Conceptual Smart Earth Model

AMC Priyashantha, AJCE Fernando#

General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

#eneshfernando@hotmail.com

Abstract— *The Internet of Things (IoT) is growing day by day rapidly with modern devices getting connected all the time. Smart world is envisioned as an era in which smart objects such as mobile devices, computers, transportation, communication etc. It automatically provide various services to humans in a particular manner. The conceptuality of a smart earth model, varies from city to city and country to country. This can be a long term goal and cities can work towards developing such comprehensive infrastructure incrementally, adding on layers of 'smartness'. This paper discuss various technologies such as Information and Communication Technologies (ICTs) to bring the earth to a live online conceptual model and retrieve data from the smart network for future and present decisions. Furthermore, smart earth model brings all living and non-living elements to a live model and users of the network can retrieve data without consuming much time. Base on the smart earth model users can predict the future conditions and can be prepared for any possible circumstances. Smart earth model mainly focus on health care, communications, power, transportation, weather, forensic data, infrastructure and much more networks which can be more useful day to day applications as well as military applications.*

Keywords— **Internet of Things (IoT), Information and Communication Technologies, Conceptual model.**

I. INTRODUCTION

The world is becoming smart day by day, introducing new smart concepts and technologies with the rapid growth of Science and Technology. People automatically connected to smart devices (e.g., mobile devices, computers, watches, wearable devices). Human to Machine communication era change rapidly to Machine to Machine communication with the IoT backbone. The concept of Internet of Things was adopted by the European Union in the Commission Communication on RFID, published in March 2007 (Palattella et al., 2013). "By 2025 Internet nodes may reside in everyday things, food packages, furniture, paper documents, and more. Today's developments point to future opportunities and risks that will arise when people can remotely control, locate, and monitor even the most mundane devices and articles. Popular demand combined with technology advances could drive widespread diffusion of an Internet of Things (IoT) that could, like the present Internet, contribute invaluably to economic development and military capability" (The US national intelligence council's global trends 2025, 2009). For example using water level and quality sensors mounted on a river, data can be uploaded to a server that is matched with a pre-defined data pattern which can be returned with a decision making of quality of water up to human consumption, floods due to over floor of river boundaries, available water quantity. Furthermore, wearable device automatically detects the person's abnormality in health conditions and send data to a dedicated server and traces the conditions with mapped data which is stored in a data bank and send emergency alerts to the nearest reachable hospital, dedicated consultant physician and GPS location of the person to ambulance and family members using his/her mobile, vehicle embedded Global Positioning System (GPS) transceiver. In this concept people's mental, social, physical and all other aspects are inter connected through a virtual model. Smart Earth model is more important in analysing past data and predict future scenarios in more prominent way.

II. LITERATURE REVIEW

Smart Earth Model is a modern concept which interconnect each and every element on earth with a virtual model. Most of the research conducted based on smart city concept. [14]. Huston, Rahimzad, and Parsa, 2015 discusses regarding Smart sustainable urban regeneration: Institutions, quality and financial innovation. Over 75 % from the conducted research and surveys identifies smart city trends, connectivity, and quality. The main scope in the present research is to focus on a smart earth model that connects all the elements surrounded. In addition, this model helps to collect and retrieve data in no time and helps to predicts future circumstances.

III. METHODOLOGY

Internet of Things (IoT).

Internet of Things (IoT) , enables the doors to the smart earth model concept by connecting various devices and objects such as wearable devices , mobile phones , vehicles , computers and much more with interchanging information and interacting with each other also with world. IoT was mainly developed by Massachusetts Institute of Technology (MIT) from Auto-ID center in 1999. In 2003, there were approximately 6.3 billion people living on the planet and 500 million devices connected to the Internet. By dividing the number of connected devices by the world population, we find that there was less than one (0.08) device for every person. Based on Cisco IBSG's definition, IoT didn't yet exist in 2003 because the number of connected things was relatively small given that ubiquitous devices such as smartphones were just being introduced. Explosive growth of smartphones and tablet PCs brought the number of devices connected to the Internet to 12.5 billion in 2010, while the world's human population increased to 6.8 billion, making the number of connected devices per person more than 1 (1.84 to be exact) for the first time in history. (Evans, 2011)

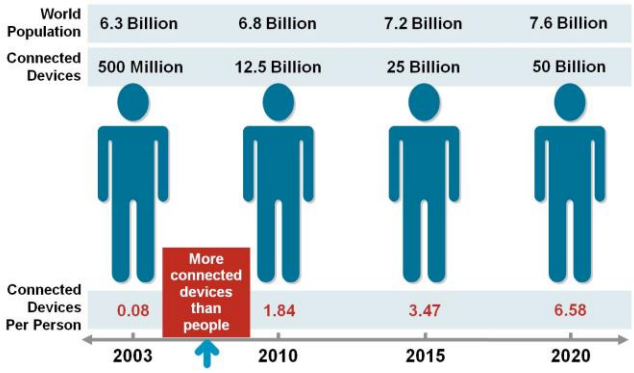

Figure 1. Growth of IoT (Source: Cisco IBSG, April 2011)

The key elements in IoT can be classify as sensing, communication, Cloud Based Capture & Consolidation, Delivery of Information. Sensing is collecting data from environment and sending data to servers, data center or a cloud. The sensing can be biometric, environmental, biological, audible or visual. The data is further analysed for a specific purpose. In communication many protocols available for IoT such as Near Field Communication (NFC) , IEEE 802.15.4 , Wi-Fi (IEEE 802.11).Collected data from sensors are transmitted to a cloud service where information aggregated with other storages to process useful information to the users. The processed information should be sent to the end user. Multiple device platforms across multiple operating systems can be used such as Android, iOS, Windows.

Achieving smart earth model through IoT , it gives access to large amount of valuable data in everyday things i.e., dynamic vehicular traffic conditions , real-time weather conditions , public transport schedules , plantations , literacy, forensic data etc.

APPLICATION

Smart Dynamic Vehicular Traffic Control System:

Unpredictable traffic conditions cause numerous problems in people's daily routines. Due to the increase in the number of vehicles on the roads more and more congestion is caused. However we are unable to get information of congestion in advance. Hence we need a method to monitor the traffic condition before reaching that area, in order to use alternative routes. Most of the present day vehicular traffic control systems depends on static vehicular traffic data which is not a perfect solution for the dynamic complicated traffic conditions. Hence we can implement traffic nodes and collect data according to a time period and process vehicular traffic count and upload to a server infrastructure which will controlled a Programmable Logic Controller (PLC) to change the node timing according to the live traffic condition. At the same time all the data can be updated to a mobile application which users easily access to the application which assist the shortest root according to the live vehicular traffic condition using Global Positioning System (GPS) to identify the user.

Smart Health Care System:

Health Care performance can be improved using embedded sensors and actuators in patients monitoring systems which can track the health conditions and upload the data patterns to a dedicated server or cloud which can be mapped with particular abnormal health conditions. Data can be collected from the hospital servers and personal wearable devices. System can be correlate with ambulance services and personal consultant physician.

Disaster Recovery Management System:

Unpredictable weather conditions can be monitored using pre placed sensors such as using smart weather stations we can collect the data and processed them. Weather station can accessed to the worldwide weather link and compare

the abnormality in weather (e.g., heavy rain falls, floods, Tsunami, volcano eruption, earth quakes) and lot of life's can be save by pre-assumption of natural disasters.

Smart Grid:
Power can be offered proportional to the population growth. Energy consumption can be enhanced using monitoring systems and enhance the Quality of Service (QoS). Meanwhile power system protection, power shedding can be analysed and production failures can be reduced.

Smart Building:
Buildings can be monitor and operated according to the smart earth model data fed from the servers. (e.g., responsible persons can analyse what are the opened windows, control the illuminance inside the building ecofriendly, heating and air-conditioning systems, weather conditions around the building, etc.)

Closed-circuit television (CCTV):
By addressing a particular node CCTV feeds can be achievable. This implementation can be used for security data recovery and forensic data analysis. A particular digital video footage can be gained using the smart earth model.
Transportation Schedules:
Data regarding the transportation schemes (e.g., Public Transport Systems) can be monitored and retrieve data using the smart earth model. (i.e., Tourists can access to a particular country train schedule and by submitting their start and destination they can retrieve live video feeds, prises and connect with other people who had experienced on particular transportation scheme and share ideas).

Technologies applies to achieve Smart Earth Model

M2M (machine to machine):
In the process of communication M2M is a data communication form which involves one or more entities without any human interaction. In 3GPP M2M known as Machine Type Communication (MTC). It can carried over mobile network infrastructure (e.g. GSM-GPRS, CDMA EVDO networks). Mobile network is used to serve as a transport network in M2M communication.

DC (data center):
Data Center facilitates to centralize IT (Information Technology) operations and equipment's, where it stores, manages and disseminates data. Asset Discovery and Asset Tracking can be done. Data Centers enable virtualization environment. Data Centers integration with real-time monitoring systems. Therefore it collect actual power usage/environmental data to optimize capacity management, allowing review of real-time data vs. assumptions around nameplate data.

CC (cloud computing):
Delivering computing services using internet backbone is known as cloud computing. Cloud services allow individuals and businesses to use software and hardware that are managed by third parties at remote locations. Cloud model can be access using computer source from anywhere with an available connection. (e.g., online file storage, social networking sites, webmail, and online business applications.) It provides a shared pool of resources, including data storage space, networks, Computer processing power, and specialized corporate and user applications etc.

RFID (radio-frequency identification):
RFID enables identification from a distance, it does so without requiring a line of sight. RFID tags support a larger set of unique IDs than bar codes and can incorporate additional data such as manufacturer, product type, and even measure environmental factors such as temperature etc. Furthermore, RFID systems can discern many different tags located in the same general area without human assistance.

WSN (wireless sensor network):
A wireless sensor network is a collection of nodes organized into a cooperative network. Each node consists of processing capability (one or more microcontrollers, CPUs or DSP chips), may contain multiple types of memory (program, data and flash memories), have a RF transceiver (usually with a single omnidirectional antenna), have a power source (e.g., batteries and solar cells), and accommodate various sensors and actuators. The nodes communicate wirelessly and often self-organize after being deployed in an ad hoc fashion.

WBAN (wireless body area network):
A WBAN will be a network containing sensor nodes monitoring , e.g., vital signs of the human body and a more intelligent node capable of handle more advanced signal processing etc., which all sensors report theirs data to. The sensor nodes could be on the body (wearable) as well as implant (inside the body).

Sensor Clouds:

Sensors are capable of sensing the several appearances and can be utilized in several areas like healthcare, defense, government services, environmental services etc. These sensors may provide various useful data but are closely attached to each of their relevant applications and services directly, causing several other services to be unused. Hence large number of our meaningful, expensive resources may become waste. But if anyhow we can integrate these sensors by sharing each other's valuable data through the number of unlimited services, it would accelerate the service creation. This is an infrastructure that allows truly pervasive computation using sensors as interface between physical and cyber worlds, the data-compute clusters as the cyber backbone and the internet as the communication medium.

Data market

Collected and processed data from servers and clouds can be processed in a useful client base method. Android, Windows and iOS based applications can be developed for the user requirements. Furthermore data pools can be created which can be host by the user based platform with easy access for the required information with in no time. Processed data can be host via web portals such that data will be automatically processed using intelligent algorithms and share with necessary peer applications. The system should be able to self-correct using the current data available in the system.

Security

Security is a major concern in this smart earth model. Smart Earth Model mainly depends on IoT applications and security attacks can be problematic in this manner. All sensors and actuators can be access by physically, and the system openness and accessibility for the system contains a wide risk arena. Earth model security concerns a high risk due to sensitive data (i.e., health conditions, personal documents etc.) Earth Model should provide its services in a random failure scenarios as well as attack situation. IoT applications should be able to recover effectively from security threats. After deploying the system it should adapt to the new attacks. System should capable with strong attack detection capabilities. System should be capable of self-healing from attacks and share the information with neighbouring systems.

Privacy

Smart Earth Model give access to, much valuable and useful data which these services can be useful as individuals but it creates more opportunities to violate privacy. To reduce privacy breaches smart earth model privacy policies should be specified. The privacy should be enforce with in the users of the system. New privacy language should be implemented. One of the most difficult privacy problems is that systems interact and communicate with other systems. Separate systems have their own privacy policies.

CONCLUSION

This paper discussed about the conceptual smart earth model development and various technologies and issues related to IoT, which plays a main role in achieving this smart earth model. Mainly we have established the concepts based on smart earth model using real time scenarios which can be performed using IoT backbone. The technologies related to smart earth model (e.g., RFID , Cloud Computing , M2M , Data Centers , etc.) have been introduced.

REFERENCES

[1] J. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, "Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions," Future Generation Computer Systems, vol. 29, no. 7, pp. 1645–1660, Sep. 2013.

[2] R. Palattella et al., "Standardized protocol stack for the Internet of (important) things," IEEE Communications Surveys & Tutorials, vol. 15, no. 3, pp. 1389–1406, 2013.

[3] "The US national intelligence council's global trends 2025," Population and Development Review, vol. 35, no. 1, pp. 209–214, 2009.

[4] D. Evans, "How the Next Evolution of the Internet Is Changing Everything," The Internet of Things, 2011.

[5] Mitchm, "Internet of things: The Four key elements," 2014. [Online].Available:http://intelligentproduct.solutions/blog/internet-of-things-4-key-elements/. Accessed: Jun. 08, 2016.

[6] P. Castillejo, F. Martínez, L. López, and G. Rubio, "An Internet of things approach for managing smart services provided by Wearable devices," International Journal of Distributed Sensor Networks, pp. 1–9, 2013.

[7] C. Zhu, M. Leung, L. Shu, and C. Ngai, "Green Internet of Things for Smart World," IEEE Access, vol. 3, pp. 2151–2162, Nov. 2015.

[8] A. Stankovic, "Research directions for the Internet of things," IEEE Internet of Things, vol. 1, no. 1, pp. 3–9, Feb. 2014.

[8] P. Neirotti, A. De Marco, C. Cagliano, G. Mangano, and F. Scorrano, "Current trends in smart city initiatives: Some stylised facts," Cities," vol. 38, pp. 25–36, Jun. 2014.

[9] P. A. Networks, "What is a data center," 2016. [Online]. Available:www.paloaltonetworks.com/documentation/glossary/what-is-a-data-center. Accessed: Jun. 11, 2016.
[10] Q. Han, S. Liang, and H. Zhang, "Mobile cloud sensing, big data, and 5G networks make an intelligent and smart world," IEEE Network, vol. 29, no. 2, p. 4045, Apr. 2015.
[11] J. Ma, T. Yang, O. Apduhan, R. Huang, L. Barolli, and M. Takizawa, "Towards a smart world and ubiquitous intelligence: A walkthrough from smart things to smart hyperspaces and UbicKids," International Journal of Pervasive Computer Communication, vol. 1, no. 1, p. 5368, Mar. 2005.
[12] R. Want, "An introduction to RFID technology," IEEE Pervasive Computing, vol. 5, no. 1, pp. 25–33, Jan. 2006.
[13] V. Albino, U. Berardi, and M. Dangelico, "Smart cities: Definitions, dimensions, performance, and initiatives," Journal of Urban Technology, vol. 22, no. 1, pp. 3–21, Jan. 2015.
[14] A. Alkandari, M. Alnasheet, and T. Alshekhly, "Smart Cities: Survey," Journal of Advanced Computer Science and Technology, vol. 2, no. 2, pp. 79–90, Jun. 2012.

ACKNOWLEDGMENT

Major AMC Priyashantha received his B.Sc degree in Electronic and Telecommunication Engineering in 1999 from General Sir John Kotelawala Defence University , Sri Lanka and B.Tech in 2009 from Jawaharlal Nehru University India. His current research interests are Internet of Things (IoT) , Wireless Sensor Networks (WSN) , Human-Computer Interaction (HCI) , and Electronic Warfare.

AJCE Fernando is currently pursuing the B.Sc degree in Electronic and Telecommunication Engineering from General Sir John Kotelawala Defence University , Sri Lanka.
He is a student member of IEEE and his current research interests are Internet of Things , Mobile Networks , Cloud Computing , Industrial Automation (PLC) and Robotics.