Study of Smart Things Applications in Robotics, Protocols, and Standards for the Internet of Things

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Abstract - Smart Things has been around for more than a decade and stems from Mark Weiser's original dream of omnipotent information technology. Today, IoT is more of a descriptive term for the vision that everything should be connected to the Internet. IoT applications are very diverse and rich; they range from relatively simple home automation scenarios to the most complex scenarios of interconnected smart cities Human life today without their applications would become boring. Networks and data form the foundation of IoT protocols. Wireless technologies include Bluetooth, ZigBee, and LongRange Wide Area Network (LoRa WAN). There is rapid development of new standards, technologies, and platforms for the IoT ecosystem. This article, focus on the current state of IoT, possible use cases, and challenges affecting Internet of Things adoption. Additionally, this article focuses on the state of smart objects and its applications, as well as an overview of IoT network protocols. Smart Things applications, including healthcare, home automation, disaster recovery, and industrial automation with the development of robots makes it possible for us to perform tasks without human intervention.

Index Terms - Internet of Things (IoT), smart things, IoT network Layer protocols, Robots

I. INTRODUCTION (INTERNET OF THINGS)

In today's world, we can use our ecosystem of connected devices to create a user-friendly experience almost anywhere, including (but not limited to) our home, cars, home care and manufacturing facilities. However, customers' needs are always changing: As connected devices raise privacy concerns, businesses and their engineers need to innovate while building trust. Internet of things (IoT) refers to latest improvement withinside the interconnectivity of gadgets. Internet utilization has come to be the norm in greater components of our normal lives in latest years. Internet use has become the norm in many areas of our daily lives in recent years.

IoT consists of two key elements: "internet" and "things". IoT = Sensing + Communication + Computation the IoT connects regular "things" with the Internet. Computer engineers had been including sensors and processors to regular gadgets in view that the '90s. But development is gradual due to the fact the chips are becoming larger and larger. IoT is important for many applications, including healthcare, transportation, automation, agriculture, automotive and disaster. It also pledged to do more in improving smart homes, business applications and overall quality of life. Smart homes equipped with sensors that control the temperature, heating and cooling in our homes are an example of the current IoT ecosystem. Future upgrades to these systems could include making coffee, operating the TV, watching our health information and running our cars. These applications will cause additional problems and the necessity of changing the model according to the needs of various applications.[2]

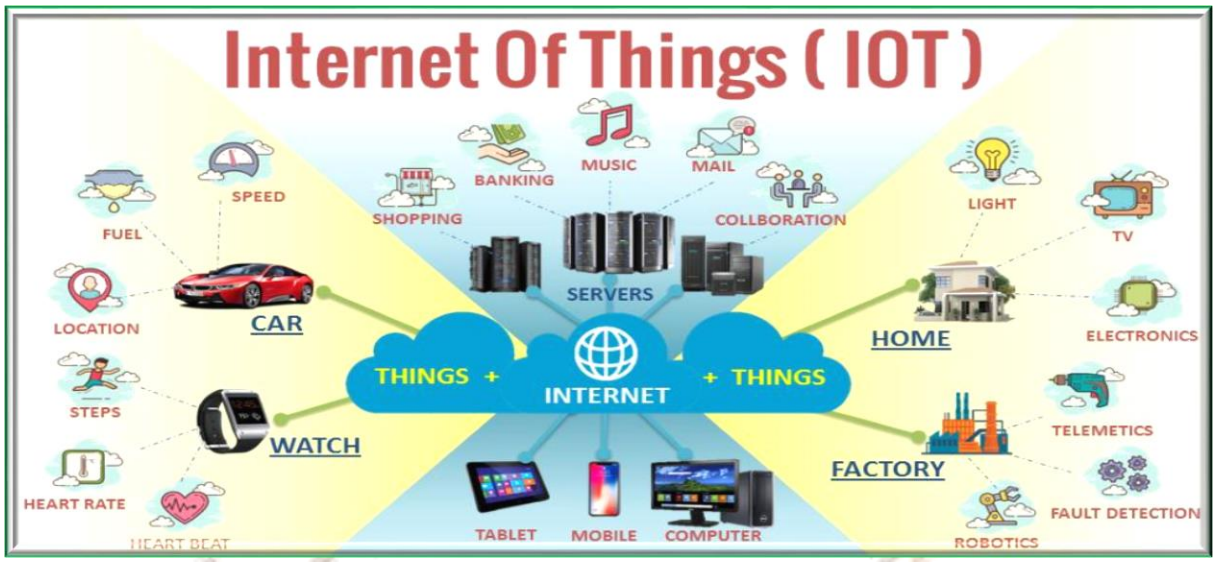

Fig.1 Internet of Things

II. INTERNET OF THINGS IS SIGNIFICANT FOR SEVERAL REASONS

The Internet of Things has emerged over the past few years as one of the most important trends of the 21st century. We can now connect everyday things (kitchen appliances, cars, thermometers, baby monitors) to the internet through embedded devices, seamless communication of people, processes and possibilities. When we connect our computer, phone or tablet to the internet, we can connect to other computers, printers and other machines around the world. It helps us shop online, bank transactions, listen to music and more. Now the next step on everyone's mind is how do we connect the other things we see around us to the internet? do you like my car? see? Are these lights? television? automobile? When your car is connected to the internet, you can track your fuel gauge, speedometer, and even your car's location. I can control my lights and all my devices from my phone. The term IoT or Internet of Things refers to the integration of connected devices and technologies that support communication between devices and the cloud, and between devices themselves. The IoT connects everyday "things" with the Internet. Thanks to the 21st century Internet of Things, computers can figure things out themselves, such as GPS-based location awareness.[8] Over the past few years, GPS has helped people find their way around the Internet, the has the potential to allow things like self-driving cars in the future, reduce traffic and pollution, and allow cities to grow more land, roads.

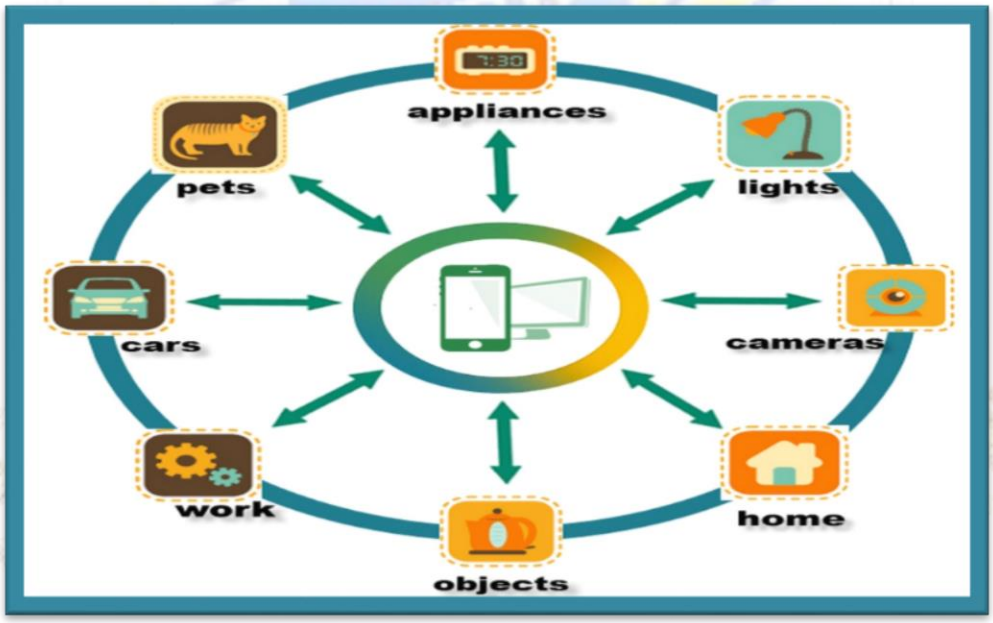

Fig. 2 Internet of things is significant for several reasons

III. NETWORK PROTOCOL LAYERS AND THE INTERNET OF THINGS

These gadgets use Internet Protocol (IP), which identifies computer systems on the World Wide Web and allows them to communicate with each other. Bring critical information to the surface faster than machines that rely on human intervention. An IoT architecture consists of devices, networks, and cloud technologies that enable IoT devices to communicate. A simple IoT architecture consists of three layers: Sensing (sensors, gadgets and other devices) Network (connection between devices) Application (user interactive layer)[7]. This system is written and supported by IoT data processing. The architecture goes beyond the OSI model to include transforming data into usable data. The different types of connectivity that IoT has, including connections between devices, gateways, and data systems. When the devices are in direct contact, information can be transmitted immediately without intermediaries. Sensors and gateway nodes exchange data through device-gateway channels. Data is transferred from the

gateway to the data source through the gateway connection to that data source. Besides connecting systems, there is another way to transfer data between data centers or cloud servers.

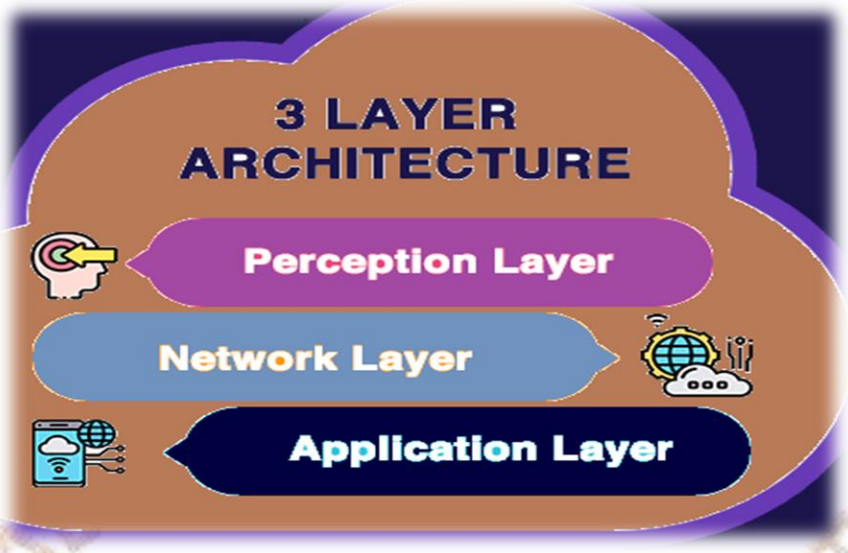

Fig.3 Network Layer Protocol

Perception Layer

These layers support the sensors and implement the system. These sensors collect a lot of data on demand. This also includes end devices, sensors and actuators that interact with the surrounding environment. It can find certain spatial features or other smart objects/objects around. This is the physical process of architecture. This is where sensors and connected devices come into play, as they collect a lot of information depending on the needs of the project. These can be end devices, sensors and actuators that interact with their environment. The network layer of IoT is basically divided into two parts. Routing layer sends packets from source to destination and encapsulation layer is mainly responsible for packet creation. Let's learn about IoT network layer protocols.[8]

Internet of Things Network Layer Protocol

1. RPL is a routing protocol for low power and lossy networks. Low-power and lossy networks are resource-constrained networks RPL is a remote routing protocol. RPL is primarily aimed at collection-based networks in which nodes periodically send measurements to collection points. The design of the protocol had to be well suited to network conditions and provide an alternate route when the default route was unavailable. RPL provides a mechanism for propagating information through a dynamically generated network topology. RPL can handle thousands of nodes.
2. CORPL or Cognitive RPL is an extension of the RPL protocol. DODAG cognitive networks and topologies use this network design protocol. CORPL also provides two new updates to the existing RPL protocol. It uses opportunistic forwarding to transmit packets between each module or node. In addition to maintaining parent information, each node also remembers redirection settings. Each node uses DIO messages to update its neighbors.
3. Cache Array Routing Protocol, also known as CARP, is a protocol developed by Microsoft and implemented by Microsoft proxies. This allows you to cache distributed content by combining multiple proxies into a single logical cache. CARP is implemented as a set of algorithms applied on top of Hypertext Transfer Protocol (HTTP). CARP allows web browsers or downstream proxies to determine exactly where in an array of proxies' stores information about common resources requested. CARP allows monitoring of proxies with an automatically updated list of array members with a lifetime countdown feature. This feature periodically checks the array's active proxies. CARP uses a hash function and associates the hash value of each requested URL with each proxy.
4. 6LoWPAN connects things to the cloud. Low power consumption, support for IP management nodes and mesh networks make this technology an excellent enabler for the Internet of Things. 6lowpan stands for IPv6 over Low Power Wireless Personal Area Network. A low-power, wireless mesh network in which each node has its own IPv6 address with direct access to the Internet. Internet packets can be transmitted efficiently within small link-layer frames.[6]

IV. IoT Applications of Smart Things

A smart object is an object that senses, informs and responds to its environment while maintaining its energy intake, protecting the information it collects from threats and intrusions, and then transmitting it to other smart objects. The IoT network, the stage of IoT where things interact and form a large ecosystem, consists of many smart things that can "talk" to each other. Whether it's a car or kitchen appliance, a thermometer or a baby monitor, a shipping box or a cell phone, what makes them "smart" is debatable. Smart cities use Internet of Things (IoT) sensors in urban areas to collect data and systems such as transportation, energy use and waste management. In this way, smart cities increase the efficiency of city services, reduce costs and provide a better quality of life.[14]

Fig. 4 IoT in Smart metropolises

1) Water Level Analysis

The power of water is one of the most important promises to the home. Smart Detector allows you to quickly check the condition of your water. These detectors can issue triggers and alarms to responsible managers when water levels are low or high. Spillage and water dispersion can be combined with IoT detectors and ICT fabrics. In the same way, all areas with high water can be set partially on the satellite, and tides can indicate flooded or water scarce areas. Water experts using the IoT fabric can be provided with complete waterproofing strength readings along with GPS directions.

2) **Smart transportation**

Connected automobiles have made their manner to the vanguard of public transit—and the efforts have already began out to endure fruit. Insider Intelligence tasks US related vehicles will make up 97% of the full wide variety of registered automobiles via way of means of 2035. Specifically voice seek and vicinity facts competencies are appealing to drivers, and as clever programs keep to conform and grow, so will the adoption of clever transit. The transportation framework for the citizens may be advanced with IoT−empowered frameworks. The armadas may be overseen and observed making use of GPS beacons. Legislatures can end armadas' organization, planning, ongoing situating, support, and unfastened time for executives with IoT frameworks. The citizens can likewise gain from transportation administrations with a card−primarily based totally framework for tickets and so on.[15]

3) Healthcare

Healthcare is an incredibly vital factor of life, mainly in contemporary instances whilst non-communicable sicknesses like coronary heart issues and most cancers are growing in large towns at the same time as there are nonetheless numerous deaths from infectious sicknesses in poorer places. In this sort of situation, IoT era can truly assist in improving the healthcare machine in order that the satisfactory healthcare is obtained through everybody. Application areas in this field; ability to monitor patient adherence to medications, telemedicine solutions, and patient health alerts. Thus, sensors can be used for outpatient and inpatient care, dental bluetooth devices, and toothbrushes that can provide data and monitor the patient after use. Other elements of IoT include: RFID, Bluetooth and Wi-Fi etc. These will improve the measurement and monitoring of blood pressure, body temperature, heart rate, blood sugar, cholesterol level and many other important functions.

4) Smart Energy Management

One of the main problems of government administration is to reduce energy consumption and create a suitable basis for it. Smart placement, energy meters and lighting are some of the things that legislators use to monitor energy efficiency. The Power Profile can show regular power usage, failures and maintenance times. IoT-enabled planning can increase the power of city councils.

5) smart house

One of the key components of a smart city is the smart home, the center of life. city dwellers. Smart homes use sensors installed everywhere. A person's home that provides information about the home and its occupants. these Sensors include environmental sensors, motion sensors and power consumption/energy.

6) Smart lifestyle

In this domain, IoT can be applied in remote control devices whereby one can remotely switch appliances on and off hence preventing accidents as well as saving energy. Other smart home appliances include refrigerators fitted with LCD (Liquid Crystal Display) screens, enabling one to know what is available inside, what has over stayed and is almost expiring as well as what needs to be restocked. This information can also be linked to a smartphone application enabling one to access it when outside the house and therefore buy what is needed. Furthermore, washing machines can allow one to remotely monitor laundry.

7) **Smart Industry Intelligence**

Industries around the world are constantly seeking to improve performance and increase productivity while reducing costs. The Business 4.0 paradigm requires the vision of a connected enterprise where all central functions are seamlessly integrated and work in tandem with each other. This is possible thanks to Internet of Things [26]. The use of IoT in manufacturing and manufacturing brings many benefits, such as the integration of physical integration of workers and machines, faster and better transformation to the business, optimization of production (resources and processes), quality and reliable products. factory security 4,444 workers. However, the smart market presents some challenges to the use of IoT, using different devices and systems has its own challenges and requires a flexible physical network eight in configuration, connectivity and fast usage for smart IoT business applications. AI, along with and the Internet of Things, has already driven the development and delivery of Industry 4.0 services

V. ROBOTIC APPLICATIONS OF VARIOUS SMART THINGS

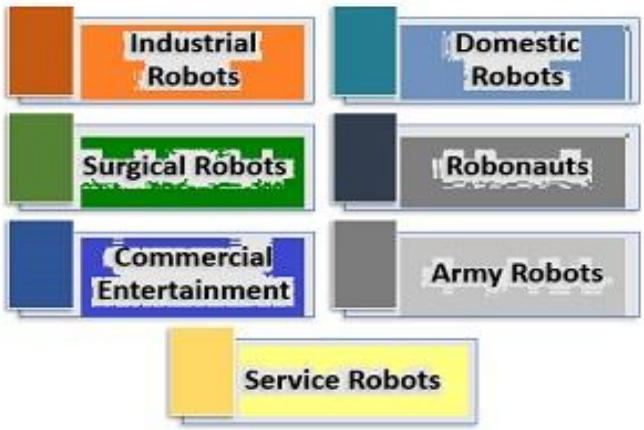

Fig. 5 Robotics Application

1) Industrial Robots

Today, as technology advances, distinguishing between industrial robots and service robots and how to delineate their working areas becomes more complicated. In the World Robotics 2021 report it is determined that the classification into industrial robots or service robots is made based on their intended application. Industrial robots are robots "designed for use in industrial automation applications", while service robots "perform useful tasks for humans or equipment, excluding automation applications." industrial chemistry". An industrial robot has been developed to automate intensive manufacturing tasks, such as those required for continuously moving assembly lines. As large, heavy robots, they are placed in fixed locations in industrial facilities and all other tasks and processes of workers revolve around them. Today, large companies are no longer the only ones with access to industrial

robots. More and more small and medium-sized businesses are experiencing increased profits and reduced production costs thanks to the automation of certain processes.[18]

Fig.6 Industrial Robots

2) Domestic Robots

Household robots are electronic robotic devices designed to perform different types of tasks in the home. Some of them have functions like housekeeping. Others are designed to keep the elderly company, monitor children's activities and operate kitchen appliances. The number and types of robots currently in use are quite limited. However, many companies are currently developing robot models with greater capabilities. Among all the types of home robots currently in use, the most popular are smart vacuum cleaners. This home robot is capable of moving across floors, cleaning carpets as well as hardwood and other floor types. The robot uses sensors to determine the presence of furniture and other objects and changes direction if necessary. Small and relatively simple, the robot takes up a fraction of the storage space that a traditional vacuum requires. Robots like these often run on batteries that can be easily recharged with household electricity. The most popular among all the home robots in use today is the smart vacuum cleaner. This home robot can move across the floor of a room and clean carpets, hardwood, and other types of floors. It determines the presence of furniture and other objects using sensors.

Fig.7 Domestic Robots

3) Surgical Robots

Robotic-assisted surgery uses specialized technology that enhances the capabilities of your surgeon's hands. It allows surgeons to perform procedures in hard-to-reach places through small incisions. Specialized technology also allows for precise movement and increased magnification. This technology includes: A surgical arm with small instruments with cuffs at the end. Special cameras provide enhanced, magnified 3D images of the surgical area. A surgical console where the surgeon controls all movements of instruments and cameras.At the beginning of the 21st century, the miniaturization of cameras and the development of relatively small robotic systems promise to allow deep procedures and exploratory surgery to be performed through the body's natural orifices. The development of haptics (haptic feedback technology) in robotic surgical systems has the potential to improve

precision. Achieving these goals is expected to further reduce the invasiveness of already minimally invasive procedures and, therefore, create less stress for patients.[16]

Fig. 8 Surgical Robots

4) Commercial Entertainment Robots

Entertainment robots, as their name suggests, are not robots designed to perform a specific task but are intended to bring pleasure to the humans they serve. They can be used in trade shows to attract media attention and can often be programmed with different speeches, dances, and more. In the coming years, the global commercial entertainment robotics market is expected to witness steady growth, driven by a combination of continuous technological advancements, recognition Environmental awareness is growing and the need to streamline operations is increasing. To capture the growing market opportunities, industry players are expected to focus on product innovation, strategic collaborations and geographical expansion.

Fig. 9 Commercial Entertainment Robots

5) Military robots

Military robots can be remotely controlled robots or automated robots. They are mainly intended for the search for the soldier, his rescue and attack depending on the situation. Some robots are designed and others are invented. Military robots are nothing new to the armed forces as they have been used in many areas of the world for many years. Military robots provide quick backup plans in the event of a major fire, reducing the challenges faced by the military. These robots come in many different sizes and shapes. Many countries are trying their best to make robots for these purposes. Robots come in many different shapes and sizes, designed according to their job.

Fig. 10 Military robots

6) Service robots

A service robot is one of the robots that behaves and operates like humans and is quite interactive. These robots can perform tasks that humans sometimes do not hesitate to perform, including cleaning tasks, some dangerous activities as well as household chores such as washing dishes, washing clothes, etc. etc. Service robots are programmed in such a way that they perform every operation. Service robots are known for their ability to perform activities and make decisions just like any human. Service robots are quickly becoming an essential part of the business operations of healthcare, hospitality, logistics and retail service companies looking for

innovative ways to delight customers. Service robots are most commonly used to assist employees with daily tasks so they can focus on more valuable, customer- and patient-centric work.[18]

Fig. 11 Service robots

VI. CONCLUSIONS

The Internet of Things consists of smart objects. The Internet of Things plays an active role in our daily lives and its applications are amazing and countless. Several application protocols are presented and compared. These standards include communication, routing, network layer, and session protocols that are developed to meet IoT requirements. IoT is not only for home applications, but also for commercial and industrial applications, including manufacturing, chemical, medical, pharmaceutical, and R&D. In addition, applications are expanding into other sectors such as government, education, mining, geospatial and disaster management. Several application protocols are presented and compared. These standards include communication, routing, network layer, and session protocols that are developed to meet IoT requirements. Research on service robots also aims to bring comfort and ease to people's lives in an aging world. Robots in the field of application such as humanoid robots, field robots, underwater systems and Mobile robot platform for many researches on right robotics Great effort to solve in a few years the challenges of This new field of research will, in large part, be determined by Interaction between humans and robots.

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