

Study and Analysis of Internet of Things for Monitoring Fire

S. R. Vijayalakshmi^{*a} and S. Muruganand^a

ABSTRACT

This article gives the analysis on the development and advantages of Internet of Things (IoT) on fire monitoring application in many aspects, such as requirements of fire fighting, logistics of fighting products, supervision of fighting product quality, monitoring of construction firefighting facilities, maintenance of fire fighting facilities, home fire fighting safety, fire fighting equipments and establishing smart city fire monitoring.

Keywords: Internet of Things; fire monitoring; smart city; security; fire safety;

I. INTRODUCTION

The application of Internet of Things (IoT) in firefighting industries are important to design a smart city. The three main characteristics of IoT on fire are (i) fully perceivable (ii) reliable transmission and (iii) information processing. IoT can be used to assure the fire fighting security and maintain social stability. The fire monitoring could be done by the IoT as per following steps. Environment is perceived independently by the IoT things. IoT exchanges data and information as per environment changes. It make spontaneous reaction according to time and environment. It provides service interfaces to the people. Hence people easily consult different kinds of smart interfaces of Internet about the status and information of things. IoT is an information industry with computer, internet and mobile communication network. IoT can be divided into three layers for fire monitoring application such as perception layer, network layer, and application layer. The perception layer consists of various kinds of sensors and interfaces for network to perceive the environment and to identify objects or fire events. The network layer consists of different specialized network, Internet, wire and wireless communication network, network management and cloud computing for transmitting and processing information provided by the perception layer. The application layer is interface between IoT and users for intelligent application.

Perception layer

The perception layer is composed of different kinds of sensors and sensor gateway. It is mainly used to identify objects and collect the information of the environment. It determines the physical address by the unique identification of objects. It perceives the environment by transmission of sensors. It is the foundation layer for the application and development of IoT.

Network layer

Network layer includes mobile communication network, Internet, satellite network, radio and TV network, industrial Virtual Private Network (VPN) and integrated network. It is similar to human nerve and brain. It transmits and processes information sent by the perception layer. It is used for data saving, consulting,

* Department of Electronics and Instrumentation, Bharathiar University, Coimbatore-641046, Tamilnadu, India, *E-mail:* svijisiva@gmail.com *(corresponding author)

understanding and decision making. Cloud computing platform is the technology used for data processing platform in network layer.

Application layer

The application layer provides colourful services for end users by processing analyzed specific data from perception layer. It is the purpose of Internet development and service target. It gives intelligent control technology.

The rest of the paper is organized as follows. Section 2 presents the related work analysis. In Section 3 the IoT on fire application is presented. Section 4 presents the system implementation and suggestion on development of IoT on fire. Section 5 provides suggestions on developing IoT for fire monitoring application and finally conclusion is discussed.

II. RELATED WORK

Son. B (1) was discussed about a design and implementation of forest-fires surveillance system based on wireless sensor networks for south Korea mountains. Talpur et al. (2) designed a healthcare monitoring system depends on the use of internet of things (IoT) technologies. Wei Tan *et al.* (3) is discussed the mine fire detection system based on Wireless Sensor Network. The Gui Yang *et al.* (4) are analyzed about the study on remote monitoring system for landslide hazard based on Wireless Sensor Network and its application. Junguo Zhang *et al.* (5) are discussed about the forest fire detection system based on a ZigBee wireless sensor network.

III. IOT ON FIRE APPLICATION

The IoT on fire can be specially applied in fire fighting field. The fire fighting facilities with IoT is helpful to perceive the hidden dangers of fire, detect and timely come out earlier fire disaster and intelligently evacuate people during fire. Any people can feel personally at any time about the fire fighting management around them. By the application of IoT on fire monitoring, people have a good awareness of fire fighting.

Requirements of fire fighting

People require excellent physical environment monitoring. IoT fire monitoring gives ability to stand against fire disasters. It definitely ensures highest level of fire protection and safety. People themselves prepare to meet fire protection and fight against fire. They could able to monitor the system in global is excellent in IoT.

The IoT in the logistics of fighting products

Each firefighting product has a unique identification by the classification and coding standardization technology. At the same time the production unit, design unit, logistics unit, construction and commissioning unit, and any other units related with fire industry's physical location and service relations in the fire fighting product supply chain can be coded. Hence, the processes, status and direction of flow of fire fighting products can be traced and managed by the technique of identification devices.

The IoT in the supervision of fighting product quality

Enterprises can produce fire fighting products only after being certified by relevant authorities. These products can only be accessible to market after the qualification of the relevant departments. Market access system shall be practiced in the market of fire fighting products. Therefore they are intelligently monitored during the circulation and inspected where Internet is available. Any quality problem is found, people can report to quality inspection institution and make follow up at any time and place.

The IoT in the monitoring of construction firefighting facilities

The fire fighting monitoring system is built around a city to transmit fire fighting information within buildings by communication and network to distant fire fighting monitoring center. By IoT fire fighting technology, each related person within buildings can have a good understanding on the safety of own environment by Internet or communication network. Hence, a full participation of citizens on firefighting can be realized in this easiest way.

The IOT in the maintenance of firefighting facilities

Fire fighting facilities are characteristics of high professional, high reliability and long stand by time. Once a product has some mistakes, IoT can find them in time and inform relevant institutions to make specialized maintenance. The physical location of the manufacturers products can be traced so that maintenance responsibility can be properly handled.

The IOT in home firefighting safety

Smart intelligent home create a high efficient home living management system by Internet technology or IoT. With the development of modern nuclear family, time of home vacancy becomes longer and home property becomes more. People begin to pay more attention on family fire fighting. By IoT of home fire fighting, people can make real time monitoring and management on their homes by Internet and communication network. IoT of fire fighting safety is a part of intelligent smart home. It is also both an important and feasible part. By IoT more and more people and families may become more aware of fire fighting safety.

The IOT of firefighting equipments

Experts and responders may realize the real time monitoring to the site of disasters by public security specialized communication network platform. This IoT technology provide precise and real time site information to firemen. Experts from different fields may get information at any time and place. They are able to monitor and judge degree of danger. Based on danger they set the status and orders to fireman according to site information. They could make timely orders of withdrawal and diminish the casualties of fireman. The IoT of fire fighting equipments include detecting equipments, protective equipments and fire fighting materials etc. The IoT of fire fighting equipments can realize control management on the production, delivery, warehouse, usage, maintenance and declared damage of fire fighting equipments. Hence IoT improve the efficiency of material management.

Establishing smart city fire monitoring

The Smart City concept has been revolutionized and has evolved into a new era with recent developments in IoT that combine wireless sensor networks and computer networks. The smart security is one of the components of smart city as shown in figure 1.

IV. SYSTEM IMPLEMENTATION AND SUGGESTION ON DEVELOPMENT OF IOT ON FIRE

The system is implemented by the different following methods.

The application of identification card information in firefighting products

Identification card management system is implemented for all fire fighting products such as fire extinguisher. This is gives single unique identification RFID tag and build a nationwide firefighting product information database and tracing of management system. This system can realize an Internet based dynamic tracing

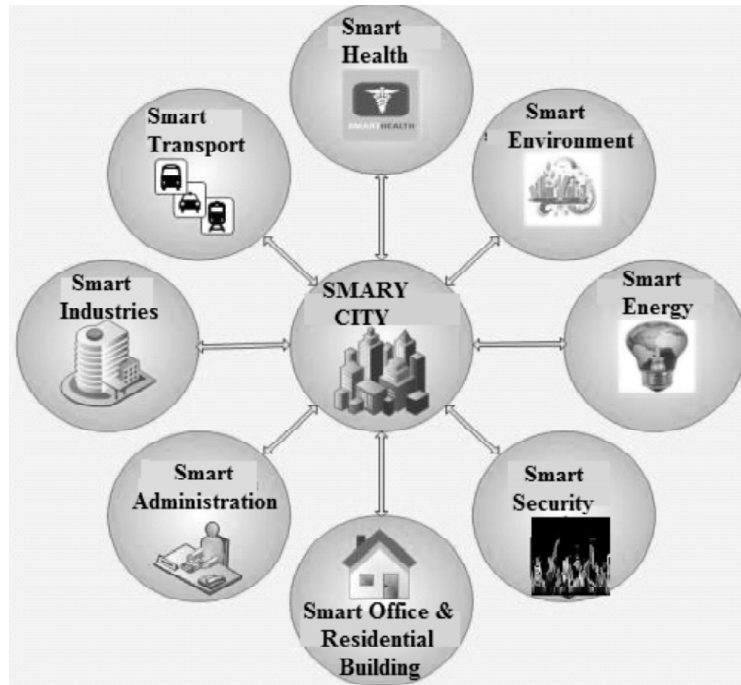


Figure 1: Smart City Components

management system for all fire fighting products in the processes of their production, sale, maintenance and supervision etc. This IoT based Id system is very significant in improving fire fighting product quality and assure public security.

The wide application of fire automatic alarming system

The wireless sensor network system is implemented for monitoring environment and fire. Fire detector system transform the physical amount of smog, heat, flames, temperature, humidity etc produced at the early stage of fire to electronic signals. These signals are send to fire alarming controlling machines. These alarming signals and control signals displayed at the controlling machine PC with location and time of fire. Hence people can timely discover the fire. They could take effective measures to come out early fire. It save the life of the people and their property. With Internet interface and management software in a building, fire detection can be realized worldwide.

The application of distant monitoring system in urban firefighting

Distant monitoring system or fire fighting information system is linked with separated fire alarming system in buildings through communication network. It make real time monitoring at the center of all buildings along with geographic information system, digital video monitoring system. It make centralized management system for firefighting facilities.

V. SUGGESTIONS ON DEVELOPING IOT FOR FIRE MONITORING APPLICATION

Better early than late

The building of IoT for fire monitoring can elevate the society fire fighting management level completely. It grows on the application of computers and fire automatic alarming systems. Hence it need less input. But the IoT system is more efficient than any other available. The challenge of fire fighting industry becomes more powerful with the globalization. IoT for fire monitoring as an emerging industry must be early for its development.

Speeding up the procedure of standardization

Standardization is an important tool to promote production and technology development. Advanced standards can lead the technology. It become blueprint of industrial development. It can promote the innovation of technology. It is possible with the transformation of results to improve corporate competency and industrial development level. IoT for fire is an emerging industry and it urgently needs a blueprint of development. The development of fire monitoring on IoT also needs much more standardization. Its development is an opportunity and challenge to improve the efficiency in firefighting management institutions and the society's fire fighting safety management level. Fire fighting industry is an internationalized industry.

Enhancing the public welfare of fire IoT operation platform

Fire monitoring IoT industry has three basic characteristics

1. It is driven by a country and government . After considering economic development, smart city designing, public security etc it is necessary to give great importance to it and provide support in polices;
2. Its industrial chain is complicated and different without single responsibility subject;
3. Lagging in standards, highly professional, highly exclusive.

Under this consideration, it needs careful thinking in how to promote IoT in fire monitoring and how to position it. It is an assurance to build firewall of public security. By increasing government input and strengthening the extent of its public welfare, can it really play its role as a fire monitoring IoT and make safety management model accepted by people and play its role of “firewall” in building a social fire fighting security.

CONCLUSION

The development of wireless sensors networks with the integration of Internet of Things arise new challenges in several fields. This new approach gives a reliable solution that can permit to detect fires risks, in order to avoid severe damage of this disaster, when it happens. People themselves can predict and protect from fire disaster and gives excellent fire management system globally through Internet. Application of IoT in fire monitoring is an excellent solution for smart city creation.

ACKNOWLEDGMENT

This work is supported by the University Grants Commission, Government of India under grant no. F.151/2014-15/PDFWM-2014-15-OB-TAM-24657.

REFERENCES

- [1] Son, B, “ A design and implementation of forest fires surveillance system based on wireless sensor networks for south korea mountains”, International Journal of Computer Science and Network Security, 2006 Vol.6 , No.9B, pp. 124–130.
- [2] Talpur, M.S.H *et al.*, “Energy efficient healthcare monitoring with smart phones and IoT technologies”, International journal of high performance computing and networking, 2015, Vol.8, No.2, pp.186 - 194.
- [3] Tan, W. *et al.*, “Mine Fire Detection System Based on Wireless Sensor Network”, Proceedings of the 2007 International Conference on Information Acquisition, 2007, Korea.
- [4] Yang,G. *et al.*, “Study on remote monitoring system for landslide hazard based on Wireless Sensor Network and its application” Journal of coal science & engineering, December, 2011, Vol.17, No.4, pp.464-468.
- [5] Zhang, J. *et al.*, “Forest fire detection system based on a ZigBee wireless sensor network”, Journal front for China, 2008, No.3, pp. 369–374.