A SURVEY OF SMART SYSTEMS BASED ON INTERNET OF THINGS

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ABSTRACT

The IoT mainly involves a group of devices and networks which get connected via Internet, meaning that there is a requirement to sense the environment and act according to it. A new environment can be created using new techniques which, in turn, improves the lives of the people. Making use of IoT, devices communicate with each other virtually or physically, making the environment smarter and facilitating the connection of devices whenever necessary. These days, the current generation is quite adept at communicating and controlling their devices more than ever before via the Internet which necessitates the IoT to collect and make data analysis based on the data coming from different devices as well as sensors which can be transmitted by a wireless connection. Over the years, applications of IoT have evolved dramatically, playing a crucial role to enhancement of the living standard which may involve becoming environmentally friendly. IoT has capabilities to facilitate services that are in demand in today's fast-pacing world. What this work carries out is a survey on the IoT used in intelligent system applications as well as usage of IoT with high efficiency.

Key words: *Smart house elements, Smart System, Networks, Smart cities, IoT and Sensors.*

Introduction

IoT is known to have flexibility and abilities to adapt to the environment with ease. The more IoT is used, the more intelligent the environment becomes with the applications [4]. In terms of communications, IoT is comparatively better than communications among Machines, GPRS and different types of mobile networks such as GSM, GPS, microcontrollers and Microprocessors. IoT can be seen or imagined as a combination of hardware with software [8]. One of the primary aims of the IoT is to provide connection

among devices and keep them connected without cessation via a network [5]. IoT made an evolution from communication known as a machine-to-machine (M2M) type of communication through which, sensors and devices get linked to with cloud while collecting info. However, a large number of appliances, data collecting nodes produce and share necessary and useful information in real-time to take the right decision in advance when using the IoT. Thus, communication among machines is pivotal with regard to the development of IoT [9]. If IoT architecture is looked up-close, it can be seen that it comprises of triple layers which are gateway, things and cloud which include objects, detectors and some appliances. In the Fig 1, an architectural structure of IoT can be seen which clearly illustrates which parts consist of what kind of elements like the example of gateway which is comprised of protocols used in IoT and ZigBee, Bluetooth along with Cloud bear responsibility to enable devices to get connected wirelessly like using Wi-Fi and cellular technology. Cloud and Gateway are comprised of Edge Computing.

Wireless technology is the main means of communication used by the IoT to provide internet connection among devices and objects. With the help of the IoT, data can be transferred, communication can be made and data can be shared at anytime and anywhere through Internet [10].

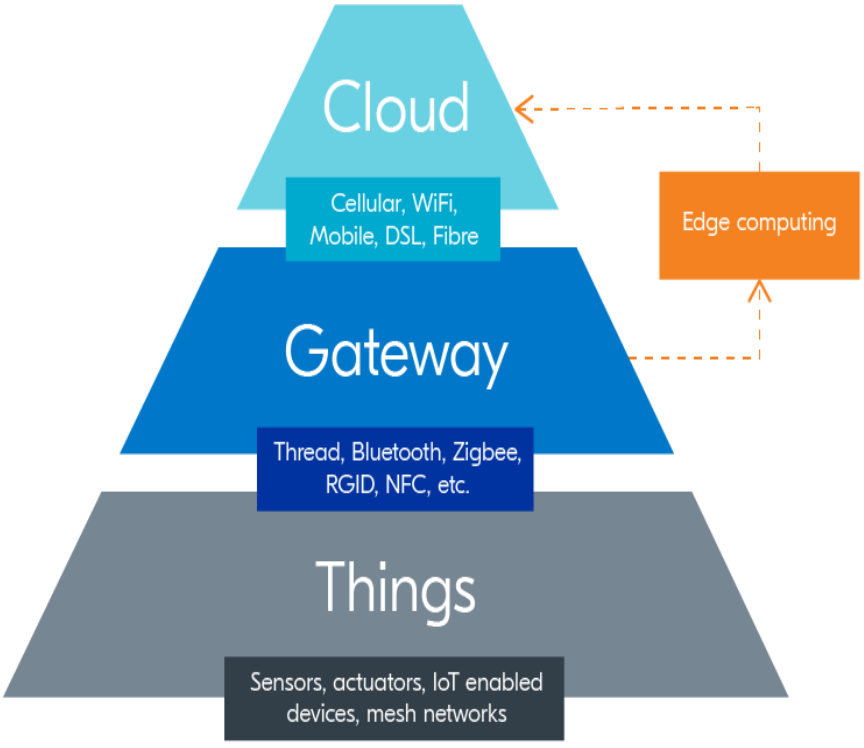

Fig 1. IoT architecture

Since IoT enables data access from anywhere remotely, it has been included in many real-time projects as the main element in smart agriculture and everything else which is considered intelligent. The environment of IoT is illustrated in Figure 2 from which, it can be clearly seen that IoT is comprised of technologies like installed systems, Actuators, Pervasive computing, Sensors, Ambient Intelligence and Communication technologies. Classifications of IoT can be based on some of its functionalities [11]. There are three functionalities which are Semantic, Internet and Things-oriented.

Internet of Things will help to overcome some of the hurdles in a way which cause the constraints in terms of enabling the machines to communicate with multiple objects, making a contribution to seamless communications [3]. So far, the amount of created information is immense which has been made use of for some of the activities which make the life extracting and more protected.

These days, since the IoT is an intensive research area, researchers are putting more effort into it, with many of them looking towards urban development and they carried out relative work. Having said that, the world always confers with the determining and activating the things installed in the different environments since the development is fast unimaginably [2].

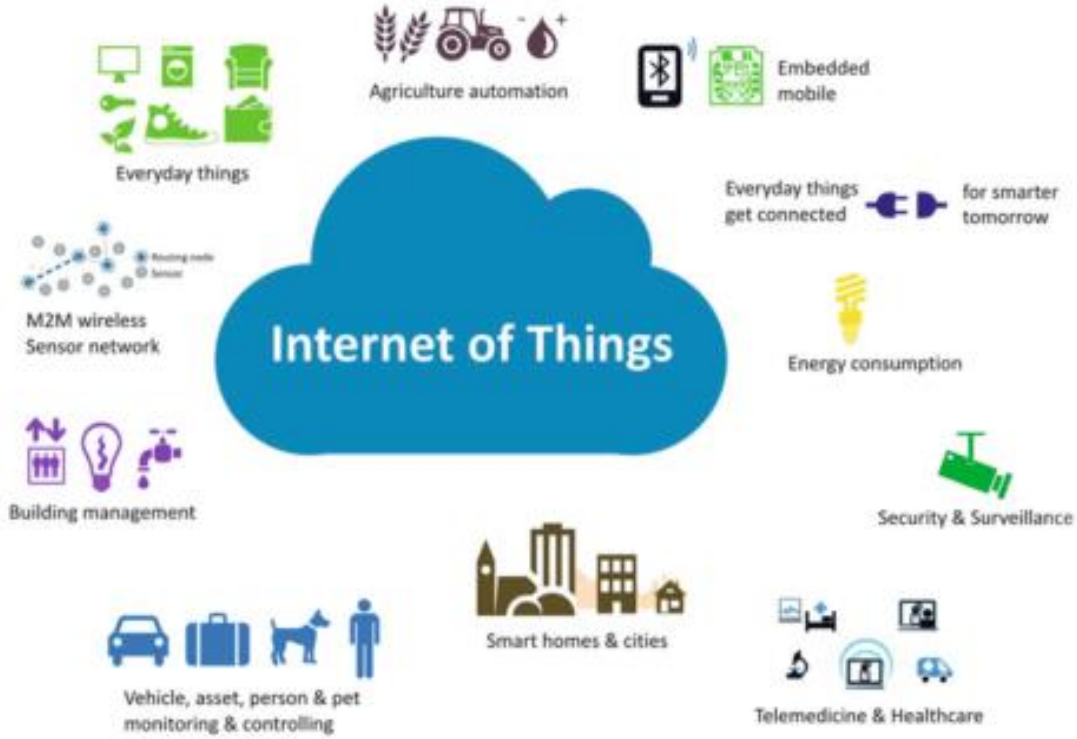

Fig 2. IoT application areas

Nowadays, with the help of the mobile systems, networks can be conveyed which can improvise entreaty and latest administrations. Due to the availability of applications in the technology, autos, substructures, controlling pursuits, vivid meters, and workstations play a crucial role in the interface.

The system of sensors is innovated by incorporating different mechanical frameworks for which, microelectronics are indispensable as well as compatibility is considered vital. Firstly, the process of detection and sensor applications are probed which is followed by some strands which can directly influence the sensor arrangements [1]. The structure is organized thoroughly to process competently by not involving the human intervention and any of the needs requested to the framework by user message gives needed information.

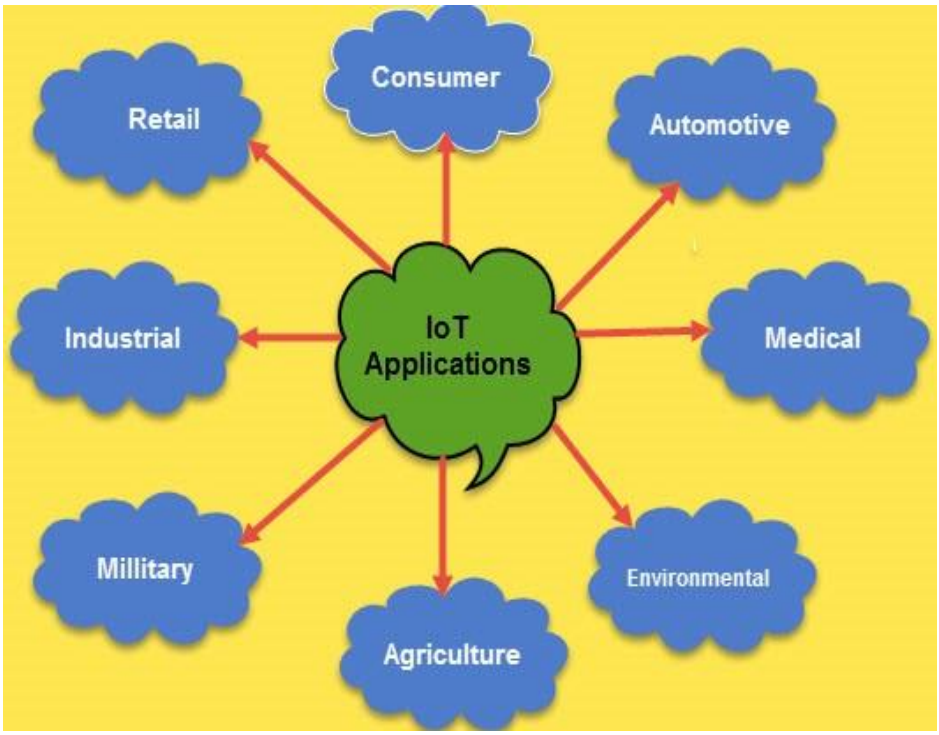

Fig 3. Applications of IoT

Applications of IoT. Implementations of IoT can be seen almost in all areas which we come across on a daily basis in applications that include building lifestyle, energy, retail, agriculture and healthcare [13]. Besides, common applications can be seen in homes, energy, cities and some industries which require getting controlled smartly and the list goes on and on.

2.1. Living smartly

IoT used for living smartly mainly involves the control of appliances that are used to turn the devices on and off remotely which, in turn, saves energy. As the weather is an important part of daily life, some devices are used to display weather conditions like humidity level, rainfall, wind speed and temperature. Majority of devices and appliances which are regarded smart and make use of an LCD screen like refrigerators tell what kind of items exist inside, the expiry date and what ingredients it has run out of as well as making this information available on the app. In Figure 3, what is shown is the applications of the IoT which are prevalent in today's society. The washing machine can be controlled remotely depending on the requirement and as well as using the washing machine remotely, it can provide some extra features like monitoring the laundry and giving the opportunity to control temperature and using the self-cleaning properties. Cameras and alarm systems at home are used for safety monitoring, making the users feel safe and intrusion detection systems can be used to detect door openings to take preventative measures to keep the intruders off. There are other smart devices that are used to control electricity and water consumption to keep the expenses at bay.

2.2. Smart Agriculture Smart agriculture usually is mainly used for greenhouse controls as well as micro-climate to boost productivity. Different techniques are used to control the level of pesticides, herbicides and insecticides. More importantly, they are used for controlling temperature and humidity and other harmful agents. Animal Tracking is considered one of the important features since it comes in handy in situations where the farm or the cattle is big, thus locating animals is difficult which in turn necessitates using some of the gadgets used for localization and identification of animals which spread sparsely over the fields and air quality or farm ventilation can be monitored. Since offspring care is important, Offspring Care can be used on farms to monitor available conditions. Monitoring the fields on time regularly with accurate data can be crucial in terms of managing and taking a control of fields.

2.3. Parking smartly. Systems involving to park smartly can be made use of for monitoring the parking plot and informing users about parking capacity as well as the availability of the space or in case one is full, informing the user of the next parking space. With the help of a waste management system, garbage can be collected more efficiently as well as optimizing the routes to collect waste. Additionally, garbage collectors equipped by the RFID that can let the specials workers know when and what kind of trash is dumped and what percentage of the bin is full.

2.4. Smart Cities. This involves monitoring the structural health of the buildings and material conditions of buildings and other structures. IoT-based systems used in smart cities can be of help in terms of monitoring any vibrations happing in the buildings [14]. The street lighting system can be also modernized as well with adaptive lighting in streets depending on the time of the year and weather conditions. Safety can consist of controlling the fire, warning in case of emergency, video surveillance and transportation can comprise of intelligent roads and motorways with changing warning messages for unanticipated situations.

2.5. Smart Industry. Industry working smartly is regarded as a collection of technologies based on the digitalization, IoT and AI to enable the service for production. It can monitor leakage of gas, monitoring oxygen and toxic gas level as well as monitoring the level of oil and gas in the pipelines. With the help of the smart industry, maintenance and repair can be done in the early stages of the malfunction and maintenance services will be assigned for certain types of failures with automation.

2.6. Smart Environment. A smart environment is an environment in which everything like air, humidity, CO2 emissions from different source and pollution which is emitted can be controlled. Forest Fire detection is one of the most important factors in terms of keeping the forests safe and IoT can make a huge difference in this scope and quality of water is considered crucial as well since it is a source of drinking water.

2.7. Smart Energy. In smart energy systems, smart grids can be used which monitor the consumption as well as adjust the power transmission depending on the consumption. Wind Turbines in the Powerhouses can be controlled ably depending on the wind amount and directions. Installations based on Photovoltaic and solar energy get utilized for monitoring and optimization of solar energy plant performance while boosting electricity production.

3. Latest IoT obstacles and developments. The new generation of intelligent systems based on IoT was put forward by an author whose work is mentioned in [15], taking emerging scenarios, latest challenges and trends into account. The work, which was proposed, provides a substantial and comprehensive overview related to fifth-generation IoT because of the increasing data rate which requires both cloud computing and edge platforms [15]. These networks based on mobile communication technology can furnish vital technologies for the technological development of IoT. Managing large amounts of data used in IoT coming from the different networks is considered one of the difficult chores and special data centers which concentrate on the energy efficiency needs to be contemplated to be built. In order to tackle these problems, AI-based algorithms and

techniques used with machine learning and neural networks must be in place to regulate the energy and enable decision-making automatically by taking real time into account. The people who are working on the implementation mainly focus on an unbiased system that involves observing and scheduling applications [6].

4. IoT Smart Home Architecture Demonstration of a smart house can be seen in the work mentioned in [16] for the implementation of IoT which made use of the GSM technology. One of the main functions of the mentioned framework is the authorization of the people who use the system to take a control of and manage the intelligent objects via the internet. Fig 4 describes an architectural structure belonging to smart house based on the IoT [16]. By using the Global System for the mobile technology and communication used via global network (internet), a connection can be fabricated among intelligent systems with those who use it and wireless communication which is based on the GSM can be developed by using the web server.

Fig 4. Smart house based the IoT

The issues and solutions appearing recently and directions of systems which are based on the IoT saw advancement which was proposed by Gabhane et al [14]. Refinement and fast technological growth in methodology make different snags appear which can directly have an effect on management of the whole system, server security as well as security of smart house [2]. The layer regarded important when it comes to sensing is in charge of data collection and transfers to a network layer that has an influence on the communication to transfer info among layers for incompatibility purposes. Hurdles involved in security occur while nodes that are sundry get connected to the internet. Establishing a first-period key that is shared among sensor nodes during wireless communication is one of the top hurdles. GUI is made possible by the collecting data sent from the different devices. Network structure requires to be organized in a way that everything connected to can be organized in unique way.

5. Automating home smartly. Work done in [17] make a proposal of automation of the home using smart house elements as well as using the Internet of Things. The proposed method applies appliance automation in the daily environment which will enable users to manage and control even if it is a critical condition. Communication is provided between entities by different technologies among which, wireless communication is prevalent which enhances the ability of IoT for webbing, analyzing and collecting data from surrounding devices and collected information is resent to mobiles or computers. Since IoT is made possible with the help of information technologies, the main requirement put on security is protection from data theft, intrusion and so on. This enables the objects to be under control remotely and objects are sensed and managed across the entire network, thus resulting in more benefits.

6. Smart Cities. A new system serving the cities to make them intelligent with the help of the IoT was the result of work mentioned in [7]. So as to make the smart city system perfect, different systems are combined together to find solutions for some of the existing issues associated with it. Since the cities are getting developed very fast in today's society, internet connectivity is crucial to make them more modish in every scope aspect [7]. One of the main aims of the research is the accomplishment of the kindred ecosphere and IT infrastructure with open access in urban areas which include actuators, sensors and other data using various applications. To start the infrastructure, the layer can be used where resources on the web and linked problems are learned carefully. Additionally, amenities for depository and data processing are likely to perform their obligations [18]. Environments mentioned in the above-mentioned smart city use devices that are either private or public depending on the inquiry. The contextualization can be regarded as a

way to make adjustments to behavior of nodes deliberately for what needs to be done at an appropriate time. Developing a smart city by incorporating IoT got put forward [12] which directly used analytical approach based on Big-data. What was proposed as an architecture and implementations are done to make a framework in real surroundings. Figure 5 describes applications of IoT in cities controlled smartly. Enactment is carried out for making cities flourish by using various data banks with improved smart systems [12]. The main idea is that gaining necessary and right information using certain device at the right time is crucial to determining the easy and swift ways to provide coherence among the devices. A system that is being proposed can achieve full security by observing the entire city continuously. This system was proposed by [11] to exploit Big Data and IoT to contribute to smart digital cities. The relationship among different IoT objects is vital to collect data in non-rural territories by Internet for the development of a city based on intelligent technologies.

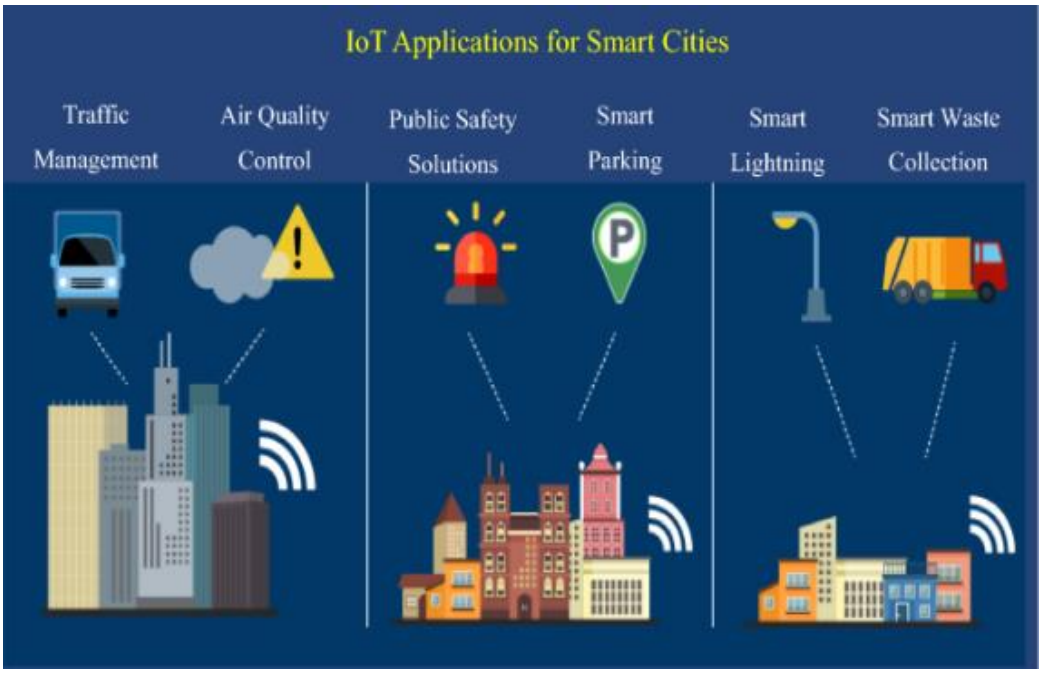

Fig 5. Smart city based on the IoT.

What is remaining to be challenging is to sort collected info for individuals who are likely to be geared towards the digital cities with a spruce environment [11]. The main scheme of the proposed procedure is to get valid information regarding the city in any situation during a specified duration.

Conclusion

IoT has an important role to play in the ongoing scenarios by influencing various domains. This research area has many opportunities and a larger number of researchers are working to fill the gap in terms of making the world smart. IoT has many different characteristics that have been reviewed by researchers and which have been mentioned in this work to get information about the existing technologies in the same field. The survey has been done considering the various features like environmental parameters, applications and the pros and cons of the existing technology. This analysis can help other researchers to get an idea of the IoT in the current scenario and will also help in improving the flaws of the existing models and support the development of new applications to make the life of humanity easier.

REFERENCES

1. Tiwari.R and Sharma.V. A review paper on IoT and its Smart Applications // International Journal of Science, Engineering and Technology Research -2016. - 5(2): 472-476.
2. Bhavna.D and Sharma.N. Smart Home Automation using IoT // International Journal of Engineering Sciences and research technology - 2018. - 7(5): 435 – 437.
3. Vandana.S and Ravi.T. A review paper on IoT and its smart applications // International Journal of Science, Engineering and Technology Research - 2016. - 5(2): 472 - 476.
4. Wang.M, Zhang.G, Zhang.C, Zhang.J and Li.C. An IoT-based appliance control system for smart homes // In 2013 fourth international conference on intelligent control and information processing - 201. - pp. 744-747.
5. Soliman.M, Abiodun.T, Hamouda.T, Zhou.J and Lung.C.H. Smart home: Integrating internet of things with web services and cloud computing //In 2013 IEEE 5th international conference on cloud computing technology and science - 2013. - 2: 317-320.
6. Perera.C, Zaslavsky.A, Christen.P and Georgakopoulos.D. Context aware computing for the internet of things: A survey // IEEE communications surveys & tutorials - 2013. - 16(1): 414-454.
7. Bruneo.D, Distefano.S, Giacobbe. M, Minnolo.A.L, Longo.F, Merlino.G and Puliafito.C. An IoT service ecosystem for smart cities: The Smartme project // Internet of Things - 2019. - 5: 12-33.
8. Zhai.S.L, Zhao.D.S, Wang.Z and Zhang.Y. Research of communication technology on IoT for high-voltage transmission line // International Journal of Smart Grid and Clean Energy - 2012. - 1(1): 85-90.
9. Singh.D, Tripathi.G and Jara.A.J. A survey of Internet-of-Things: Future vision, architecture, challenges and services // In 2014 IEEE world forum on Internet of Things (WF-IoT) - 2014. - 287-292.
10. Yashiro.T, Kobayashi.S, Koshizuka.N and Sakamura.K. An Internet of Things (IoT) architecture for embedded appliances // 2013 IEEE Region 10 Humanitarian Technology Conference, Sendai - 2013. - 314-319, doi: 10.1109/R10-HTC.2013.6669062.
11. Rathore.M.M, Paul.A, Ahmad.A and Jeon.G. IoT-based big data: from smart city towards next generation super city planning // International Journal on Semantic Web and Information Systems -2017. - (IJSWIS), 13(1), 28-47.

12. Rathore.M.M, Ahmad.A and Paul.A. IoT-based smart city development using big data analytical approach // In 2016 IEEE international conference on Automatica - 2016. - (ICA-ACCA), 1-8.

13. Lee.I and Lee.K. The Internet of Things (IoT): Applications, investments, and challenges for enterprises // Business Horizons -2015. - 58(4): 431-440.

14. Gabhane.M, Thakare.M.S and Craig.M.M. Smart Homes System Using Internet-of-Things: Issues, Solutions and Recent Research Directions // International Research Journal of Engineering and Technology - 2017. - 4(5): 1965 - 1969.

15. Shafique.K, Khawaja.B.A, Sabir.F, Qazi.S and Mustaqim.M. Internet of things (IoT) for next-generation smart systems: A review of current challenges, future trends and prospects for emerging 5G-IoT scenarios // IEEE Access - 2020. - 8, 23022-23040.

16. Ganesh.E.N. Implementation of IoT architecture for SMART HOME using GSM technology // International Journal of Computer Techniques - 2017. - 4(1), 42-48.

17. Gubbi.J, Buyya.R, Marusis.S and Palaniswami.M. Internet of Things (IoT): A vision, architectural elements, and future directions // Future generation computer systems - 2013. - 29(7): 1645-1660.

18. Chen.L.J, Ho.Y.H. Lee.H.C, Wu.H.C, Liu.H.M, Hsieh.H.H and Lung.S.C.C. An open framework for participatory PM2. 5 monitoring in smart cities // IEEE Access - 2017. - 5: 14441-14454.