INNOVATIVE KNOWLEDGE MANAGEMENT COLLABORATION THROUGH INTERNET OF THINGS

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Abstract

Nowadays communication is an essential part of our lives and Internet is one of the best medium to connect not only humans but other things such as services, systems and devices. A new paradigm shift has occurred in technology and the future is very near when every object will have its own identification and they can be connected just like humans. The implementation of this idea is also under process and few of its examples are already seen in the market such as Smart Thermostat, Smart washer/dryer. This is known as The Internet of Things or IOT, and this is the trend and where the future is. The basic idea behind this innovation is to make objects act like human. Radio Frequency Identification techniques (RFID) and related identification technologies will be used to tag the objects in the IoT. Many IoT devices have sensors that can register changes in temperature, light, pressure, sound, and motion. The IOT devices and system are integrated with internet using cellular, WIFI, 3G module, Wimax and each device is assigned a unique IP address which uses IPv6 address space. The benefit of these devices is that they work under low power and low bandwidth which make them special innovation. This paper describes the structure of IOT and its usage through library example. The starting section gives brief overview. Then it discusses the main architecture and trends of IOT. Finally a model for management of library with reference of IOT.

Keywords: Internet of things; Sensors; RFID

I. INTRODUCTION

The majority of our communication nowadays on internet is the interaction between human to human but the future will be different from it and it is going to be converted into IOT which links objects to each other over internet and it is going to be much larger than number of people connected today and in result human may become minority in generation [1].The new era of ubiquity is near in which new dimension of communication between human to things, and things to things will be revealed as shown in figure1. Giusto in 2010 defines it as the concept of pervasive presence of multiple objects such as tags, sensors, actuators, mobile phones interconnected through unique addressing schemes to access common goal [2]. According to US report IOT is included in one of the most disruptive civil technologies by US National Intelligence Council (NIC) [3]. According to them "By 2025 IOT will reside in everyday things like food packages, furniture, paper documents and others". IOT follows IPv6/6LoWPAN protocol Suit as it provides the best communication platform.6LoWPAN is a technology and

such IP infrastructure that allows merging all web services both old and new and also supports IOT paradigm [4].

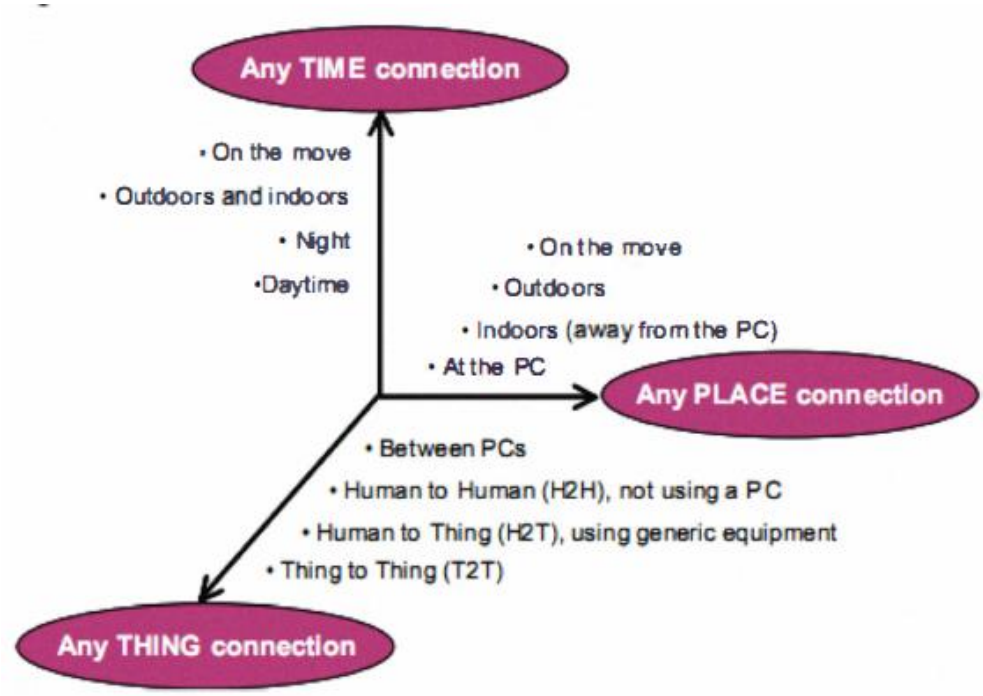

Fig 1. A New Dimension

a) VISION AND CONCEPT

The IOT will be going to change the trend in ICT development at large [5]. IOT gives a new vision to think on new approaches form conventional one that are currently used in networking. The concept of objects base on three pillars: 1- Identifiable (Any object identify itself), 2- Be in touch (Communicates with other objects) and 3- Intermingle (Interact with itself, network and end user). Smart object are such entities that:

- Have a set of associated physical features.
- Have communication facilities in them that can send, receive and understand messages.
- Have unique identification.
- Have some basic computing capabilities.
- May possess resources to feel temperature, light and other physical effects.

In Fig.2 the main IOT vision is highlighted. IOT is the convergence of three main visions: 1- Things-Oriented Vision, 2- Internet-Oriented Vision and 3- Semantic Oriented Vision [6].

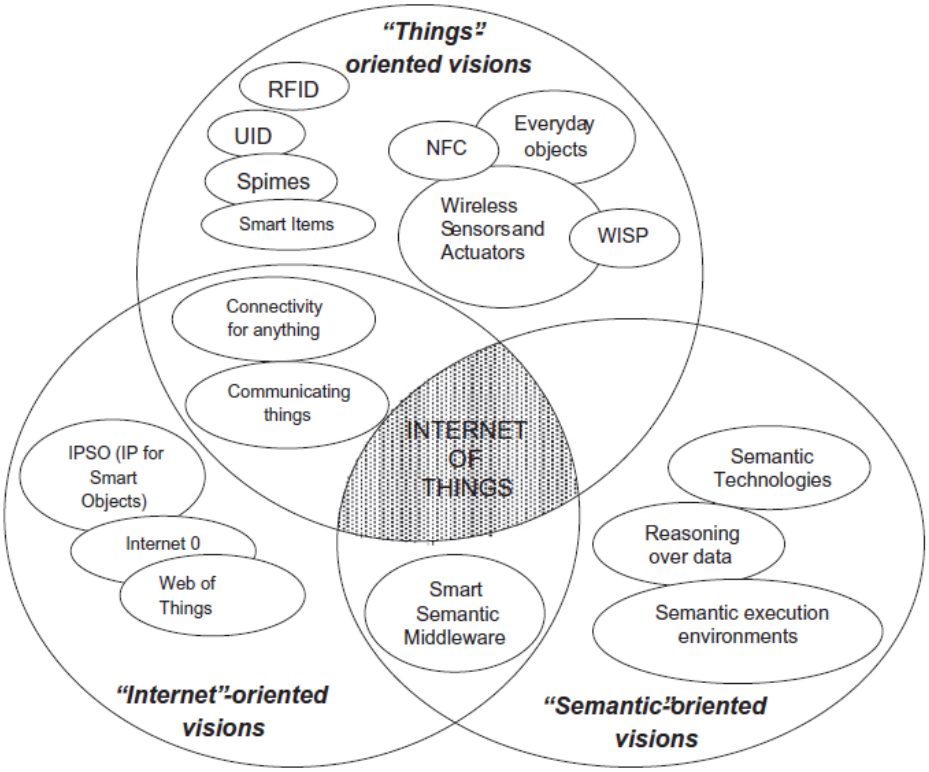

Fig.2 – Internet of things: Convergence of different visions.

b) FEATURES

Below are the features that IOT needs to support:

Devices Diversity. IOT is characterized by diversity in terms of smart devices having different communication and computational capabilities. To manage such high level heterogeneity, there must be architectural and protocols levels support.

Scalability. As smart objects are connected to each other, scalability concerns rises in terms of naming and addressing, communication, knowledge management and service provisioning options that must be available and handle such diverse resources.

Data exchange through wireless technologies. Wireless technologies will play a prominent role in order to share data. The adoption of wireless medium may pose issue in spectrum availability.

Energy-Optimized Solutions. For different IOT devices involved in computation and communication, minimizing the energy is primary constraint. Therefore device with such feature will be more attractive.

Tracking Capabilities. As entities can be identified and are provided with short range wireless communication, it is possible to track the location. It is much important in product life cycle management and logistics.

Data Management. IOT will be sharing immense amount of data, necessary to provide data in standardized format within defined language and formats.

Privacy Features. Security is the key requirement for IOT due to tight entanglement with physical realm.

c) MAIN TECHNOLOGIES

Radio frequency identification (RFID) is essential enablers for IOT. Through this technology objects can be identified and connected to each other. RFID uses radio waves to provide identification functionality [7]. Beyond identification this technology can also help in tracking to get real time information. RFID has been already utilized in health care, retail and facilities management. Sensors also play very important part in bridging physical and information world. Sensors collect data, generating information, raising awareness about context. Sensors do help in getting information about changing in environment and it assists in responding if required [8].Nanotechnology and miniaturization bring intelligence in things and make them smart. They can use information and process them and also vital in making decision.

II. TRENDS

Development trend of IOT includes three steps: Embedded Intelligence, connectivity and Interaction.

First step in development is embedded intelligences that can perform actions automatically. There are several examples like RFID tag embedded in food and RFID reader gives information about food; auto washing machine controller; engine controllers; inertial guidance system, etc. Although these devices work alone and there is no network or set of devices connected with each other.

So connectivity is the next requirement between such devices. The smart devices are named smart just because of this reason as they all connected with each other. Connectivity can be done wired or wirelessly. In IOT the basic them is to connect them wirelessly. There are many ways to connect them: WPAN, WSN, UMTS, GPRS, RFID, ZigBee, WiFi, WiMax, LAN, 3G, etc.

Connectivity does not ensure communication. We need such connectivity in which device can process information, self manage itself, make decisions for you and play their role in active manner. This kind of interaction will change from human – human to M2M communication. Fig. 3 shows the development trend of IOT [9].

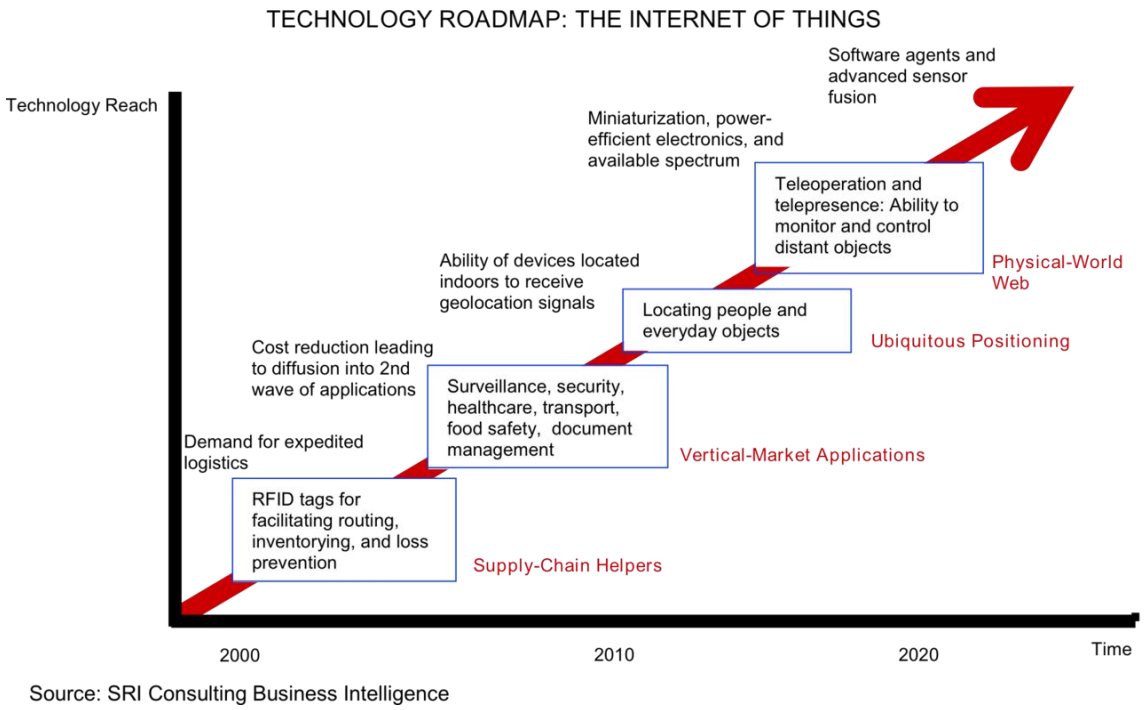

Fig.3 Trends of Internet of Things

III. STRUCTURE

Internet runs on TCP/IP protocols while in IOT with diverse devices and larger traffic needs more storage space. There is a huge mismatch between current utilization and original design of IOT. Redesigning is required but it is a complex project as many factors need to be considered. The key objective in IOT is service-oriented architecture (SOA), integration with internet, interfacing with wide range and its associated networks. RFID is handy for interfacing with physical world and include full range of edge technologies. The architecture is given below in Fig. 4 and Fig.5.

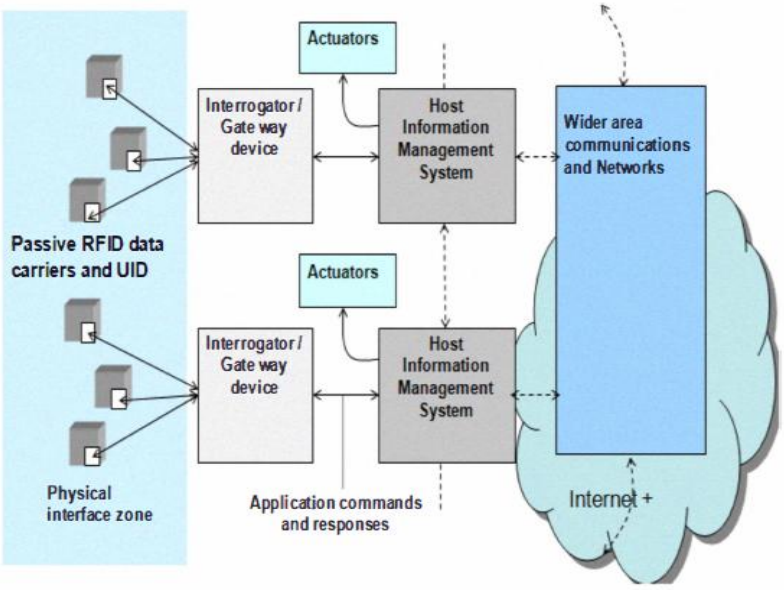

Fig. 4 Internet of Things – Basic Architecture

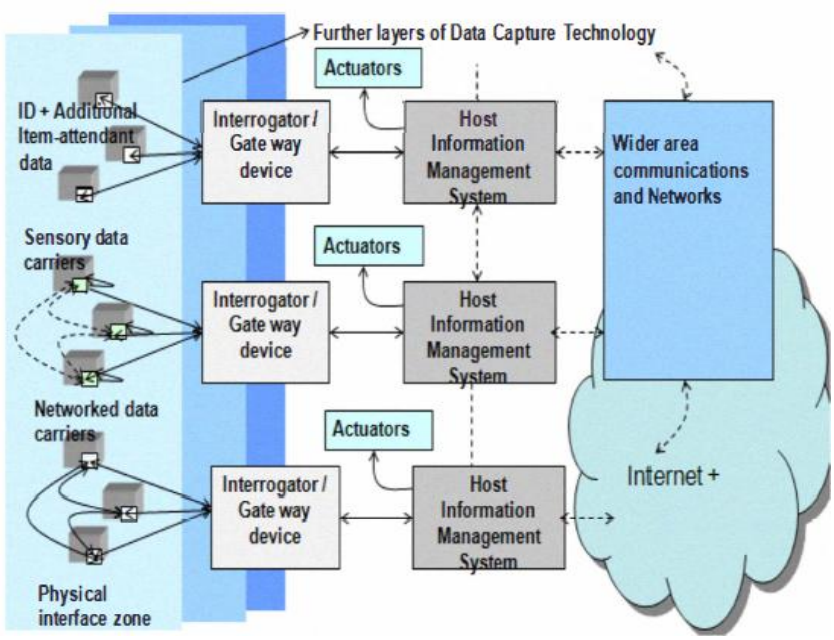

Fig. 5 Internet of things - Architecture with RFID and Edge Technologies

IV. IOT AN INNOVATIVE KNOWLEDGE MANAGEMENT

The functionality of IOT can be utilized in many places and in different applications as applied in Santander to monitor parking free slots, project was built by the collaboration of Telefonica and University of Cantabria. They have deployed 375 waspmotes used magnetic field to detect free parking slot and used Meshlium as device to collect information from those waspmotes to assist citizens in indicating the exact place to park their cars. IOT applications have been applied in different fields while connecting object to object to take benefits of IOT. IOT devices and its communication and coordination use to measure temperature, environment, water flow, in logistics for tracking and many others. The same knowledge management can be applied to manage libraries.

a). LIBRARY CONVENTIONAL SYSTEM ISSUES

The management of library includes various functions and the conventional system is becoming too complex and an automatic mechanism is required to reduce the processing time of librarian while enhancing the convenience for readers and providing real time information of library collection. Currently mostly library counter use bar code sensing device and in case of peak time if there are many books need to be borrowed by many borrowers makes things hectic and time consuming. With current system there are lots of efforts required to find the exact status of book and its classification because user needs more real time feedback. Poor inventory management is also an issue that needs to be improved.

b). IOT LIBRARY MODEL

To handle various functions of library, IOT provides the best model with its various kinds of sensing technologies. Our IOT model for library includes sensing devices like Waspmote devices [10] with multiple sensors like NFC sensor and zigBee sensors for location based service and can work over 3G / WiFi / RFID technologies for sending, receiving and sensing environment like temperature, humidity and CO2 with taking ultra low power in order to save energy.
A device that stores sensor data either in local database or over cloud like will be attached as shown in figure 6.

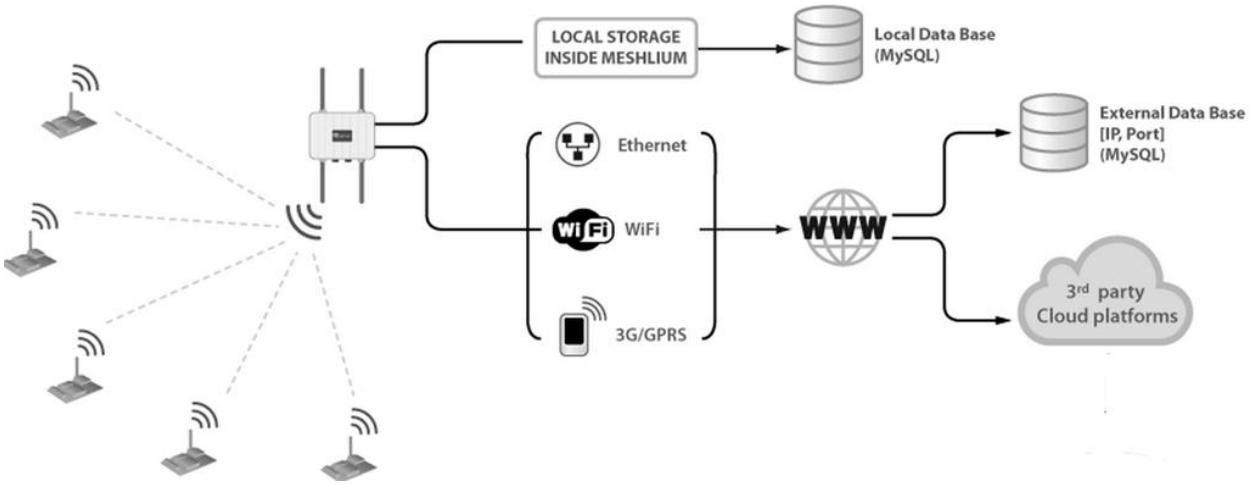

Fig. 6: Connection of Devices in IOT Model

Every book of library has been assigned a RFID tag as shown in figure 7 to give unique identification to the book. Information related to book will be written into tags like book name, author name, publishing date, special RFID code etc to identify books. The shelves of library will be converted to smart shelves by associating Waspmote devices with shelves that can read, write, send and receive data from books and small LED light system will be embedded with racks which will be connected to RFID devices and use to locate books.
RFID tags will also be integrated into library cards to streamline the entry and exit procedures. Self check out and check in systems will be placed at multiple location of library as shown in figure 8.

Fig. 7: RFID Tags

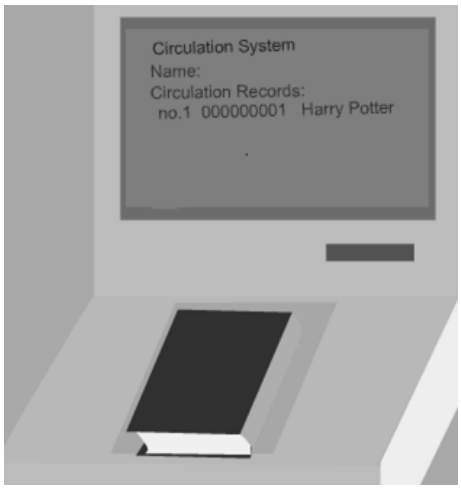

Fig. 8: Book Reader Automatic Self Check in/out System

For security purpose IOT model deploy detection gate including RFID management system using same RFID tags embedded in library items which have sensors equipped with video cameras as shown in figure 9 and 10. All of these objects will be connected to each other and having unique identification.

c). KNOWLEDGE MANAGEMENT FLOW

Each patron must have a library card to avoid any false entry. He will have to pass through detection gate and the sensor will open the gate while reading the tag from card and send information of the new patron to internal system. Nowadays almost each of the patrons has smartphone internet devices and such devices have strong potential to interact with internet oriented objects. Patron must have library interactive application installed in his device. This application will consist of library map and information of library items connected to internal database of library for information. Once user logs in, information sends to backend system with RFID tag number of user. User will inquire his desired library item and will click on the item for guiding him to the specific rack. The application will show him map with triggering another event which sends RFID tag of item that user clicks. As RFID's devices with sensors installed on racks of the shelves are connected to database system via connecting device, the message comes back to related device about patron's identification. Once user reaches near his desired rack the RFID will read the data from patron's card and blink an LED light.

Fig. 9: Detection Gate

Fig 10: Video Camera Sensors

to give signal for user convenience. Once book will be out of that rack, the device will generate another message to change the status of book into "Queue". User will borrow book by using self borrowing machines by inserting patron's library card and scanning RFID tag of book. Machine will give digital receipt to user and generates a message to make entry into the system and change the status of item to "Borrowed" so other patrons can get the real time status of book. For returning we will have multiple drop boxes in library where patron can drop his book and drop box with his sensing capability will read the tag and sends information to connecting device and change the status of book to "DropBox". The anti-theft gates would trigger the alarm when un-borrowed items passed through them and sensor will trigger a camera to record patrons.

The sensing devices will also use wireless modules sensing devices with it in library to take measurement of temperature, humidity and CO2 and trigger and event in case of any exceptional reading and SMS or call to user to take appropriate action.

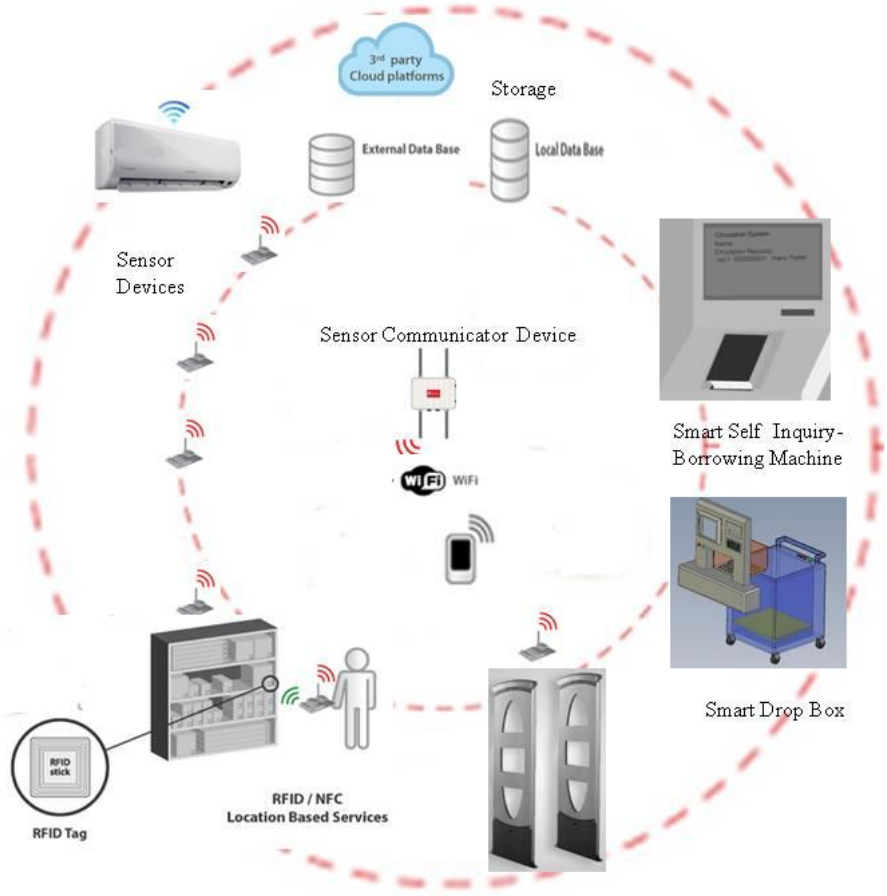

Fig. 11 Internet of Things: Objects connectivity for Knowledge Management

V. CONCLUSION

To conclude the above discussion, we can say that the future is IOT with all its innovation and beneficial application and it can be utilized in various manners depends upon utilizing its innovative capabilities and features but it is in its infancy age and besides with its innovative applications and one of its main features is its usage of multi communication technologies. In order to fully utilize its application TCP/IP protocol needs to be standardized and recognized. One of its major concerns with respect to its largest acceptance is security and privacy. Security and privacy does matter not only technical point of view but also socio-ethic and rules and regulations point of view.

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