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LEARNING LATENT REPRESENTATION FOR IOT ANOMALY DETECTION

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ABSTRACT:

In this paper, we seek to highlight the concept of Internet of Things (IoT) in general, as well as reviewing the main challenges of the IoT environment by focusing on the recent research directions in this topic. Recently, IoT has emerged as a new technology that is used to express a modern wireless telecommunication network, and it can be defined as an intelligent and interoperability node interconnected in a dynamic global infrastructure network, also it seeks to implement the connectivity concept of anything from anywhere at any time. Indeed, the IoT environment possesses a large spectrum of challenges has a broad impact on their performance, which can be divided into two categories, namely, i) General challenges: such as communication, heterogeneity, virtualization and security; and ii) Unique challenges: such as wireless sensor network (WSN), Radio Frequency Identification (RFID), and finally Quality of service (QoS) that is considered as a common factor between both general and special challenges. In addition, this paper highlights the main applications of the IoT.

Keywords: IoT; heterogeneity; virtualization; WSN; RFID; QoS

[1] INTRODUCTION

Today, we are living in the era of smart technologies which represents a "ubiquitous computing" or "web 0.3". Internet of Things (IoT) has emerged strongly as a more prosperous area to express this kind of a new technology. It is not the first technology in this field, but also the cloud computing technology has been used to represent the ubiquitous computing world. In the seventh in the series of ITU Internet Reports originally it was launched in 1997 under the title "Challenges to the Network", and it was first coined by Kevin Ashton in the RFID journal 1999, In 2005 this name was changed to "Internet of things". The vision of IoT according to Kevin's vision was to enable networked devices to propagate their information about physical world objects through the web. In

recent years, the most of the IoT proposed architectures are used, web semantic to publish information through the social networks; for instance, the iPhone has innovated service is Nike + iPod to record information and published it on the social networks and the social network friends . Actually, the definition of IoT varies based on who you talk, but formally, it can be defined as a dynamic global network infrastructure with self-configuration and interoperable communication. Simply, IoT means the ability to make everything around us starting from (i.e. Machine, Devices, Mobile phone and Cars) even (Cities and Roads) are expected to be connected to the Internet with an intelligent behaviour and taking into account the existence of the kind of autonomy and privacy. Meanwhile, the IoT environment contains a huge number of the different objects/things can be classified into two types namely; I) Things rechargeable batteries things: the most of them are mobiles (e.g. Laptop, tablets and mobile phone), and ii) Things are non-rechargeable things: these things are static from the mobility point of view. Generally, IoT includes three main demands are: the first, a shared understanding of the situation of its users and their applications. Secondly, software architecture and pervasive communication networks to cover and process contextual information, and lastly, the analytics tools in IoT that aims for autonomous and intelligent behaviour.

[2] ARCHITECTURE AND DESIGN

Best design of the architecture is a foundation stone to build a privileged IoT system; this architecture helped to address a lot of issues in the IoT environment such as scalability, routing, networking, etc.. Typically, the IoT architecture approach based on three main dimensions are:

Information items: it includes all items connected to IoT environment may be sensing items, identifying items and control items; ii) Independent network: which includes several features such as self-configuration, self-protection, self-adaptation, and self-optimization; and iii) Intelligent applications: which have intelligent behaviour over the Internet generally; the intelligent behaviour may be intelligent control, exchange data methods through network items, data processing, all the applications which are related to the IoT can be classified according to these dimensions, new space named “infrastructure of IoT”, which provides support systems to serve the special things, which can provide various services such as goods identification, location identification and data protection. Fig 2 depicts the three dimensions of IoT and relationship between them.

In this end, There are several approaches to build an architecture of IoT, the paper will focusing on two kinds namely, architecture called “EPC global network“ and another called “Unite and ubiquitous IoTs or U2IoTs”, to create an application on IoT, the architectural approach favoured which based on an open architecture the EPC global network. The system designed by AutoID centre for conveying the dynamic information about objects/things to provide a history of the product movement for the authorized users, the RFID technology plays a key role to differentiate between these mobile objects,

this system is called “the EPC global network”. The IoT uses the EPC global network as a principle to design the architecture framework .

2.1 Differences between IoT and Traditional network

In the beginning, the IoT technology has broken a lot of the traditional ideas of network and started a new era of telecommunication technology. Can be considered IoT as an extension and expansion network based on the Internet; but it is different from either traditional network or the so-called Internet of people and WSN although considered as backbone to build any IoT block. The major equation to represent the IoT environment is "IoT environment= Internet + WSN", it is a common statement that uses to express the IoT environment. To analyse and judge the correctness of this statement, must be determined the similarities and differences between IoT, Internet, and WSN according to table 1. From the previous knowledge about the IoT environment can be judged on this view, it's a wrong; because there are two basic reasons for rejecting this view. First; IoT may not necessarily use IP in all cases for addressing things, because nature of IoT needs lightweight communication protocols, the complexity of the TCP/IP protocol is not suitable in particular, when works with the smart little things. Second, the IoT environment is mainly based on the connected smart objects unlike traditional network. That’s what makes them move from only a mere extension of the Internet, also the behaviour of IoT depends on the creation of the interoperable systems [10], based on these arguments, can be corrected the previous statement:

IoT= Internet + WSN+ Smart Items surrounded by Intelligent environment.

International Journal of Computer Applications (0975 – 8887) Volume 128 – No.1, October 2015 39 Finally, IoT supports a set of useful features such as interoperability, self-configuration, self- adaptive and self-protection. The intelligent environment is a way to ensure the existence of a minimum level of the previously mentioned elements within the network.

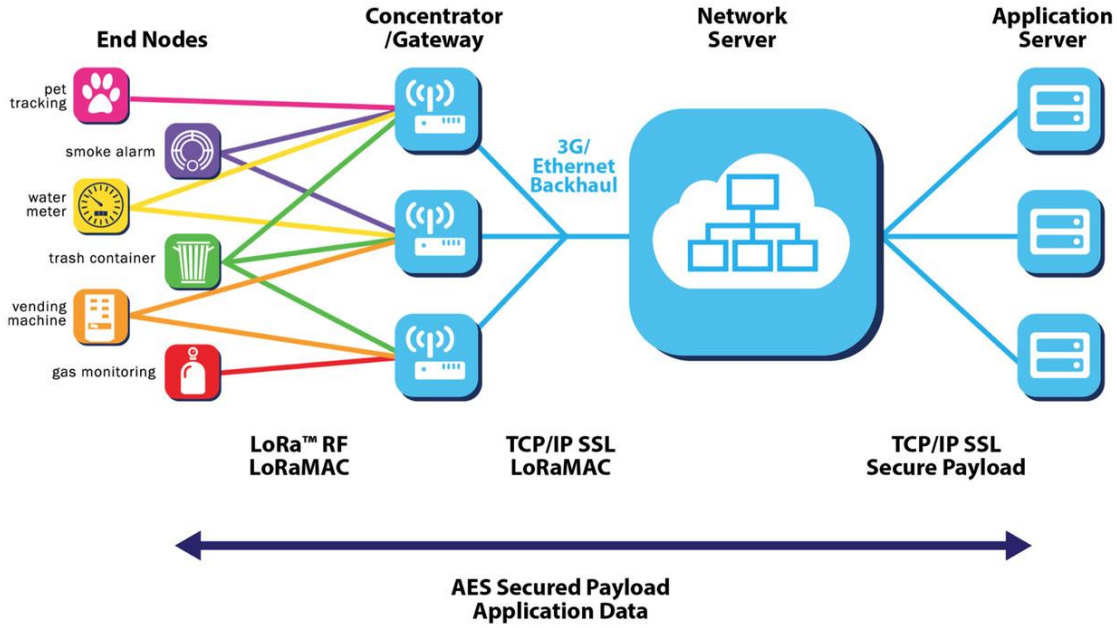

Fig 1: IOT Layers

[3] 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. Finally, Table 3 reviews the recent research directions and the proposed solutions for each one of them, in addition to table 4 which reviews the summary for the future research topics in the IoT.

3.1 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 [11] D. Giusto et al. 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.

3.2 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 [12], 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).

3.3. Interoperability

Interoperability concept can be defined as the ability to create systems or devices cooperating with each other in an efficient way. In [16] Jussi et al. 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.

[4] THE HOT TOPICS AND RELATED CHALLENGES –

The IoT consists of a host of other elements, which are considered as an extension for the general challenges of IoT or it can be called "unique challenges". The section seeks to explain some of these elements in a nutshell.

4.1 Radio frequency Identification (RFID)

RFID is a breakthrough in embedded communication and WSN, RFID is used to generate a unique ID for the object in WSN. It consists of two parts are: passive RFID: which used to power of the reader's interrogation signal to communicate the ID to the RFID, and access control International Journal of Computer Applications (0975 – 8887) Volume 128 – No.1, October 2015 43 application as well. Active RFID: readers have their own battery supply and instantiate the communication. RFID uses Ultrawide Bandwidth (UWB) technology to enhance RFID performance in a specific IoT application field. UWB is a technology allows the next generation of RFID to overcome many of the current restrictions in current RFID such as low security, reduce area, and sensitivity to interferences. The RFID contains three key elements are: the RFID tag or transponder that carries object, the RFID tags reader or transceivers that read and write tags and back-end database.

4.2 Wireless Sensor Networks (WSN)

WSN is an important part of IoT, it's considered as a core to build the IoT block, it consists of a group of specialized sensor data are shared among sensor nodes with communication infrastructure for monitoring some of events or states of objects such as temperature, sound, pressure, etc. these sensor nodes work autonomously and can be linked between them by self-organizing. Notable, WSN support the distribution concept between sensor nodes, and each sensor network includes some of elements such as radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source.
The section seek to show the components that make up WSN in the following:
 WSN hardware contains a sensor interface, processing units, transceiver units and power supply. WSN communication stack the nodes deployed in an ad-hoc manner for most applications. WSN middleware is mechanism to combine cyber infrastructure with service oriented architecture (SOA). SOA is an architectural style that enables the composition of applications by using loosely coupled and interoperable services. Secure data aggregation; it is a very important to ensure reliable data collected from sensors.

[5] CONCLUSION –

IoT is a one the main techniques that is used to express the ubiquitous computing approach, but it still not popular like the cloud computing technology. This paper has sought to highlight the IoT concept in general through the three sections namely; section I, reviewed an overview about the IoT concept via highlighting its history and its inception since 1999 at the hand of Kevin Ashton who considered as one of the pioneers who talked about IoT and even Cisco company now. Then it has reviewed the main idea to design the IoT structure that relies on the integration between three dimensions are: information items, independent network and intelligent applications. Accordingly, the future of the IoT structure relies on the integration among real or physical worlds, cyber-world and social world. Lastly, in this section is pointed out to the differences between both IoT and the traditional network. Section II, reviewed the main general challenges which had a significant impact on the performance of IoT such as communication, networking, Qods, scalability, virtualization, big data, heterogeneity and security; this section sought to illustrate and provide the recent solutions for each element of these challenges. Also, this section reviewed another kind of challenges that are called "unique challenges" under subtitle "The Hot Topics and Related Challenges" which includes more related challenges to the IoT environment. Finally, section III, reviewed a set of the popular applications which are offered by IoT and the IoT cloud paradigm such as healthcare, smart city, smart grid, smart transportations, etc.. Based on the above, can be considered the IoT environment as a rich search point, and flourishing area to the research in particular in the integration topic with cloud computing, which provides the new sceneries to handle the smart services and application.

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