. They used them for automated tracking of goods in manufacturing and supply chains. In the 1990s, as internet use increased, more objects got connected. Kevin Ashton coined the term "Internet of Things" in 1999 while working for Procter & Gamble to connect food supply chains digitally. He saw a future where the Internet extends into the real world and embraces everyday objects. Over the next decade, RFID, embedded systems, and web services advanced. They enabled more connections between physical objects via the internet. By 2010, machine-to-machine communication had grown. The number of IoT devices then exceeded the global population.

METHODOLOGY



Application layer:

The application layer processes data. It analyzes and acts on data to find insights. It enables many IoT applications and services. It includes parts like IoT platforms and cloud services. It also has edge computing resources, analytics engines, and specific software. This layer enables many functions. These include real-time monitoring, predictive maintenance, remote control, automation, and optimization. They work across domains like smart homes, healthcare, transportation, agriculture, and industrial IoT.

Data processing layer:

The data processing layer is part of IoT architecture. It collects and analyzes data from IoT devices. It includes software and hardware. This layer receives raw data from devices. It processes the data and makes it available for analysis or action. The data layer has many technologies and tools. These include data systems, analytics platforms, and machine learning algorithms. Users use these tools to extract meaningful insights from the data and make

decisions based on that data. **Example** of a technology used in the data processing layer is a data lake, which is a centralized repository for storing raw data from IoT devices.

Network Layer:

The network layer helps devices in the perception layer communicate. It does this with the higher-level layers. It includes many networking technologies. These include Wi-Fi, Bluetooth, Zigbee, RFID, cellular networks, and LoRaWAN. This layer ensures reliable transmission of data. It also ensures connectivity between the devices and the IoT platform.

Sensing layer:

The sensing layer is the first layer of the IoT architecture. It collects data from different sources. This layer has sensors and actuators. They put them in the environment to gather data. The data is about temperature, humidity, light, sound, and other factors. They connect to the network layer through wired or wireless protocols.

INTERNAL WORKING OF IoT

We have organized the modules in our architecture into layers . Two lower layers handle discovery activities while the two upper layers handle search activities. Storage modules for resource collections and indexes link two sets of layers. The measures protect the whole system. They cover security, privacy, and trust. They organize themselves into a vertical layer. To be specific, the Discovery Layer is an interface to Web resources. These resources include sensor streams, representations, functionalities, websites, and Web services. The Index Layer stores and indexes resources with its Collection Manager and Indexer modules. This layer also ranks the resources. The Search Layer carries out the query resolution process. The Query Processor module transforms raw user queries into the form processable by the system. The Q.D. Ranker scores found query resources. They are about the user query. It uses the recorded links between resources to find their matching result resources. The Ranking Aggregator module handles combining different Q.D and Q.I ranking results into a final score for each resource. Finally, the Result Processor extracts info from matching resources. It also aggregates it and makes search results. The User Interface (UI) layer interfaces WoTSE with users. It provides a Query Interface to get queries and a Result Interface to return search results.

DISCUSSION

Technologies

The Internet of Things was initially inspired by members of the RFID community. The key IoT technologies are RFID, sensor tech, nanotech, and embedded intelligence tech. Among them, RFID is the foundation and networking core of the construction of the Internet of Things.

Radio Frequency Identification (RFID):

Radio Frequency Identification (RFID) is a system. It transmits the identity of an object or person wirelessly using radio waves. It does this in the form of a serial number. In 1948, Britain first used an RFID device to Identify Friends or foes during the 2nd World War.

Electronic Product Code (EPC):

An Electronic Product Code (EPC) is a 64-bit or 98-bit code. An RFID tag stores it. The goal is to enhance the EPC barcode system. The EPC code can store info about the type of EPC and the product's unique serial number, specs, and maker. The Auto-ID Centre at MIT made the code in 1999.

Barcode:

Barcode is just a different way of encoding numbers and letters by using a combination of bars and spaces of varying width. Behind Bars serves its original intent to be descriptive but is not critical.

Wireless Fidelity (Wi-Fi):

Wi-Fi is a networking technology. It lets computers and devices communicate over a wireless signal. They have named Vic Hayes as the father of Wireless Fidelity. NCR Corporation in Nieuwege, Netherlands, invented the precursor to Wi-Fi in 1991. The company introduced the first wireless products to the market under the name WaveLAN, offering speeds of 1 Mbps to 2 Mbps.

Bluetooth:

Bluetooth is a cheap, short-range radio technology. It removes the need for special cables between devices like notebook PCs, handheld PCs, PDAs, cameras, and printers. It works at a range of 10 - 100 meters. And generally communicate at less than 1 Mbps and Bluetooth uses specification of IEEE 802.15.1 standard. At first in 1994 Ericson Mobile Communication company started a project named "Bluetooth". Users use it to create Personal Area Networks (PAN).

ZigBee:

ZigBee is one of the protocols developed for enhancing the features of wireless sensor networks. The ZigBee Alliance, founded in the year 2001, creates ZigBee technology. ZigBee has low cost and low data rate. It also has a relatively short transmission range. But, it has scalability, reliability, and a flexible protocol design.

Near Filed Communication (NFC):

NFC is a set of short-range wireless technology at 13.56 MHz. It typically works at a distance of 4 cm. NFC technology makes life easier for consumers. It makes it simpler to make transactions, share digital content, and connect electronic devices with a touch.

Actuators:

Actuators convert energy into motion. They use this motion to drive mechanical systems. It takes hydraulic fluid, electric current, or some other source of power. Actuators can create a linear motion, rotary motion, or oscillatory motion. Cover short distances, typically up to 30 feet, and generally communicate at less than 1 Mbps.

Wireless Sensor Networks (WSN):

A WSN is a wireless network. It consists of distributed autonomous devices using sensors. They cooperate to track physical or environmental conditions. These include temperature, sound, vibration, pressure, motion, or pollutants. They watch these conditions at different locations. Hundreds or thousands of motes form the locations. The motes communicate with each other and pass data from one to another. A wireless sensor network is an important element in the IoT paradigm.

Artificial Intelligence (AI):

Artificial Intelligence refers to electronic environments. They are sensitive and responsive to the presence of people. In ambient intelligence, devices work together to help people with their everyday activities. They do this in an easy, natural way using hidden information in the network-connected devices.

COMPARISON BETWEEN IOT,INTERNET,WSN

CHARACTERISTICS	IOT	INTERNET	WSN
COMM. PROTOCOL	Lightweight Comm. protocols.	(TCP/IP)	Lightweight Comm. protocols.
SCALE DEGREE OF AREA	Cover wide area	Cover wide area	Cover local area
NETWORK APPROACH	Determine backbone	Determine backbone	Self-organization
IDENTIFY OBJECTS	Must	Can not	Can
TYPE OF NODES	Active and passive	Active	Active
BEHAVIOUR	Dynamically	Fixed	Dynamically
NETWORKING TIME	Timing synchronization	Unlimited	Unlimited

CONCLUSION

The Internet of Things (IoT) has grown a lot globally over the past decade. It continues to expand quickly. Here are some key factors contributing to this growth:

Technological Advancements:

Hardware has gotten smaller. Wireless and sensors have improved. Data analytics have too. This progress has made it cheaper to deploy IoT across many industries.

Cost Reduction:

The cost of IoT sensors, devices, and connectivity is decreasing. This has made IoT more accessible to businesses of all sizes. It has allowed widespread adoption across industries.

Industry Adoption:

Many industries have embraced IoT. These include manufacturing, healthcare, agriculture, transportation, smart cities, and retail. They use IoT to improve operations, enhance customer experiences, and create new revenue.

Data Analytics and AI:

IoT makes lots of data. Advances in data analytics and AI let organizations get valuable insights from this data. This has led to better decisions and predictive abilities.

5G Connectivity:

5G networks will be faster, with lower delay and more capacity. They will speed up IoT adoption by enabling real-time communication and support for more devices.

Regulatory Support:

Governments and regulators see the benefits of IoT. They see them in areas like infrastructure, the environment, and safety. This has led to supportive policies and initiatives.

Consumer Adoption:

IoT devices are for smart homes, wearable tech, and connected appliances. They are becoming more popular among consumers. They are driving demand for IoT solutions and services.

Security Concerns:

As IoT adoption grows, so do concerns about data privacy and cybersecurity. We must put in place strong security measures and standards. They will address concerns and ensure the growth and adoption of IoT technologies.

Experts expect the IoT to continue growing. Organizations across industries see the value of connected devices and data. They use them to drive innovation, boost efficiency, and improve customer experiences.

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