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Implementation of IoT Technology in building Smart Cities

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ABSTRACT: Today the world is moving in building smart Cities and people want the world on their hands, It outlets the revolutions of computing and smart environment. Some technologies like ambient intelligence satisfy the maximum need of smart world but these technologies are not tightly coupled with internet, so the people need another technology extension. Internet of Things (IoT) is an ideal emerging technology to influence the internet and communication technologies. Simply "Internet of Things" connects “living and non-living things" through “internet". Traditionally in the object oriented paradigm everything in the world is considered as an object, but in the IoT paradigm everything in the world is considered as a smart object, and allows them to communicate to each other through the internet technologies by physically or virtually. IoT is the network of physical objects-devices, vehicles, buildings and other items embedded with electronics, software, sensors, and network connectivity-that enables these objects to collect and exchange data. The internet of things allows objects to be sensed and controlled remotely across existing network infrastructure. According to the Gartner, 260 million objects will be connected by year 2020. Several companies and governments have tried to make references with IoT in initial times, but nowadays in manufacturing, retail and SOC (Social Overhead Capital) industries, successful best practices are built recently. In this paper,we summarized tangible IoT based service models which are helpful to academic, Traffic Service and industrial world to understand IoT business.

KEYWORDS: Internet of Things, Smart city, Creative economy, Sensor, Business model

I. INTRODUCTION

In today's modern and smart trend people expect new devices and new technologies to simplify their day to day life. The innovators and researchers are always trying to find new things to satisfy the people but the process is still infinite. In the early 1990s, Internet connectivity began to proliferate in enterprise and consumer markets, but was still limited in its use because of the low performance of the network interconnects. In the 2000s Internet connectivity became the norm for many applications and today is expected as part of many enterprise, industrial and consumer products to provide access to information. However, these devices are still primary things on the Internet that require more human interaction and monitoring through apps and interfaces. The objective of IoT is Anything, Anyone, Anytime, Anyplace, Any service and any network. Fig. 1 describes the coupling of C"s and A"s. That reveals, people and things can be connected anytime, anyplace, with anyone, ideally by using in any path/network and any service.

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Figure 1. Objectives of IoT

This implies addressing elements such as Convergence, Content, Collections (Repositories), Computing, Communication, and Connectivity in the context where there is seamless interconnection between people and things or between things and things so theA and C elements are present and tightly coupled. This paper proposes a novel architecture of IoT enabled Smart home which is control and monitor smart devices through GSM and Internet Technologies. Normally the smart homes will be conscious about what happens inside a building, mainly impacting three aspects:

- Resource usage (water conservation and Energy consumption etc),
- Security
- Comfort

The user can control or check the status of any resources or enable/disable security options of the smart home. In this paper, the definition, status, components, and standards of IoT (Internet of Things) are introduced, and possible business models that can implement IoT in a smart city are examined. There are many research data on IoT in Korea, and IoT case studies have been conducted in other countries as well. However, there were few studies on IoT business models that were directly applicable to national and regional development. This study was conducted to present practical service models using IoT in line with domestic circumstances and thereby, it is expected to contribute to academic circles and related industries.

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II. IOT – INTERNET OF THINGS

2.1 OVERVIEW OF INTERNET OF THINGS

In the digital world, especially the computer communication starts with sharing data between machine to machine, and it moves to machine to infrastructure, then machine to environment, and machine to people but now internet is everything. The people also want to communicate with all non-living things through internet such as home appliances, furniture's, stationeries, clothes etc.

The people already have a lot of technologies to interact with living things but IoT enable to communicate with non-living things with comfort manner. IoT is a convergence of several technologies like ubiquitous, pervasive computing, Ambient Intelligence, Sensors, Actuators, Communications technologies, Internet Technologies, Embedded systems etc. see Fig. 2.

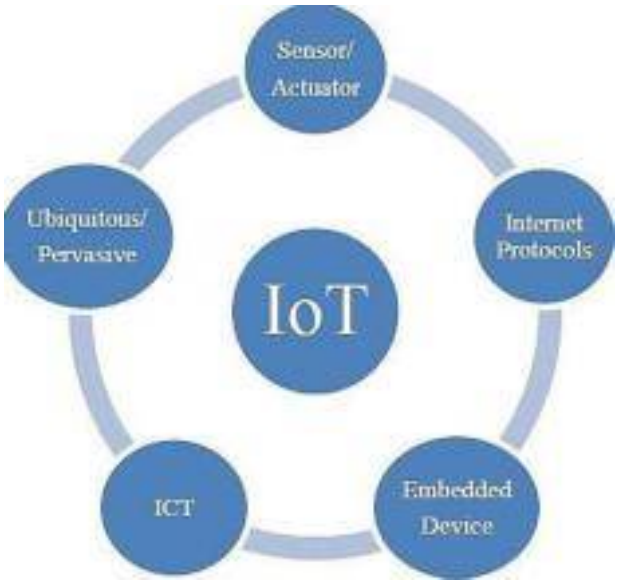

Figure 2. IoT architecture.

In the architecture, embedded system, sensors and actuators are the physical components which are directly interacting with the users. The users manipulate the data through these components. ICT, ubiquitous/pervasive computing, Internet protocols used to create communication among the devices and manage high end user interactions. According to the IoT architecture the components are further classified into three functional units (Fig. 3). In the IoT architecture, "Internet Oriented" represents internet and its technologies and it acts as a middleware between user and intelligent things and so it's called as intelligent middleware. Intelligent middleware will allow the creation of a dynamic map of the real/physical world within the digital/virtual space by using a high temporal and spatial resolution and combining the characteristics of ubiquitous sensor networks and other identifiable "things".

"Things Oriented" is known as "Intelligent Things" which represents sensors and actuators which is respond it to stimuli from the environment in a consistent manner. This phase sense and react based on the environment and user actions such as When white light is shown on a red object the dye absorbs nearly all the light except the red, which is reflected. At an abstract level, the colour surface is an interface for the object, and the light arriving at object Can be a message sent to the thing, and accordingly its reflection is the response from the thing. The consistency in responses received from the interfaces for each message, enables things to interact with their surroundings. Hence to make the virtual world comprehensible, there needs to be consistency in messages and it responses. This is enabled through standard interfaces, which is in turn to facilitate interoperability. Simply this phase focuses the functionalities and

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communications among sensor/actuators, embedded devices and any other smart devices.

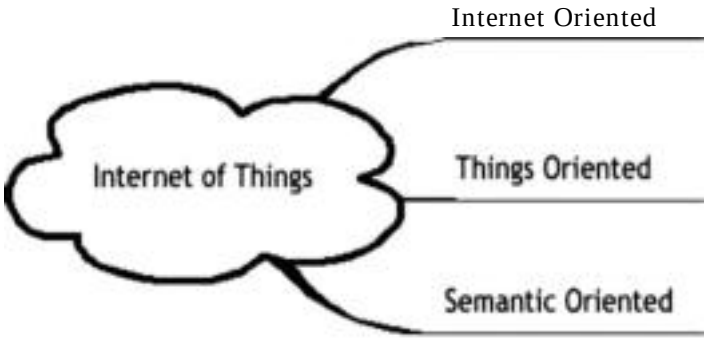

Figure 3. Classification of IoT based on functionalities.

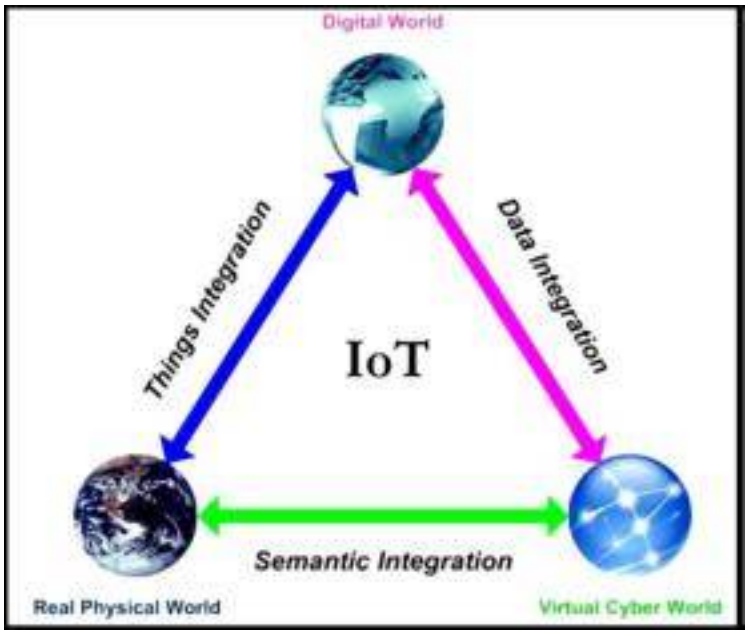

Figure 4. Functional Integration of IoT

"Semantic Oriented" is known as "Intelligent Process" which represents knowledge based and decision making processes.The rapid development of information technology (IT) has brought forward a hyper connected society in which objects are connected to mobile devices and the Internet and communicate with one another. In the 21st century, we want to be connected with anything anytime and anywhere, which is already happening in various places around the world. The core component of this hyper connected society is IoT, which is also referred to as Machine to Machine (M2M) communication or Internet of Everything (IoE).

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III. SMART CITY IMPLEMENTATION MODELS BASED ON IOT

Recently, many local governments have been aiming to implement an IoT-based smart city through the construction of a test bed for IoT verification and an integrated infrastructure. This movement also corresponds to the creative economy that is emphasized by the government.

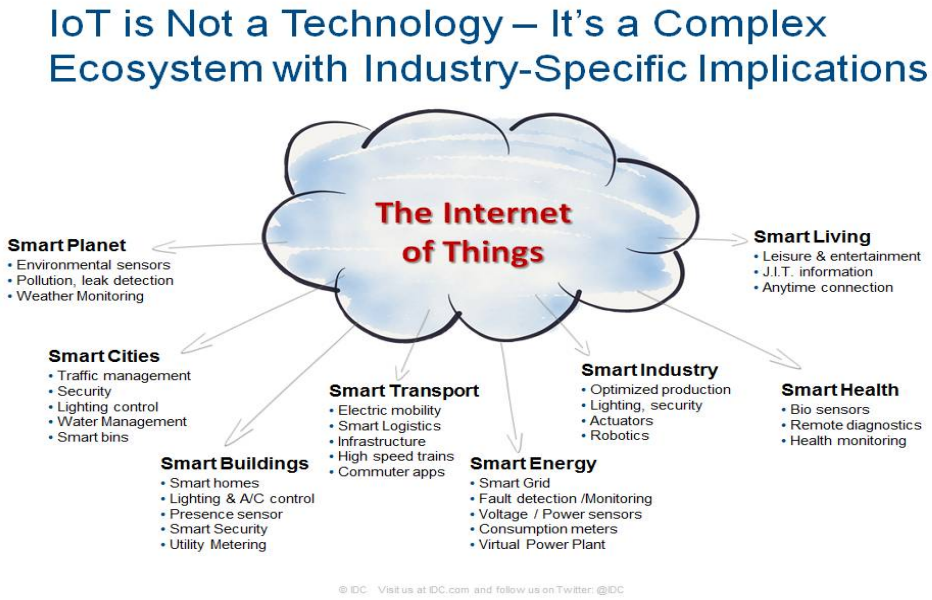

Figure 5.a Usage of IoT Technology

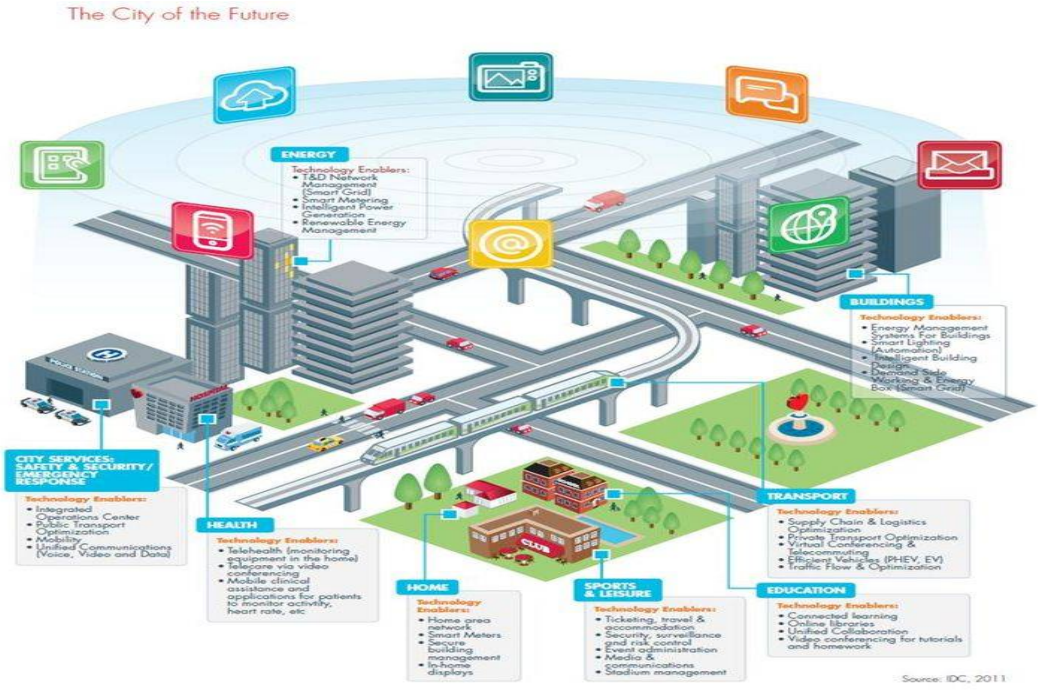

Figure 5.b Smart City blue print

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In this article, smart city implementation models based on IoT that can be implemented by local governments are described through examples.

3.1 SMART TRAFFIC SERVICE

(1) Service Outline

Major smart traffic services include smart parking services to prevent illegal parking and facilitate convenient parking, citizen participation-oriented illegal parking prevention services, and smart safe crosswalk services. Smart parking refers to the construction of a platform that enables real-time checking of available space and parking prices in areas that require parking and facilitation of reservation/payment through Web and mobile connections. The citizen participation-oriented illegal parking prevention service is an improvement of the illegal parking crackdown system of the traffic authority by allowing citizens (including victims of illegal parking) to conveniently report such violations through their smart phones. Furthermore, the smart safe crosswalk service can contribute to the prevention of pedestrian accidents and secondary car accidents by detecting pedestrians in children protection zones, and alerting pedestrians and approaching vehicles through electronic display boards.

(2) Service Diagram

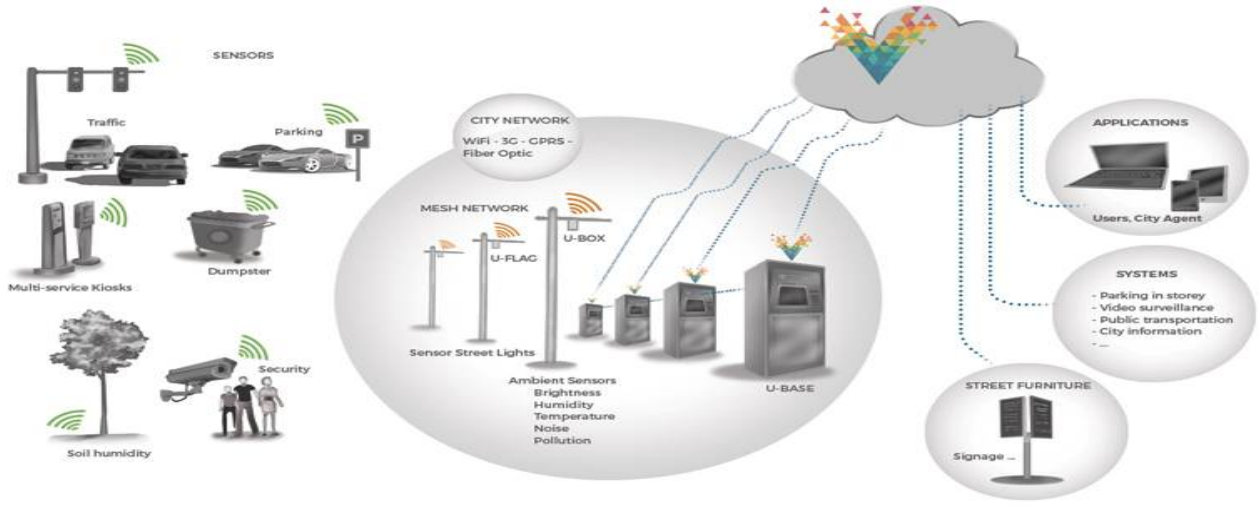

Figure 6. Smart Traffic Service Diagram

3.2 SMART GARBAGE & FOOD WASTE MANAGEMENT SYSTEM

Smart Cities constitute the future of civil habitation. Internet of Things (IoT) enables innovative services exploiting sensor data from sensors embedded in the city. Waste collection is treated as a potential IoT service which exploits robustness and cost efficiency of a heterogeneous fleet. In this paper we propose a dynamic routing algorithm which is robust and copes when a truck is overloaded or damaged and need replacement. We also incorporate a system model which assumes two kinds of trucks for waste collection, the Low Capacity Trucks (LCTs) and the High Capacity Trucks (HCTs). By incorporating HCTs we achieve reduction of the waste collection operational costs because route trips to the dumps are reduced due to high waste storage capacity of these trucks.

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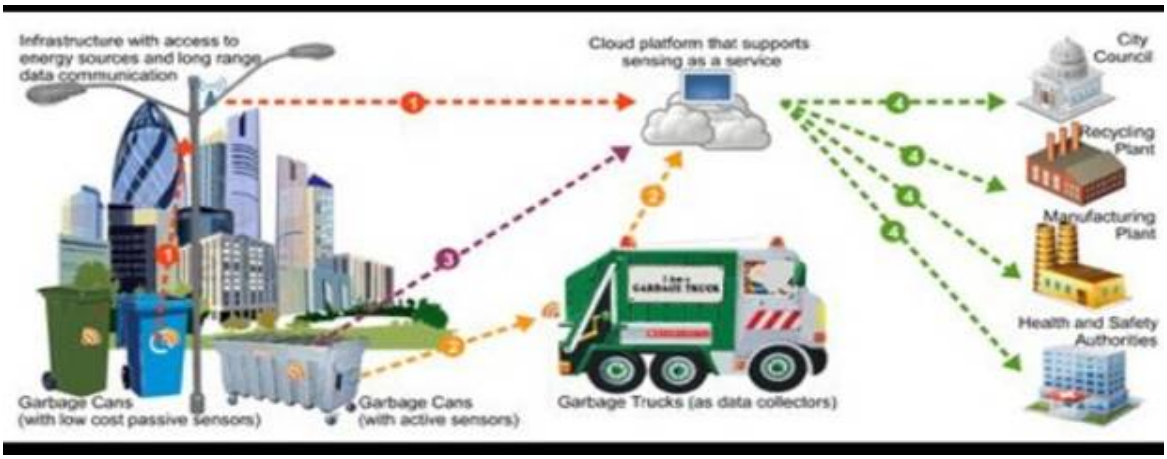

Figure 7. Smart Waste Management System Diagram

3.3 SMART EDUCATION SERVICE

(1) Service Outline

This service provides real-time, interactive high-definition lectures that feel like face- to-face meetings at home through high-definition (HD) services and wide-area Internet infrastructure. Instructors participate in the lectures by using equipment in private educational institutes or separate places, and even foreign language teachers in other countries can access this service through the Internet.

(2) Service Diagram

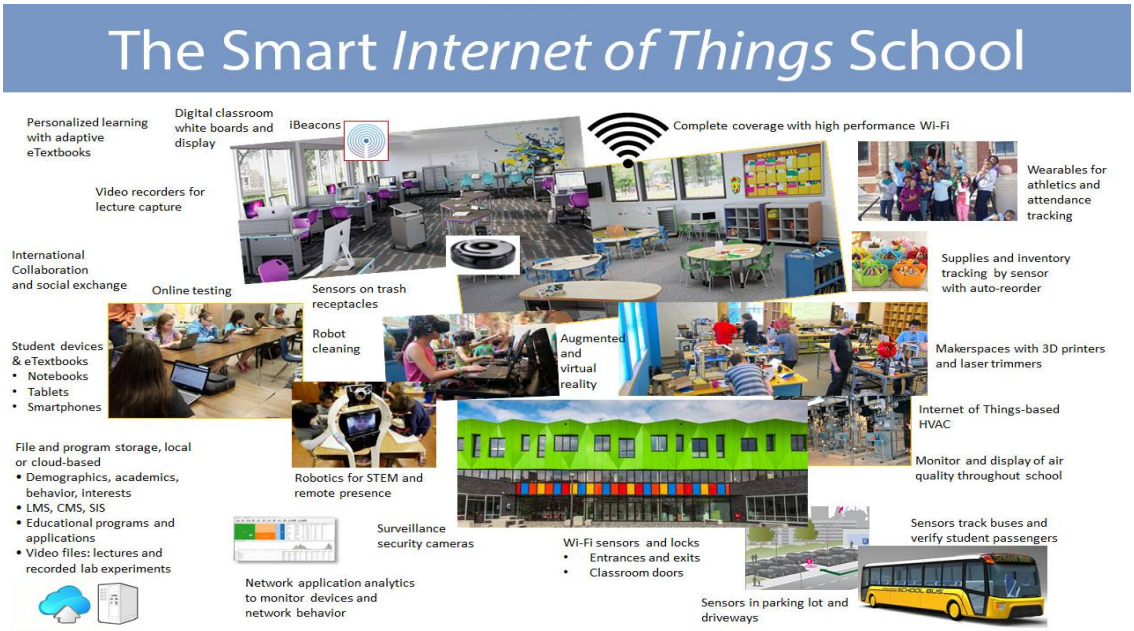

Figure 7. Smart Education Service Diagram

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(1) Service Outline

The proposal of system is to develop an IoT based Interactive Industrial Home wireless system, Energy management system and embedded data acquisition system to display on web page using GPRS, SMS & E-mail alert. This device is essential for sensor data collection and controlling of the industrial Home Wireless Sensor Networks (WSN) in the Internet of Things (IoT) environment. It is planned to style a re-configurable sensible device interface for industrial WSN in IoT atmosphere, during which ARM is adopted as the core controller. Thus, it will scan information in parallel and in real time with high speed on multiple completely different device information. Intelligent device interface specification is adopted for this style. The device is combined with the most recent ARM programmable technology and intelligent device specification. By detecting the values of sensors it can be easily find out the Temperature, Smoke, and Fire present in the industrial environment on the Website and we can handle any situation from anywhere in the world through IOT. So that critical situation can be avoided and preventive measures are successfully implemented.

IV. CONCLUSIONS

This study is significant in outlining general information about IoT, such as definition, market size, and status of IoT, which has become a hot IT topic nowadays, and in presenting applicable IoT business models to help business entities and research institutes participating in related projects build a smart city as part of the future vision of local governments by reflecting the new information paradigm of IoT. A limitation of this study, however, is the lack of available data in that hinders the required empirical analysis on the benefits of IoT technology. We hope that more research in this field will be conducted in the future.

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