Internet of Things Survey: Basics, Applications & Emerging Trends

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Abstract— This Survey Paper addresses Internet of things, its basics, applications and emerging trends. Net of Physical things electronically embedded with software's and network connectivity is defined as IoT. These connected physical things enable objects to collect and exchange data. The Internet of Things permits objects to be identified and controlled remotely across existing network structure and it will create path for more direct integration between the physical world and computer-based systems and resulting in improved proficiency, precision and financial benefit. We will provide an overview of some of the applications presented in the recent literature and provide a summary of related research work. In this way the Internet of Things (IoT) is able to incorporate clearly and effortlessly a large number of diverse and various end systems to provide open access to specific selected things.

Key words: Internet of Things; Industrial Applications; Sensors; Network Connectivity; RFID; WIFI; WSN; Machine To Machine Communication

I. INTRODUCTION

The Internet of Things (IoT) has become worldwide term in the world of technology, which is rising noticeably over the past few years. The IoT refers to the network or networks covering the use of standard Internet Protocol (IP) technologies to connect people, processes, and things to enable new cyber-physical systems. Basically defining IoT in very simplest way is connecting anything, anytime, anyone, anywhere, any service or any network. In this paper we focus mainly on basics of Internet of things and its evolution to new emerging trends. The capability to code and track objects has allowed companies to become more proficient, speed up practices, reduce error, prevent larceny, and incorporate complex and flexible organizational systems through IoT [1]. Majorly IoT has three types

1) Industrial internet of things: The term IIoT (Industrial Internet of Things) is often usedin the manufacturing industries, it refers to the industrial division of the IoT. IIoT in manufacturing could generate so much business value that it will ultimately help to the fourth industrial revolution
2) Consumer IoT: Consumer IoT basically focuses on convenience of original consumers. Consumer IoT focuses on improving network at consumer end. Comprehensive solutions will be available at consumer end as much as IoT develops.
3) M2M IoT: Machine to Machine IoT focuses on machine to machine communications.

II. ESSENTIALS OF IOT

A. Technologies enabling IoT

Through the integration of several enabling technologies actualization of IoT concept is possible into the real world. Most of the relevant ones are discussed in our paper. It is not possible to provide complete survey of each technology. So in brief way we just have highlighted our major aim by providing the role they will likely play in the IoT. Interested readers will find references to technical publications for each specific technology [2].

1) RFID technology [3]:

RFID uses electromagnetic fields to automatically detect and track tags attached to objects. The tags contain electronically stored data. Passive tags collect energy from a nearby RFID reader's interrogating radio waves. Active tags have a local power source such as a battery and may operate at hundreds of meters from the RFID reader. Unlike a barcode, the tag need not be within the line of sight of the reader, so it may be embedded in the tracked object. RFID tags are used in many industries, for example, an RFID tag attached to an automobile during production can be used to track its progress through the assembly line; RFID-tagged pharmaceuticals can be tracked through warehouses; and implanting RFID microchips in livestock and pets allows for positive identification of animals. Since RFID tags can be attached to cash, clothing, and possessions, or implanted in animals and people, the possibility of reading personally-linked information without consent has raised serious privacy concerns.

2) WSN (Wireless sensor networks)[3]:

Wireless Sensor Networks (WSNs) consist of small nodes with sensing, computation, and wireless communications capabilities. These sensors have the ability to communicate either among each other or directly to an external base-station. WSN accord different multichip communication. Recent technological advances in low-power integrated circuits and wireless communications have made available efficient, low-cost, low-power miniature devices for use in WSN applications.

Remote environmental monitoring and tracking of the target such applications are important applications of WSN. This is because in recent years sensors that are smaller, cheaper, and intelligent are available on large scale. These sensors are equipped with wireless interfaces with which they can communicate with one another to form a network [4].

III. ARCHITECTURE OF AN IOT SYSTEM.

[6] Today Internet is using TCP/IP protocol stack widely for communication between network hosts which was proposed long time ago. Still, the IoT connects number of objects which will create much larger traffic and higher data storage is needed [9]. Also, IoT will face many contests specifically related to privacy and security [10]. Proposed architecture for IoT needs to talk various factors like scalability, interoperability, consistency, QoS, etc.

Thus, development of IoT depends on the technology progress and various new applications designed and business models. The basic architecture of IoT is proposed in [9] and [11]. Usually, the structure of IoT is distributed into five layers as shown in Fig. 3. These layers are described below:

1) Perception Layer: The Perception layer is also known as 'Device Layer' [6]. This layer consists of two types of devices in this layer sensors and actors. Perception layer is basically made of Cameras, RFID, barcode, Bio-metric, infrared sensor, Smart sensors etc. Sensing element can be any sensor. This layer identifies data and collects data to transform to network layer. The information can be about location, temperature, orientation, motion, vibration, acceleration, humidity, chemical changes in the air etc. which mainly depends on the sensor. The collected information is then passed to Network layer for its secure transmission to the information processing system.
2) Network Layer: The Network layer can also be called 'Transmission Layer' [6]. This layer transfers the information from sensor devices to the information processing system securely. The transmission medium can be wired or wireless and technology can be 3G/4G, Wi-Fi, Bluetooth, infrared, ZigBee, ZIWAVE, NB-IOT, GPS, GPRS, WSN etc. which depends upon the sensor devices. In some cases network layer is divided into gateway and internet. Thus, the Network layer transfers the information from Perception layer to Middleware layer.
3) Middleware Layer: This layer provides different type of services, where each device can do the connection and communication with specific devices which are having same type of service. This layer is responsible for the service management and has link to the database. It receives the information from Network layer and store in the database. It performs information processing and ubiquitous computation and takes automatic decision based on the results.
4) Application Layer: This layer provides global manage-Business Layer Network Layer Application Layer Middleware Layer Perception Layer RFID, Barcode, Infrared Sensors Secure Transmission Info Processing Service Management Smart Applications and Management System Management Flowcharts Graphs Physical Objects 3G, UMTS, Wifi, Bluetooth, infrared, ZigBee etc Universal Computing Decision Unit Database Business Models Figure 1: The IoT Architecture[6]. The applications layer basically consist of cloud management, mobile payment, RTLS, Smart Home, Smart workplace etc. Application layer consist of industrial applications which we are going to focus in our further work.
5) Business Layer: The management of IoT applications and services is managed in this layer. Building flow charts, application development is major responsibility of this layer. Work of business layer depends on the application layer data. The real success of the IoT technology also depends on the good business models [6]. Depending on the analysis of results, this layer will help us to determine the future actions and business schemes.

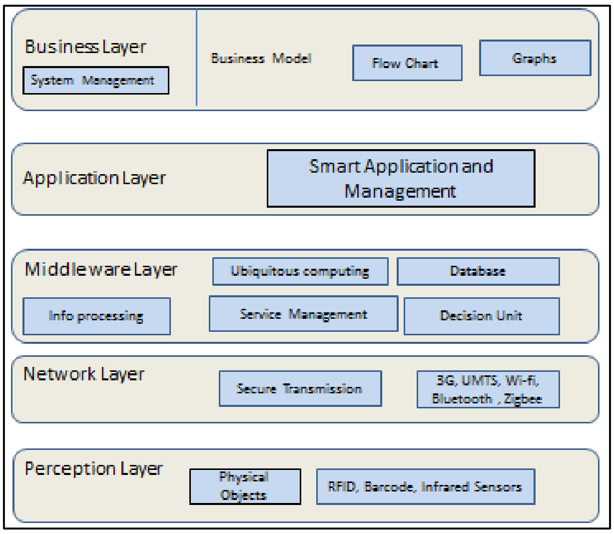

Fig. 1: IoT Architecture

IV. EVOUTION OF IOT

For in the perspective of evolution of The Internet of Things (IoT), It has not been around for very longer time period . However, in early 1800s with a good vision some of the machines are communicating with each other. In 1830s and 1840s. Machines have been providing direct communications since the telegraph (the first landline) was developed Described as "wireless telegraphy," The first radio voice transmission took place on June 3, 1900, providing another necessary component for developing the Internet of Things. The development of computers began in the 1950s.One additional and important component in developing a functional IoT was IPV6's remarkably intelligent decision to increase address space. Steve Leibson, of the Computer History Museum, states, "The address space expansion means that we could assign an IPV6 address to every atom on the surface of the earth, and still have enough addresses left to do another 100+ earths." Put another way, we are not going to run out of internet addresses anytime soon.

V. LITERATURE SURVEY

The author Luigi Atzori, Antonio Iera, Giacomo Morabito states in there paper "The Internet of Things: A survey" [2] approaches mainly on complex discipline and contribute to its development. In this paper author observed that the IoT should be considered as part of the overall Internet of the future, which is likely to be dramatically different from the internet we use today. Different visions of this Internet of Things paradigm are reported and enabling technologies reviewed.

The Author rafiullah khan, in paper "Future Internet: The Internet of Things Architecture, Possible Applications and Key Challenges" described the existing development trends, the generic architecture of IoT, its distinguishing features and possible future applications. Also hey emphasizes on key challenges such as naming and identity management, Interoperability and standardization, information privacy, Objects safety and security, Data confidentiality and encryption etc associated with the development of IoT [6]. Author explained briefly generic architecture of IoT.

The Author Dhananjay Singh, in paper [8] “A survey of Internet-of-Things: Future Vision, Architecture, Challenges and Services” introduces a novel architecture model for IoT with the help of Semantic Fusion Model (SFM). This architecture introduces the use of Smart Semantic framework to encapsulate the processed information from sensor networks. The smart embedded system is having semantic logic and Semantic value based Information to make the system an intelligent system. Author presents a discussion on Internet oriented applications, services, visual aspect and challenges for Internet of things using RFID, 6lowpan and sensor networks.

The author Jasper Tan categorizes in Paper “A Survey of Technologies in Internet of Things” various technologies present that are commonly used by internet of things. Author also surveys different technologies in Wireless sensor networks such as ZigBee, Z-Wave and there use in IoT, also various technologies used in IoT. RFID is also making more enhancements to communicate data [12].

The author In Lee and Kyoochun Lee discussed in paper “The Internet of Things (IoT): Applications, investments, and challenges for enterprises” regarding the five technical and managerial challenges. Those Five IoT technologies that are essential in the deployment of successful IoT-based products and services and states three IoT categories for enterprise applications used to improve customer value. In addition, it examines the net present value method and the real option approach widely used in the justification of technology projects and illustrates how the real option approach can be applied for IoT investment.

VI. IOT APPLICATIONS

IoT applications are developed rapidly in various areas such as industries including environmental monitoring, healthcare service, inventory and production management, food supply chain (FSC), transportation, workplace and home support, security and surveillance [13]. Our main focus in our paper is in industrial applications. In Industrial IoT applications we need to consider multiple goals. We have considered some of the IoT typical applications for our further work.

1) IoT usage in the healthcare service industry [14]. With the help of IoT it is possible to provide new opportunities to improve healthcare [15]. IoT Healthcare services are basically characterized by Sensing, Identification and communication. All health care related information such as logistics, Diagnosis, therapy, recovery, medication, management, Finance can be poised, managed, and shared efficiently. IoT-based healthcare services can be made mobile and it can be personalized [16]. Security of this data and information gathering are major challenges.
2) IoT usage in Food supply chain [13]. Today we have very distributed and complex Food supply chain. It shows large geographical and temporal scale, complex operation processes, and huge number of Stakeholders [13]. Due to this complexity FSC is weak in the quality management, operational efficiency, and public food safety. IoT technologies support for promising abilities to address the traceability, visibility, and controllability challenges. Huge amount of data transfer is also the Key challenge in FSC, this problem solved using IoT for FSC.
3) IoT usage in Intelligent Transportation [17]. China needed a solution for intelligent transportation based on IoT platform.

The increasing growth rate of China’s urban intelligent transportation control system market is high, including electronic police, intelligent traffic signal control, traffic video monitoring, intelligent Taxi service management, urban public transport information technology, and ETC [17].

In recent years, vehicular network infrastructure integration technology attracts a large amount of attentions; it also brings immeasurable economic value, and will play an important role in the next upcoming years of intelligent transportation systems and communication network development. In vision of 2020 built in sensor connectivity will be mandatory for the vehicles. Thus all work is regarding making cities smarter than now. But for industrial automation some more efforts need to be taken.

VII. CONCLUSION

Internet of Things for industrial machines refers to the careful integration of complex physical machinery with high- end software and networked sensors for industrial machines refers to the careful integration of complex physical machinery with high- end software and networked sensors. Unlike many other sectors, industrial manufacturing has direct contact with millions of machines, equipment, and components that are ready to fully embrace technology and innovation. The IoT is at the heart of this transformation – connecting machines, products, and services to streamline the flow of information, enable real-time decisions, productivity and enhance customer satisfaction.

VIII. FUTURE ENHANCEMENT

A major concern surrounding the Industrial IoT is interoperability between devices and machines that use different protocols and have different architectures; complexity of the IOT of machines arises when we try to implement in Industry due to variance in machine types. In the current industry scenario not all the machines in the shop floor are smart machines. The major hurdle of the implementation is the missing smart machine concept which would be difficult to implement on a common platform. This paper is used to resolve this complexity in terms of implementation of reactive maintenance status.

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