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A STUDY ON RESEARCH DIRECTIONS TOWARDS INTERNET SERVICES MODELS

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ABSTRACT

IoT is the future of present technology. It generally mean mechine IoT to mechine communication. According to study there will be 20.8 billion devices connected to internet till 2020. Many industrial IOT applications have been increasingly developed and deployed in recent years. Now-a-days, controlling and monitoring plays a main role in our day to day life. Everything we can monitor and control using advanced technologies. Remote access is a wonderful feature that came because of high speed internet. The main objective of proposed system is to provide a technology oriented and low cost system to make an advanced industry for those who away from their industry and want to control devices. This paper provided the recent research directions towards internet of things.

Index Terms: Internet of Things, research directions, challenges

I. INTRODUCTION

The term "Internet of Things" was coined by Peter T. Lewis in a 1985 speech given at a U.S. Federal Communications Commission (FCC) supported wireless session at the 15th Legislative Weekend Conference. In his speech he states that "The Internet of Things, or IoT, is the integration of people, processes and technology with connectable devices and sensors to enable remote monitoring, status, manipulation and evaluation of trends of such devices.

As the talk, the number of companies to help enable their IoT ideas. And as a result, we hear about new ideas and solutions that are already solving business challenges with M2M (Machine to Machine) communication. And today, we want to highlight some of the most compelling IoT applications in an- other industry—agriculture. Agriculture IoT is becoming one of the fastest growing fields (pun intended) within the IoT. Today, more than ever, farmers have to more effectively utilize and con- serve their resources. That's where the need for data comes in, and M2M communication has made the ongoing collection of that info easy

Thousands of applications can be identified in each domain and new ones appear everyday, requiring a strong interconnection among things [1]. Interconnection is not only a mere technological issue but it concerns also aspects such as privacy, standardization, legal issues, etc. This inevitably brings new challenges driving research and innovation in industry and academia over the last decade [2]. We believe that the core technological challenges, such as interconnection among heterogenous devices, very low computational and energy demand have to be overcome to pave the road for the adoption of IoT. Projects in industry and academia around the world strive to solve parts of these challenges. A fundamental importance will be the development
of an open, scalable and trusted architecture.

The vision of the Internet of Things (IoT) describes a future where many everyday objects are interconnected through a global network. They collect and share data of themselves and their surroundings to allow widespread monitoring, analyzation, optimization, and control. Until recently this was merely a vision, but in recent years this has slowly developed into a reality. Ever decreasing prices, dimensions, and energy requirements of electronics now allow tiny devices to unobtrusively measure their surroundings. Many devices use low-energy communication technology to send those measurements to other, more powerful components, such as bluetooth gateways, mobile phones, or WiFi hotspots. Devices are increasingly incorporating long-range wireless technologies such as LoRa or existing 2G and 3G networks. Local edge processors, hubs, or internet services in turn analyze and process IoT sensor data to create new knowledge, which can be used to act back on the environment through actuators. In short, the IoT can be seen as a giant cyber-physical control loop. In that context, the term "Machine-to-Machine communication" is often used to describe such a setting.

Different incarnations of IoT systems for varying use cases have been created over the years by companies and research institutions. Smart Homes are one example of such IoT systems. In other areas, similar developments are underway, such as Connected Cars, Smart Cities, Demand Side Management, Smart Grids, or Smart Factory systems.

While local processing of the data generated by these systems is possible and a reasonable approach for use cases where low latency is required, cloud based platforms are used for processing and analyzing larger data sets [7]. As a result, over one hundred such platforms have been created over the last few years. Some examples include AWS IoT, FIWARE, OpenMTC, and SmartThings.

These platforms come in various shapes and sizes. While standardization efforts are ongoing, there are no generally agreed-on standards for IoT at this time [8]. Rather, development of these platforms has often taken place in silos. These different environments have influenced not only the choice of concepts and technology, but also the choice of terminology. As a result, the platform landscape has become very heterogeneous. At the same time, however, all these solution do roughly the same things: they allow connecting different devices, accessing and processing their data, and using the knowledge gained through this activity to create automated control.
The heterogeneity of these approaches creates an issue for someone who has to select one of these solutions. Finding the right platform for a use case becomes very time consuming when each solution uses different technologies and terminology. You have to read and understand the descriptions and documentation of each platform to make a decision. This requires not only time, but also the technical knowledge to be able to understand and compare the different concepts.

II. CHALLENGES AND RECENT RESEARCH DIRECTIONS

In this section, the paper discusses the bulk of popular challenges or general challenges of the IoT environment; it also displays the recent research directions for each topic.

Networking

Generally, the Networking issue has a great relevance in the Internet because of it includes some of the important factors which uses to manage networks. First of all, traffic and protocols that have a significant impact on the behavior of the network, these points are mentioned in [1]. Sought to deal with networking challenges via mobile Ad-Hoc Network. The authors have used mobile ad hoc networks (MANET) interconnected to fixed networks by different gateway. In IoT, can't be predicted where the object moved, and the object may be needed to transmit from network to another. The biggest problem is in dynamic gateways change and the difficulty of Identifying the location of things. The MANET consists of a number of self-organized mobile nodes or objects and it considered as a way to maintain a connection, additionally Multi-homed ad-hoc is seen as an extension to the existing infrastructure in IoT.

Routing

Routing process means selecting the best path between the source and the destination to complete the communication process successfully. There are various ways to determine the best path based on the communication protocol type such as a number of hops, costs, and bandwidth. Can be classified routing protocols into two main categories are: i) Reactive protocols: the path is established after transmission request is made, ii) Proactive protocols: initial path before the request is made. In [2], Sudip Misra et al. proposed the protocol under the name of "fault-tolerant routing protocol" for IoT. This protocol has designed by using learning automate (LA) and cross-layer concept. LA dealing with optimization problems to choose optimal solutions, the need to cross-layer is saving energy of the items of IoT (i.e. FRID).

Heterogeneity

The IoT environment is the best-known example to represent the heterogeneity issue because it contains a plethora of the different devices in their nature; the main objective of IoT is creating a common way to abstract the heterogeneity of these devices and achieving the optimal exploitation of their functionality. In this vein, the researchers always seek to find an effective method to deal with these devices regardless of their nature.In [3], C. G. Garcia et al. sought to introduce solutions to some of the IoT problems such as interconnection, heterogeneity, and generate an application that allows people to interconnect services over the Internet, these solutions are represented in: creating a domain specific language (DSL), graphic editor and IoT platform Midgar software. For instance, over recent years emerged a lot of applications used to solve the heterogeneous objects problem over the Internet e.g. WhatsApp, Skype and so on, it's considered as a simple example to overcome this problem. The authors have reviewed Midgar software to handle the heterogeneous smart things through the IoT environment and DSL software is designed for the specific purpose, the main idea of this software is generating a domain which allows the interaction between things easy, regardless their nature.

The authors have reviewed Midgar software to handle the heterogeneous smart things through the IoT environment and DSL software is designed for the specific purpose is generating a domain to enable the interaction between things easily regardless their nature. The Midgar Software used to avoid the complexities in traditional methods that are used to handle this problem. In the future the connectivity is won't be limited to the electronic devices, but it will also include people this is will climb the problem; for this reason can be considered Midgar as a first step in this point.Moreover, IoT like any networks uses the service oriented architecture (SOA) approach to enhance the heterogeneous resource behavior (i.e. Sensors and Actuators) and it provides the highest level of flexibility and scalability to the system in both the external integration processes and the exchange processes within the middleware.

Middleware Layer

The middleware layer is a software layer or a set of sub- layers interposed between the technological and the application layer, it provides a standard way for representation and communication. In general, the middleware layer supports the transparency concept that is used to hide all complex details from end user; actually the transparency concept is a one of the most distinctive features of distributed systems.The Service oriented Architecture (SOA) is a common example of the middleware technology that is used to deal with IoT, SOA allows to re-use and utilize real world service in a dynamic way [7]. The SOA supports some of the services and one of them is called "Service Level Agreement (SLA)", which used to make an agreement between the service provider and service user, the most important feature of SLA is the contracted to delivery time service, this feature provides QoS.

The middleware layer consists of three main layers are: **i) Service composition layer:** the common layer on top of SOA middleware; it provides the functionality for composition of single service and builds specific application. This layer concerned about services or providing services only. Service composition architecture consists of individual architecture of the participating services, this architecture published SLA [4].

Service Management layer: the layer allows management in IoT. Service management can be classified into two areas are: i) runtime: services that based on time as a critical factor to implement them directly. ii) Design time: services a part of maintenance lifestyle and service development [5]. Service management layer encompasses is a set of services such as object dynamic discovery, status monitoring, service policy enforcement, service Meta model updates and service configuration, some of middleware include additional features that are related to Qos management and lock management. It's notable that through the service management layer can develop new services during run-time [7].

Object abstraction: the need to object abstraction layer is summarized in vast and heterogeneous objects which scattered through IoT, layer organized harmonizing access to different devices with common language and procedure. Object abstraction includes wrapping layer consists of two sub-layers, interface sub-layer that management, incoming/outcoming messages and it provides an interface exposing the available method through a standard web service interface. Second sub-layer is a communication sub- layer that implements logic at web service methods and translate these methods at devices to communicate with real-world objects [7].

Interoperability

Interoperability concept can be defined as the ability to create systems or devices cooperating with each other in an efficient way. In [6] sought to use the semantic level interoperability architecture for pervasive the computing and IoT; the architecture is relied on the semantic information sharing solutions called "smart-M3".

The principle idea of the proposed architecture relies on dividing IoT environment into small spaces to facilitate their management process. A Semantic Information Broker SIB is used to provide methods for agents to share semantic information with each other and also provides monitoring and updating of the physical world in real time. The main observation of the architecture, performance after using the agent interaction operations scale very well also enable interaction with the physical world in real time. The architecture needs for tools the support development and deployment of devices and applications in the future IoT systems.

Quality of Service (QoS)

Ideally, QoS is defined as "the amount of time that is taken to deliver the message from the sender and the receiver" if this time is equal or less than pre-specified time requirement the QoS is achieved. ITU re-defined QoS concept as a degree of conformance of delivering service to the user by the provider with agreement between them. For QoS assurance, must cope with service models to determine which degree of QoS for each Internet service.

Moreover, Internet services can be classified according to Internet service models which considered as a supplement to provide the following: firstly, the ability to categorize Internet applications by priority; and secondly, determining QoS demands necessary to achieve user satisfaction. A service models consist of three main models based on three factors, namely, a delay factor is concerned with time, which can be classified into Hard Real Time (HRT), Soft

Real Time (SRT), and Non-Real Time (NRT), a critical factor is concerned with the kind of process/application (i.e. Sensitive application or not) (yes/no), and finally, an interactivity factor depending on the user's subscription (yes/no). According to table 1, the major types of Internet service models are: an open service model, an Supple service model, and a complete service model, the main function of these categories helping to offer QoS provisioning upon Internet services. In [9], sought to find an efficient algorithm more suitable with large-scale and real time in IoT, they made a comparison between the three common algorithms are: Integrated Linear Programming (ILP), Genetic Algorithm (GA), and Backtracking Algorithm (BA) to find a suitable algorithm that can deal with this context by efficiently. The authors chose BA as a more suitable algorithm to serve this idea because it's a suitable to cover the large- scale area in IoT and gave the good results in real-time compared with the counterpart of algorithms.

IoT Models	Delay	Process/App.	Interactivity
Open service	Not real time	Not mission critical	Interactive
Supple service	Soft real time	Mission critical	Application dependent
Complete service	SRT/HRT is depending on app.	Mission critical	Not interactive

Table 1: Internet Services models

Scalability

Scalability is one of the most important challenges of IoT, which means how to deal with the sustainable growth of the Internet in an efficient manner. In the other words, "Scalability is the ability of a system or network to handle the growing scale of any environment without an effect on performance". Currently, the Internet comprises around 9 billion devices with a next era of the Internet which known Web 0.3 or ubiquitous computing it is expected to reach 24 billion devices, the increasing of this number have a broad impact on the performance of the network.

In [5], to apply the cloud computing technology represented in Aneka software with IoT environment. Generally, cloud computing provides a set of features such as high storage resources, scalability, visualization platform and client delivery; plus the cost of each service based on pay-per-use. Aneka cloud computing software provides a utilize storage and computing resources of both public and private cloud.

Virtualization

Virtualization is known as the ability to share hardware resources among multiple operating systems. The virtualization technology allows for the multiple operating systems and software like applications or services to run upon the same server through creating more than virtual machine inside the physical machine. The vision of this concept helps to increase the performance of the network via increasing utilization, maximizing scalability, saving cost, etc. Actually, there are three areas used to represent the virtualization technology, namely, i) network virtualization, storage virtualization, and server virtualization.

In [3], created the framework called "an IoT Virtualization Framework based on Sensor as a service notion" this frame consists of three layers are: real world layer, semantic layer and virtualization layer in addition separately database to record useful information. Primarily, the main challenges in the IoT environment can be determined into three items namely, i) there is no registry mechanism, the framework possesses database to overcome this challenge; ii) the heterogeneity and discovery, the proposed framework sought to overcome of this issue through the semantic approach to deal with the heterogeneity by providing a standard language called Sensor Model Language "SensorML"; and finally iii) the interaction between event and service in the IoT environment are absent, the framework uses the Virtualization layer to deal with this challenge by efficient way. The future directions of this framework divided into two points are: enhancing its performance in real-time domain and improving micro-formats for advertising on social networks.

Big Data

Big Data is a new expression to describe massive data whether structure or unstructured, which is difficult to deal with traditional database methods and software techniques. Simply, Big Data defined as a large volume of data. Dataset considered as a Big Data when it meets 4 V's- value, volume, velocity, and variety. Big Data attracts almost a new industrial field such as online social networks (Twitter, Facebook, and Instagram); the collection of data through the social network is very huge, for example twitter in 2010 producing up 120 terabytes of data of the day. IoT is considered as a good example of Big Data as the amount of data which was collected from deploying sensors through IoT environment was very large and heterogeneous. The coupling between IoT and Big Data was very strong.

Cloud Computing

Cloud Computing and IoT are the most popular example to represent the ubiquitous computing field; but IoT is not popular like Cloud Computing, both use the distributed computing concept. Cloud computing is a way to access large amount of computational resources and supports a large number of users in a reliable and decentralized manner; it's also provide software cheaply. Cloud Computing consists of the three main layers are: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Service as a Service (SaaS) each one provide significant features through the cloud data center. Cloud computing is considered as a standard framework to represent IoT, and both IoT and cloud computing possess a set of benefits and restrictions. IoT represents real world and small things, but it is limited storage in addition to traditional problems in the network such as scalability and privacy; in other side, cloud computing has virtually unlimited capabilities and processing power [4]. The integration of cloud computing with IoT became a very important point of recent researches; to produce system able to overcome the many challenges such as scalability, storage resource and virtualization; can be considered the main objective of this integration is to leverage from cloud computing in processing power which need for sensors and other things.

Recently, a lot of researches are mentioned integration between cloud computing concept and IoT; for example not as a limitation sought to review the existing integration between IoT and cloud computing in the CloudIoT paradigm and illustrates the benefits from them. First of all, the transparence which come with the virtualization technology to hide the complexity of sensors from the end user; in addition to some of other features such as the storage resources, the cloud computing concept provides high capability to store large amount of data which collected from sensors; the big data considered as a new vision to restructure huge volumes of data through the IoT environment; the computational resources, one of the issues of IoT is limited processing resources Cloud Computing overcome this problem to improve scalability.

The cloud computing also provides a lot of efficient solutions for the most issues of IoT and sought to offer the new visions for these issues such as providing ubiquitous access to sensor data through Sensing-as-a Service (SaaS); enabling automatic control logics implemented in the cloud computing through Sensing and Actuation-as-a-Service (SAaaS); dispatches messaging services triggered by sensor events through Sensor Event-as-a-Service (SEaaS); enabling ubiquitous management of remote sensors through Sensor-as-a-Service (SenaaS); enabling ubiquitous database management through DataBase-as-a-Service (DBaaS); providing ubiquitous access to any kind of data through Data-as-a-Service(DaaS); providing ubiquitous layer-2 connectivity to remote devices through Ethernet-as-a- Service(EaaS); enabling ubiquitous access to policy and identity management functionalities through Identity and Policy Management-as-a-Service(IPMaaS); providing ubiquitous access to recorded video and implementing complex analyses in the Cloud through Video Surveillance- as-a-Service (VSaaS).

Power Consumption

The power consumption issue is a critical point in wireless networks. Typically, the efficiency of the work of sensors depends on the lifetime of the battery. Nowadays the most of devices are equipped with sensors such as smart mobile phone, tablet and laptop to deal with the modern applications. For instance, the application of weather prediction that is relied mainly on GPS to determine location; once the GPS application is turned on during the whole sensing procedure the battery may be drained very quickly. The paper was autonomously presented on mobile energy consumption of networked consumer devices to determine the approximation of the current power requirement. The paper represented the model of the proposed self-organized power consumption approximation (SOPCA) algorithm. The principle idea of this algorithm is the use of wireless connectivity between peer devices and servers, the devices discover other devices to propagate energy sniffer agent (ESA).

ESA locates devices and keeps estimating energy consumption. Source node also locates the other node by using GPS, ESA updates their internal variables based on the observation of local energy consumption then it moves to another node. The mechanism of SOPCA algorithm avoids a re-routing between devices by using flags on the individual devices. The authors used agent-based model (ABM) to test the proposed algorithm over random network.

Security and privacy

The security rule aims to protect it from threats; these threats classify into two kinds are: the external threats such as attacks on system form attackers and the internal threats represented in misuse of the system or information. There are three main factors of security are: data confidentiality, privacy and truth. Data confidentiality guarantees only the authorized users to access and modify data, and it includes two aspects: first, access control mechanism and second, an object authentication process. Truth is guaranteed to apply security rules into system and common example of truth is digital certificates. Privacy is defined as a control access to personal data; and it allows keeping certain information and data confidential; the features of privacy are secrecy, anonymity and solitude. The most current researches seek to increase and develop privacy in the applications, the Privacy Enhancing Technologies (PET) can be oriented to the subject, the object, the transaction or the system; it is used to protect identity over the

Internet. In the IoT environment the security and the privacy are important to guarantee a reliable interaction between the physical world and the cyber world.

In [2], Biplob R. Ray et al. proposed a framework dependent on group approach and collaborative approach called "a hybrid approach", and used security check handoff (SCH) with RFID. The SCH is a bet flags (0,1) (on/off) help to keep track of the security state of the tag; also the SCH allows the tag to take a shortcut to clear the security check or re-clearance tag. Notable, the most of the existing protocols which deal with RFID suffer from threats and vulnerabilities such as insecure, inefficient identification, throughput and inadaptability. The proposed protocol provides customization to ensure the adaptability of the new efficient techniques. The development of RFID security protocol makes the IoT more robust distributed structure.

III. CONCLUSION

A lack of standardization and development in silos has led to a heterogeneous platform landscape. We argue that, as a result of this heterogeneity, comparing and selecting one of these platforms is a difficult task. Not only do they use different concepts and technologies, but also the terminology is not clearly defined. Many concepts and parts of these platforms are described with synonyms or homonyms, or differ in granularity. To help with these problems, we introduced an IoT reference architecture which is based on existing platforms. We defined each component and described the communication between them. This paper provided the recent research directions towards internet of things.

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