

IoT and its Smart Applications

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ABSTRACT

Due to the rapid growth of computing technology in last two decades, human effort of doing any works has drastically reduced. One of the most emerging areas in the field of computing technology is IoT which has completely changed human's life style. IoT is a sort of "universal global neural network" in the cloud which connects various things. Things define object or entity which has physical existence. So, IoT defines the use of intelligently connected devices and systems to leverage data gathered by embedded sensors and actuators in machines and other physical objects. The term, IoT although coined way back in 1999 by Kevin Ashton in the context of supply chain management, but it became popular after the onset of RFID (Radio Frequency Identification). Currently there are 9 billion interconnected devices and it is expected to reach 25 billion devices by 2020. Due to this rapid growth, it gained a great attention from the researchers. Several research works have conducted to create different smart applications using IoT such as smart supply chain management, Smart grid, Smart energy consumption, Smart transportation, smart waste management and monitoring system and etc. Now the next revolution will be the interconnection between objects to create a smart world in every aspect. In this paper, I review a concept of many IoT applications and future possibilities for new related technologies in addition to the challenges that facing the implementation of the IoT.

Keywords: IoT, RFID, GSM, Wi-Fi, IoT Applications, Smart Environment, WSN, Smart Applications

Internet of Things (IoT) is a concept and a paradigm that senses pervasive presence of a variety of things/objects in the environment through wireless and wired connections and then share the collected data over the internet with the help of unique addressing schemes to create new applications/services and reach common goals. It is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment. The IoT sensors can use various types of connections such as RFID, Wi-Fi, Bluetooth, and ZigBee, in addition to allowing wide area connectivity using many technologies such as GSM, GPRS, 3G, and LTE. IoT-enabled things will

share information about the condition of things and the surrounding environment with people, software systems and other machines. The goal of the IoT is to enable things to be connected anytime, anyplace, with anything and anyone ideally using any path/network and any service to provide a smart life and society^[7]. When things like household appliances are connected to a network, they can work together in cooperation to provide the ideal service as a whole, not as a collection of independently working devices. This is useful for many of the real-world applications and services. For example, one can use IoT for making a smart residence; air conditioner would be turned on automatically by detecting the presence of human in the room or light would be switched on by detecting the motion of human body. This kind of services make our life easier.

The term Internet of Things was first coined by Kevin Ashton in 1999 in the context of supply chain management^[5]. However, in the past decade, the definition has been more inclusive covering wide range of applications like healthcare, utilities, transport, etc.^[3]. Although the definition of ‘Things’ has changed as technology evolved, the main goal of making a computer sense information without the aid of human intervention remains the same. A radical evolution of the current Internet into a Network of interconnected objects that not only harvests information from the environment (sensing) and interacts with the physical world (actuation/command/control), but also uses existing Internet standards to provide services for information transfer, analytics, applications, and communications. Fuelled by the prevalence of devices enabled by open wireless technology such as Bluetooth, radio frequency identification (RFID), Wi-Fi, and telephonic data services as well as embedded sensor and actuator nodes^[10], IoT has stepped out of its infancy and is on the verge of transforming the current static Internet into a fully integrated Future Internet^[4]. The Internet revolution led to the interconnection between people at an unprecedented scale and pace. The next revolution will be the interconnection between objects to create a smart environment^[2]. The aim of this paper is to present the applications of IoT, Related Future Technologies, and the need for convergence in several interdisciplinary technologies.

Applications

Smart Residence: In home by using the IoT system, we can remotely monitor and manage our home appliances and cut down on our monthly bills and resource usage.

- ❖ **Energy and Water Use:** Energy and water supply consumption monitoring to obtain advice on how to save cost and resources.
- ❖ **Remote Control Appliances:** Switching on and off remotely appliances to avoid accidents and save energy.
- ❖ **Intrusion Detection Systems:** Detection of windows and doors openings and violations to prevent intruders.
- ❖ **Art and Goods Preservation:** Monitoring of conditions inside museums and art warehouses.
- ❖ **Wi-Fi:** Wi-Fi technology in home automation has been used primarily due to the networked nature of deployed electronics where electronic devices such as TVs, mobile devices, etc are usually supported by Wi-Fi.

Fig. 1 Shows an IoT embedded power controller with solar monitoring function which can be implemented at residence to smartly measure the consumption of electricity power and solar power by household electronic devices.

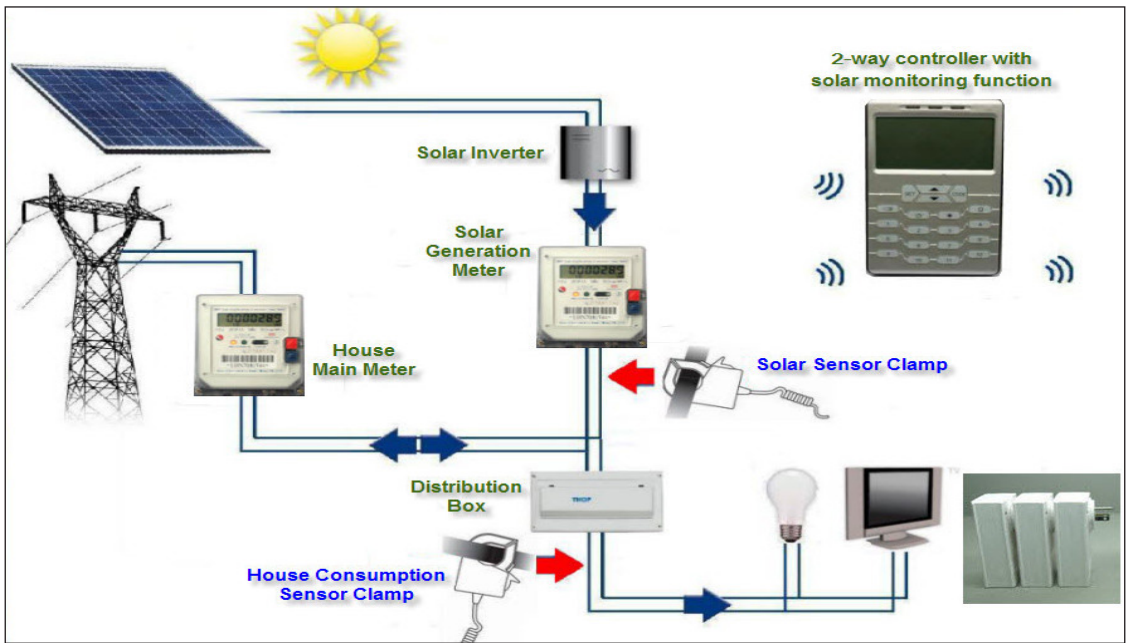


Fig. 1

Smart Cities: With the help of wired and wireless technology such as Bluetooth, radio frequency identification (RFID), Wi-Fi, and telephonic data services as well as embedded sensor and actuator nodes, IoT can make our city smart^[8]. Fig. 2 shows an overall diagram of IoT embedded smart city.

- ❖ Monitoring the traffic of the city and controlling the traffic without human interaction.
- ❖ Monitoring of parking areas availability in the city.
- ❖ Monitoring of vibrations and material conditions in buildings, bridges and historical monuments.
- ❖ Monitoring and detecting the real time data of public transport to make city's transportation more viable.
- ❖ Monitoring of vehicles and pedestrian levels to optimize driving and walking routes.
- ❖ Detecting air pollution by vehicles, factories in a city and sends warning message when air quality index will cross the limit.
- ❖ Installing electronic strolling display board in all public places
- ❖ Detect Android devices, iPhone and in general any device which works with Bluetooth interfaces or Wi-Fi.
- ❖ Measurement of the energy radiated by cell stations and Wi-Fi routers.

- ❖ Monitoring of vehicles and pedestrian levels to optimize driving and walking routes.
- ❖ Detection of rubbish levels in containers to optimize the trash collection routes.
- ❖ Intelligent Highways with warning messages and diversions according to the unexpected events like accidents or traffic jams.

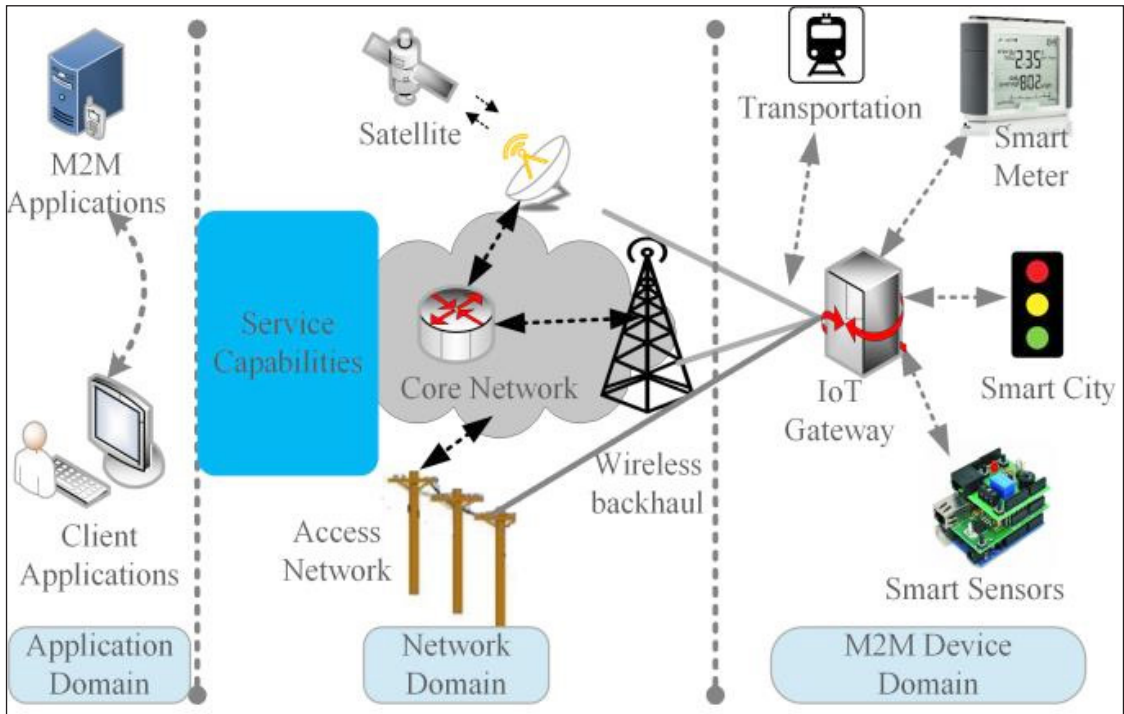


Fig. 2

Smart agriculture

- ❖ **Green Houses:** Control micro-climate conditions to maximize the production of fruits and vegetables and its quality.
- ❖ **Meteorological Station Network:** Study of weather conditions in fields to forecast ice formation, rain, drought, snow or wind changes.
- ❖ **Environmental monitor:** Monitoring the water level, humidity level and the light required by the plants.
- ❖ **Compost:** Control of humidity and temperature levels in alfalfa, hay, straw, etc. to prevent fungus and other microbial contaminants.

Fig. 3 shows applications of IoT in the field of agriculture to maximize the production and improve the quality of fruits and vegetables.

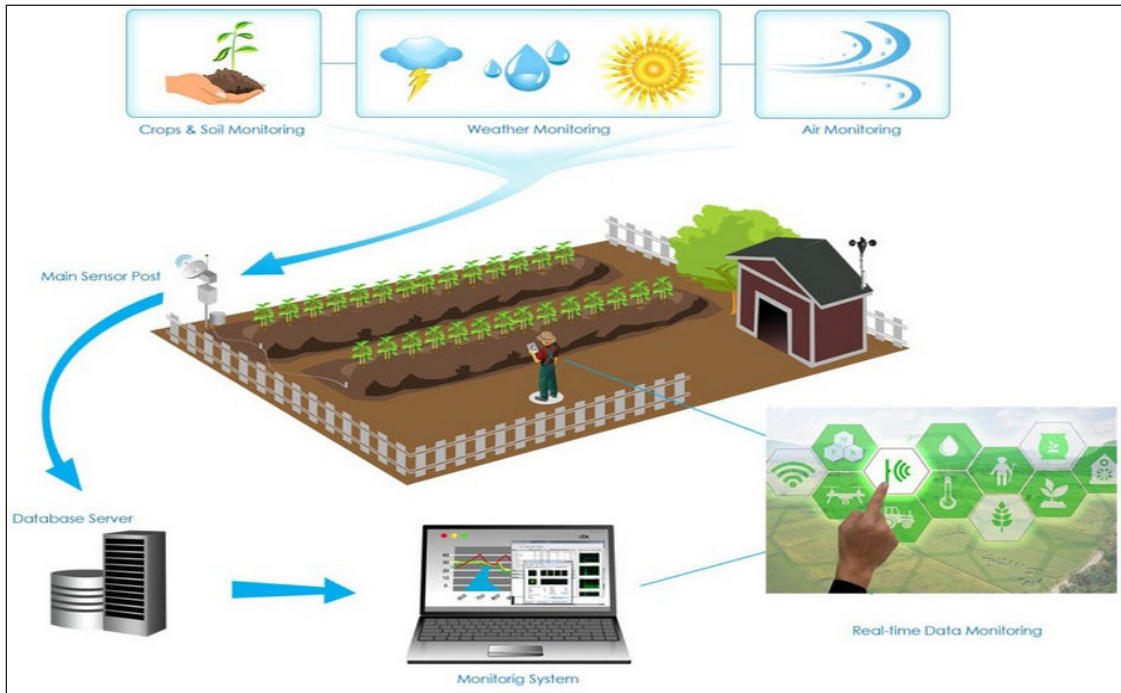


Fig. 3

Smart Transportation

Urban traffic is the main contributor to traffic noise pollution, urban air quality degradation and greenhouse gas emissions. Traffic congestion directly imposes significant costs on economic and social activities in most cities. Supply chain efficiencies and productivity are severely impacted by this congestion causing freight delays and delivery schedule failures. With the help of IoT, smart transportation and smart logistics^[1] can improve the air quality and traffic congestion in city. Dynamic traffic information will affect freight movement, allow better planning and improved scheduling. The transport IoT will enable the use of large scale WSNs for online monitoring of travel times, origin–destination (O–D) route choice behaviour, queue lengths and air pollutant and noise emissions. Fig. 4 shows that with the help of transport IoT, travellers can get instant information about any public vehicles, approximate time to reach destination, traffic information and etc.

Smart Environment: The environment needs a smart ways and new technologies for monitoring and management. Monitoring the environment is important in order to assess the current condition of the environment to takes correct life decision according to collected data from monitoring systems, and management is needed to have an efficient resource consuming and use in addition to decrease the factories and vehicles wastes. Both monitoring and waste management provide a large amount of data to force the health standard by governments or healthy environment organizations to protect people and environment, and to mitigate or to avoid natural disaster that might occur.

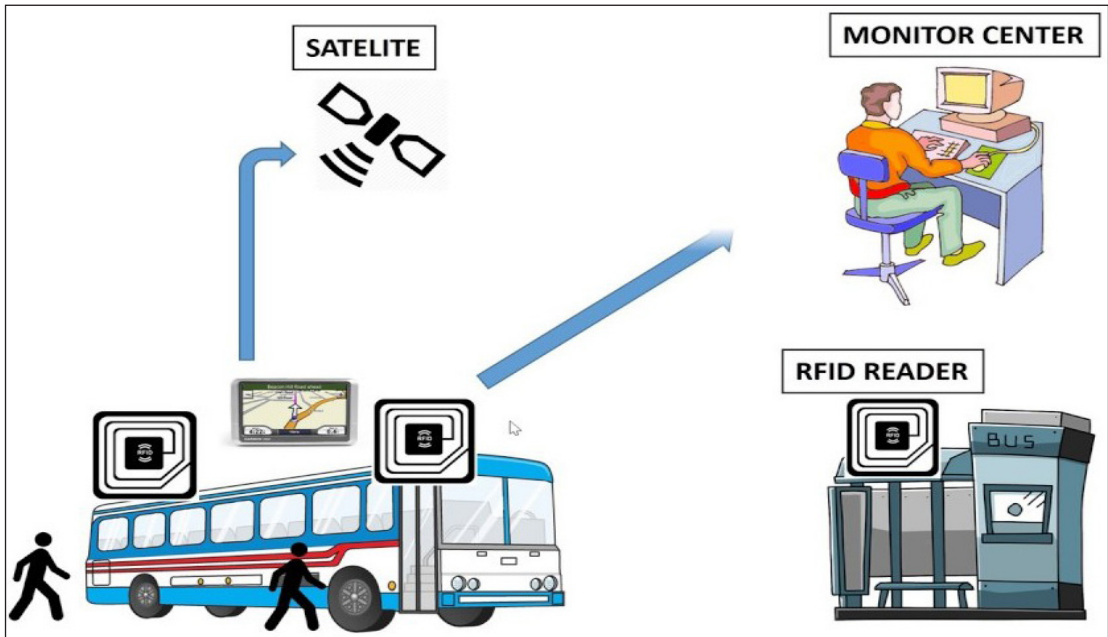


Fig. 4

Other environment aspect is a weather forecast and monitoring. IoT can provide a high resolution, and accuracy for weather monitoring by data exchange and information sharing. It's enabling weather systems to collect data from various vehicles on the road, and wirelessly communicate to the weather stations to support data that is inclusive of air temperature, barometric pressure, visibility or light, motion and other data needed. Sensors equipped in many buildings, vehicles integration with IoT help in collecting weather data which is further stored in clouds for analysis^[9].

CONCLUSION

The IoT promises to deliver a step change in individuals' quality of life and enterprises' productivity. Through a widely distributed, locally intelligent network of smart devices, the IoT has the potential to enable extensions and enhancements to fundamental services in transportation, logistics, security, utilities, education, healthcare and other areas, while providing a new ecosystem for application development.

A concerted effort is required to move the industry beyond the early stages of market development towards maturity, driven by common understanding of the distinct nature of the opportunity. This market has distinct characteristics in the areas of service distribution, business and charging models, capabilities required to deliver IoT services, and the differing demands these services will place on mobile networks. The internet of things promises future new technologies when related to cloud, distributed computing, big data, and security issues. By integrating all these issues with the internet of things, smarter applications will be developed as soon. It is hoped that a common understanding of the characteristics of IoT will enable industry stakeholders to collaborate more effectively in order to propel the market forward for the benefit of consumers and society.

REFERENCES

1. Menon1, *et al.* 2013. "Implementation of internet of things in bus transport system of Singapore". *Asian Journal of Engineering Research*.
2. Gubbi, Jayavardhana, *et al.* 2013. "Internet of Things (IoT): A vision, architectural elements, and future directions." *Future Generation Computer Systems*, 29.7: 1645-1660.
3. Sundmaecker, H., Guillemin, P., Friess, P. & Woelfflé, S. 2010. *Vision and challenges for realising the Internet of Things, Cluster of European Research Projects on the Internet of Things—CERP IoT*.
4. Buckley, J. (Ed.), 2006. *The Internet of Things: From RFID to the Next-Generation Pervasive Networked Systems*, Auerbach Publications, New York.
5. Ashton, K. 2009. That "Internet of Things" thing, *RFID Journal*.
6. Karimi, Kaivan, and Gary Atkinson. 2013. "What the Internet of Things (IoT) needs to become a reality." White Paper, FreeScale and ARM.
7. Ezechina, M.A., Okwara, K.K. & Ugboaja, C.A.U. 2015. The Internet of Things (Iot): A Scalable Approach to Connecting Everything. *The International Journal of Engineering and Science*, 4(1): 09-12.
8. Stankovic, John. 2014. "Research directions for the internet of things." *Internet of Things Journal*, IEEE 1.1: 3-9.
9. Vermesan, Ovidiu, and Peter Friess, eds. 2014. *Internet of Things-From Research and Innovation to Market Deployment*. River Publishers.
10. Yashiro, Takeshi, *et al.* 2013. "An internet of things (IoT) architecture for embedded appliances." Humanitarian Technology Conference (R10-HTC), 2013 IEEE Region 10. IEEE.

