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INTERNET OF THINGS (IOT) AND ITS APPLICATIONS

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ABSTRACT

Internet, a ground-breaking invention, is constantly evolving into new hardware and applications, making it impossible for anybody to avoid. The Internet of Things (IOT) offers a bright future for the internet where the sort of communication is machine-to-machine instead of the human-to-human or human-to-device we see today (M2M).

The Internet of Things (IOT) is a paradigm in which items that are equipped with sensors, actuators, and processors interact with one another in order to do useful tasks. We covered IOT and its architecture in this paper. Additionally, we went over the many IOT applications available to customers as well as its benefits and drawbacks.

INTRODUCTION

The network of physical objects, or "things," that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet is referred to as the Internet of Things (IOT). These gadgets include everything from common household items to high-tech industrial tools. Today, there are more than 7 billion connected IOT devices, and according to experts, there will be 10 billion by 2020 and 22 billion by 2025. Device partners are part of Oracle's network.[1]

Kevin Ashton, the executive director of the Auto-ID Center, is credited with coining the phrase "Internet of Things." Through the Auto-ID Centre in 2003, as well as in related market analytics and its publications, the Internet of Things first gained significant popularity [2].

When the idea of this type of communication first emerged, various businesses concentrated on it, tried to understand its significance, and started to pinpoint its function and related future aspects. Following this, these businesses began investing in the IOT sector at irregular but consistent intervals of time [3].

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1.1 DEFINITION OF IOT

The phrase "internet of things" (IOT) was first used in 1999, and since then it has evolved from a vague concept to a tangible reality. This can be attributed, among other development drivers, to the widespread usage of the Internet Protocol (IP), the rise of ubiquitous computing, and the ongoing advancement of data analytics. It is predicted that 20.4 billion gadgets will be connected to the IOT by 2020. The Internet of Things (IOT) continues to grow, yet despite this, it still retains some of its obscurity and is frequently discussed in abstract terms despite its obvious advantages. [4].

Another definition of the Internet of Things (IOT) is "An open and complete network of intelligent devices that have the capability to auto-organize, share information, data, and resources, reacting and acting in front of situations and changes in the environment"[5].

Current Internet of Things (IOT) research primarily focuses on how to make it possible for common objects to independently see, hear, and smell the physical environment and connect them so they may share their observations. In that regard, monitoring and decision-making can be transferred from the human to the mechanical sides of an operation.

In general, we can therefore state that IOT enables people and things to be connected Anytime, Anywhere, with Anything and Anyone using Any Network and Any Service, as shown in Fig. 1.

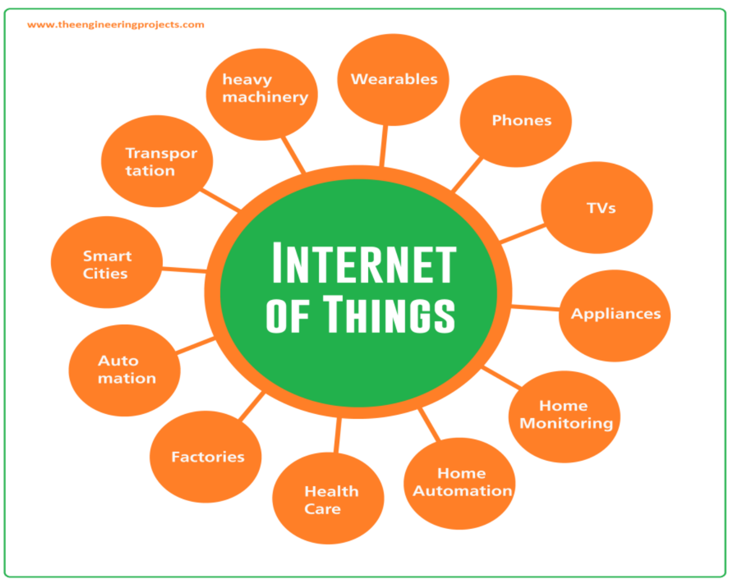

FIG-1:DEFINATION OF IOT

2. THE IOT ARCHITECTURE

The edge side and cloud side of this architecture are depicted in Fig -2.

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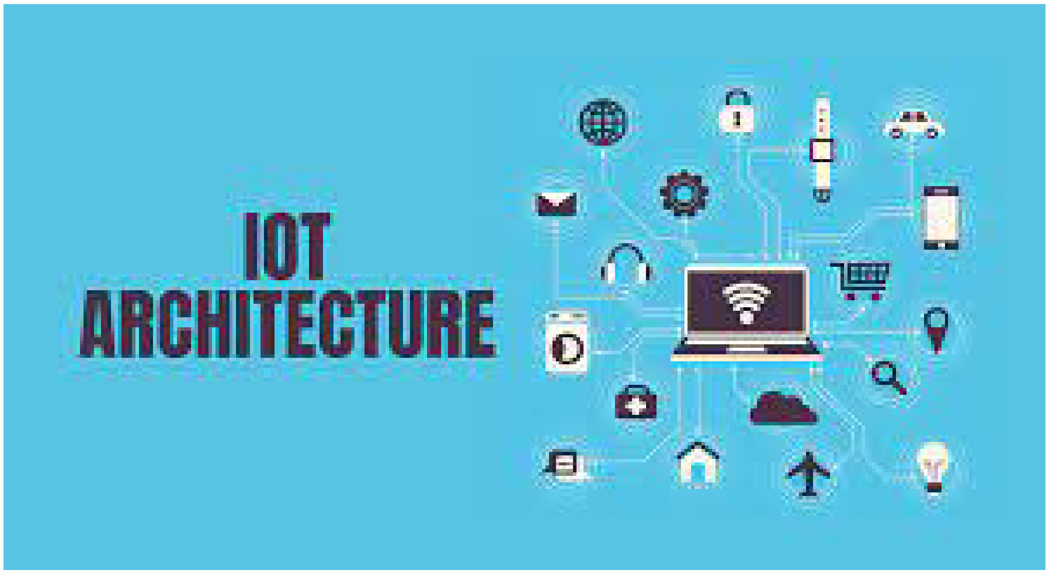

Fig 2 - IOT ARCITECTURE

2.1 THE EDGE THINGS

There may be sensors, actuators, devices, and a gateway, which is a crucial component, on the edge side. This gateway's crucial job is to regulate interactions between the items and cloud services while also establishing communications between them. The term edge originates from [6] Edge Computing, where data is processed as close to the data's source as possible at the network's edge. The edge can be an energy grid, a manufacturing floor, a smart city, a smart building, an oil rig, a wind farm, a dairy farm, a jet, a train, or a car. Turning on the data processing and decision-making that is closest to real-time is the essential component that gives edge processing its significance.

2.2 FIELD PROTOCOLS

Since there are sensors, actuators, and devices at the edge, they must communicate with Smart Gateway as well as one another. The most widely used field protocols for this kind of communication are:

BLUETOOTH:It is a crucial protocol for Internet of Things applications. Its power consumption has been greatly lowered through design. Standard: Core Specification for Bluetooth 4.2, Data Rates: 1Mbps (Smart/BLE), Range: 50-150m, and Frequency: 2.4GHz (ISM) [7].

ZIGBEE:It has a significant installed base of operation, much like Bluetooth, though perhaps historically more in industrial contexts. Other ZigBee profiles, like ZigBee PRO and ZigBee Remote Control (RF4CE), are based on the IEEE802.15.4 protocol, an industry-standard wireless networking technology that operates at 2.4GHz and targets applications that require relatively unusual information exchanges at low data rates over a constrained area and within a 100m range, like in a house or building [7].

WI-FI:Given the widespread use of Wi-Fi in LANs in homes, this type is frequently a standout selection for many developers. It can handle large amounts of data and offers quick data transfer [7].

NFC:Near Field Communication (NFC) is a technology that provides quick and secure two-way communication between electronic devices. It is particularly useful for smartphones and enables users to connect devices, access digital information, and make contactless payments. It essentially expands the functionality of contactless card technology and makes it possible for devices to communicate at a distance of less than 4 cm[7].

***2.3 IOT SMART GATEWAY*:**

IOT gateways enable communication from the Edge to the Cloud as one of their primary functions. It implies that it needs to comprehend field protocols and translate them into cloud protocols. Smart Gateways are equipped with features like routing, dataflow, data management, data monitoring, and data storage [8].

2.4 CLOUD PROTOCOLS:

The majority of Internet of Things (IOT) solutions, even those that operate primarily at the edge, require integration with cloud services or other IOT solutions built on the cloud. As stated below, a cloud protocol must be used for communication:

MQTT:IBM introduced Message Queue Telemetry Transport (MQTT) in 1999, and OASIS standardised it in 2013.

Embedded hardware frequently supports and uses MQTT, which is also widely used for machine-to-machine communications. It is intended to offer embedded connectivity between networks and communications on the one side and applications and middleware on the other [9].

AMQP:A protocol called AMQP, or Advanced Message Queuing Protocol, was created specifically for the finance sector. It supports a publish/subscribe architecture via TCP and has a similar design to MQTT. The distinction is that the broker is split into exchange and queues as its two primary parts. Receiving publisher messages and distributing them to queues based on predefined roles and conditions is the responsibility of the exchange. In essence, queues are representations of topics and subscribers who receive sensory input as it becomes available in the queue [9].

COAP:The IETF Constrained Resource Environment working group created the Constrained Application Protocol (COAP), another session layer protocol, to offer a lightweight Restful (HTTP) interface. The common interface between HTTP clients and servers is called Representational State Transfer (REST). REST, however, may result in significant overhead and power consumption for simple applications like IOT. A document transfer protocol is called COAP. Low-power sensors can use Restful services with COAP while still adhering to their power requirements. . Instead of the conventional TCP used in HTTP, it is constructed atop UDP and includes a simple way to ensure dependability. Request/Response and Messaging are the two fundamental sublayers of the COAP architecture. While the request/response sublayer is in charge of communication, the messaging sublayer is in charge of message reliability and duplication. In order to retrieve, create, update, and remove messages, COAP employs the same GET, PUT, PUSH, and DELETE message requests as HTTP [9].

HTTP:A "connectionless" protocol is HTTP. Devices do not keep a connection to Cloud IOT Core while using the HTTP bridge.

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Rather, they make requests and get answers. The Internet of Things will continue to use this protocol, which is the industry standard for online services. Although the overhead of this protocol is well known, we nevertheless utilise it occasionally when latency and bandwidth are not concerns [9].

3. USE OF IOT IN VARIOUS APPLICATIONS

The majority of applications used in daily life are already intelligent, but they lack the ability to communicate with one another and to

Communication and information sharing between people will result in a variety of creative applications.

[10]. Our quality of life would be improved by these new applications with some autonomous capabilities, all due to

to the IOT concept. We present a few IOT applications in this section, as seen in Fig. 3.

FIG-3: APPLICATIONS OF IOT

3.1 IOT FOR SMART HOME/BUILDINGA

Smart house isbecoming necessary in today's fast-paced world. Many household appliances can be connected to the internet for communication in a smart home. As shown in Fig. 4, the various household appliances, including the air conditioner, doors, windows, lighting, washing machine, and refrigerator, may all be manually operated in a smart home. IOT integration with wireless sensor networks can provide buildings with sophisticated energy management solutions. We can access energy information and control systems for buildings with the use of laptops or smart phones [11].

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FIG-4: SMART HOME

3.2 IOT FOR SMART FARMING

Using connected sensors, IOT-based smart farming systems can monitor things like light, temperature, humidity, rain prediction, and soil moisture in crop fields, as shown in Fig. 5. Irrigation system automation benefits from IOT as well. The advantages of smart farming include improved product quality and volume, increased control over production, monitoring of climate conditions, and crop management. Smart farming also increases business efficiency through process automation. It also offers lower production risks and better control over internal processes.

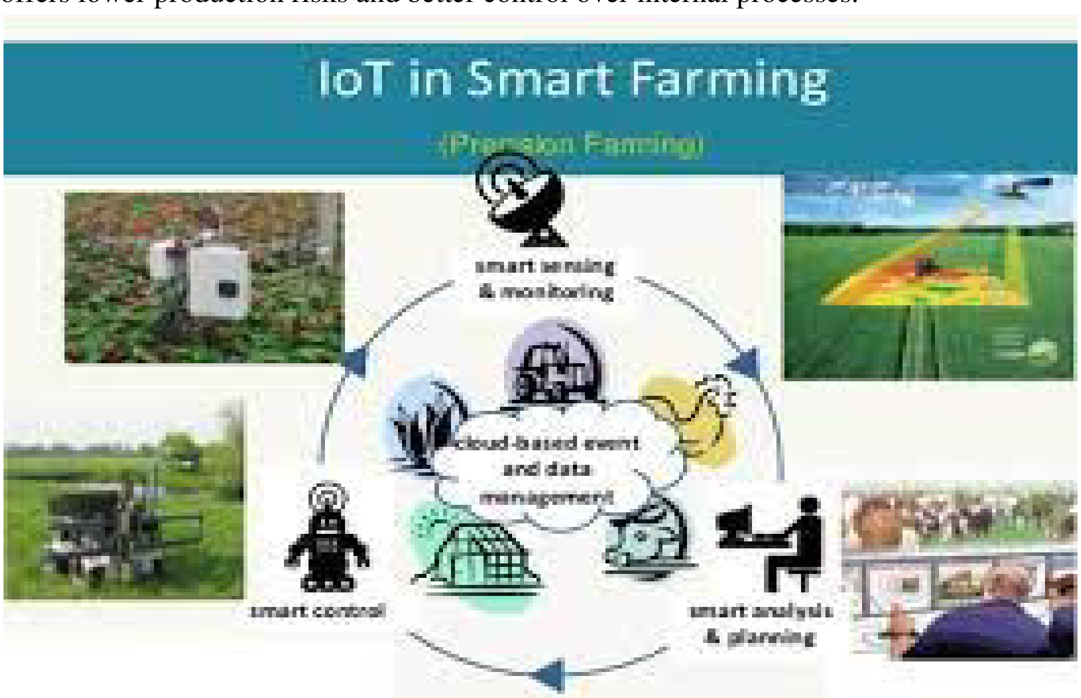

FIG-4: SMART FARMING

3.3 IOT FOR SMART HEALTH

Hospitalized patients need ongoing supervision, and IOT monitoring technology can be used to continuously check on their physiological health. For smart health, sensors are utilised to gather all available physiological data, which is then processed and stored via gateways and the cloud. The

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processed data is then wirelessly sent to caregivers for additional evaluation and analysis. [12] It substitutes a continuous automated flow of information for the process of having a medical professional visit the patient to check their vital signs. In this way, in addition to data collection and analysis as shown in Fig. 6, it simultaneously lowers the cost of care while raising the quality of care through ongoing attention.

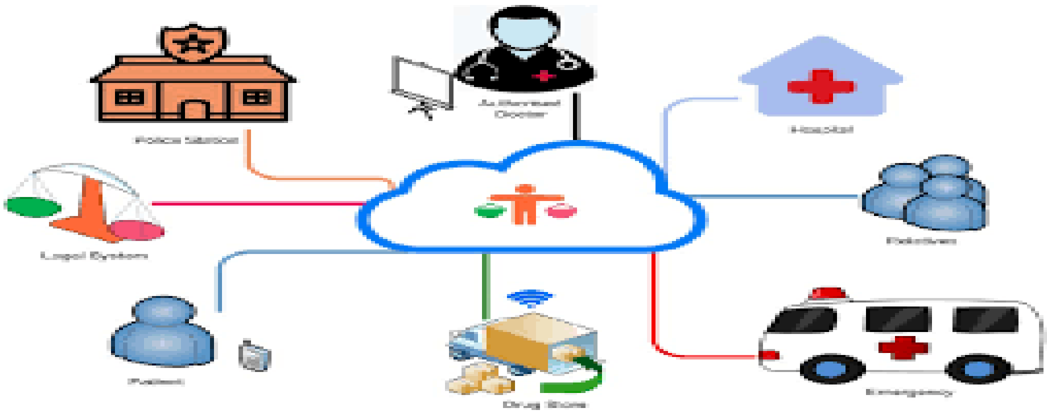

FIG-6: SMART HELATHCARE

3.4 IOT FOR SMART CITY

To integrate internet of things technology in all areas, smart cities need meticulous planning at every stage, including backing from governments and residents. Cities can be made better in a variety of ways by utilising IOT, such by increasing public transit by reducing traffic congestion and ensuring that residents are safe and healthy[13]. Fig. 7 depicts the layout of a smart city.

FIG-7: SMART CITY

4. ADVANTAGES AND DISADVANTAGES OF IOT

This section mention advantages and disadvantages of IOT Applications

Advantages:

- It can assist in the smarter control of homes and cities via mobile phones. It enhances security and offers personal protection.
- By automating activities, it saves us a lot of time.

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- Information is easily accessible, even if we are far away from our actual location, and it is updated frequently in real time.
- Electric Devices are directly connected and communicate with a controller computer, such as a cell phone, resulting in efficient electricity use. As a result, there will be no unnecessary use of electricity equipment.
- Personal assistance can be provided by IoT apps, which can alert you to your regular plans.[14-17]

Disadvantages:

- Hackers may gain access to the system and steal personal information. Since we add so many devices to the internet, there is a risk that our information as it can be misused.
- They rely heavily on the internet and are unable to function effectively without it.
- With the complexity of systems, there are many ways for them to fail.
- We lose control of our lives—our lives will be fully controlled and reliant on technology.
- Overuse of the Internet and technology makes people unintelligent because they rely on smart devices instead of doing physical work, causing them to become lazy.

CONCLUSION

Through a variety of technologies and applications, IOT has been gradually bringing a sea of technological changes into our daily lives, which in turn helps to make our lives easier and more comfortable. IOT has countless applications across all industries, including healthcare, manufacturing, transportation, education, government, mining, and habitat, among others. In this paper, various IOT applications are discussed. IOT is working to make human life more "connected" and "smart" both now and in the future.

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