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THE POTENTIAL OF IOT FOR SMARTER CITIES, AGRICULTURE, AND HEALTHCARE

Mr.Srinu Jatothu[1]., Vissavajjula Sai Krishna Veda[2]
1 Assistant Professor, Department of ECE, Malla Reddy College of Engineering for Women., Maisammaguda., Medchal., TS, India
2, B.Tech ECE (21RG1A0451),
Malla Reddy College of Engineering for Women., Maisammaguda., Medchal., TS, India

ABSTRACT

The Internet of Things (IoT) technology has revolutionized all areas of human life, making it more comfortable. IoT refers to the current trend of The Internet of Things (IoT) technology that has revolutionized all areas of human life, making it more comfortable. IoT refers to the current trend of connecting all kinds of physical objects to the Internet, even the most unexpected ones, without human intervention, which constitutes a self-configurable network. The Internet of Things (IoT) enables organizations to automate the process and improve service delivery via Internet technology and data transfer to the cloud. Nowadays, the Internet of Things (IoT) is becoming a widely discussed topic among researchers, specialists, and experts. It is seen as the next step in the evolution of the Internet. This paper covers the application of (IoT) technology in three different areas: smart cities, health, and agriculture.

Keywords: Internet of Things, Smart City, Smart Parking, Smart agriculture, Smart Healthcare

INTRODUCTION

The term Internet of Things (IoT) first appeared in 1999 in the speech of Kevin ASHTON, a British engineer. It was used to refer to a system where physical objects are connected to the Internet. Over time, the term has evolved to encompass the entire ecosystem of connected objects. Currently, the Internet of Things (IoT) is becoming a widely discussed topic among researchers, specialists, and experts. It is seen as the next step in the evolution of the Internet. With the IoT, we are heading towards a phase where all elements of our environment will be connected to the Internet and will have the ability to communicate with each other with minimal human effort [1]. The IoT contains a variety of objects that can be connected with both wired and wireless networks. These objects have an addressing system that allows objects to interact and cooperate with others to create new IoT applications and services such as smart homes, smart cities, smart energy and networks, smart transportation and traffic management and control, and others [2]. The emergence of various sensors and software tools that allow the reading of information from the sensors allows the improvement of the living environment and the maximum use of all available resources. A human can monitor and manage his environment, habits and define his daily needs with the help of various IoT-supported systems. The main benefit of using IoT in daily life is to reduce the user's involvement in their life responsibilities. Why should the user activate the light if the sensor is able to recognize the darkness? A simple example, which shows how many sensors and software tools that collect information from the sensors can improve the life of the users and solve certain obligations. The smart city concept is used to describe a better use of public resources, increasing the quality of service presented to citizens, and at the same time, reducing the operating costs of administrations [3].

RELATED WORKS

Some important work has been done in the IoT field. For example, smart parking is one of the Smart Initiatives that tries to provide a solution to the classical problems of parking environments in big cities. Smart parking is one of the topics that is becoming more and more popular and is often associated with the Internet of Things. The Internet of Things is the main actor in the concept of smart cities [7]. The Smart Parking research conducted by Wang [8] was applied by building a parking IoT application using the reservation method. In 2015, Pham [9] proposed a parking system using cloud services so that it could provide better performance. Frailer [10] contributed to the topic of Smart Parking through his research which proposed the architecture of Smart Parking systems using CCTV devices. Then the research conducted by Khanna [7], built a Smart Parking using the Internet of Things integrated with cloud services.

In the field of agriculture, Thakur et al. [11] proposed a device that can measure temperature, soil moisture, and automatic irrigation. To monitor farms with camera sensors and monitor data transmission, Sanchez et al. [12], have designed a system to do so. Janaki et al, [13] proposed an intelligent wireless sensor network system for

greenhouse. Thakur et al, [14] conducted a survey to obtain accurate information on various sensors and crops in which wireless sensor networks and the Internet are compatible. For the health domain

Related work in this area is described as follows: Acharya et al. [15] introduced an IOT application for medical monitoring in an IoT environment. The developed system monitored some basic human health parameters like Heartbeat, ECG, body temperature, and respiration. The components used here are pulse sensor, temperature sensor, BP sensor, ECG sensor, and Raspberry Pi. The data was collected from sensors and sent to raspberry pi for processing and again transmitted to the IoT network. The major drawback of the system is that no interface for data visualization is developed.

SMART PARKING

System components

For the smart city domain Balham et al. [19], proposed a smart parking system (Smart parking) to find a vacant parking space in the parking areas without involving manual efforts and thus avoid the need to spend fuel and time on efforts. Various sensors deployed in the parking area determine the availability of parking spaces, and the information can be easily accessed through the use of the Internet by users. The developed prototype of smart parking detects whether the parking area is free or occupied, and the information/data collected by the sensors is uploaded to the cloud from where the user can access the information using an Android application (fig1).

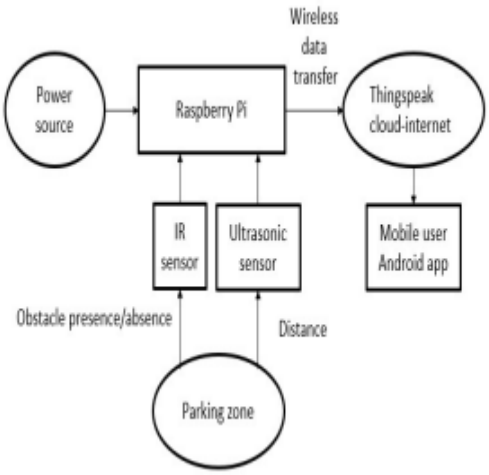

Figure 1: Architecture of smart parking system [19]

- The following steps are performed by Balhwan et al. [19]:
- The occupancy of a parking space is measured using the sensors (ultrasonic sensor and IR Sensor) with Raspberry Pi.
- After measuring the data, the presence or absence of an obstacle the data is sent to "Thing Speak" using RPi's internal wi-fi.
- The data is saved on the Thing Speak cloud. The data is displayed graphically.
- A user's mobile application connects to the cloud and provides information about parking spaces (free or occupied).

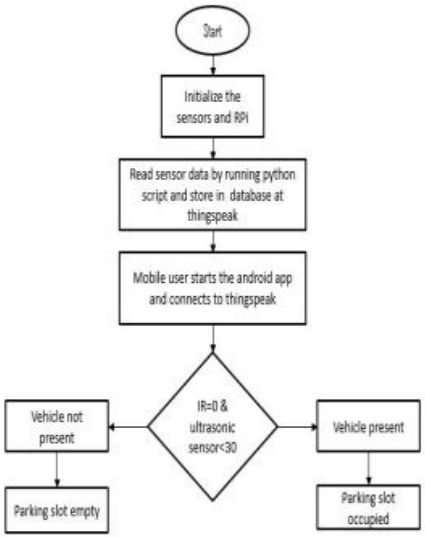

Figure 2: Diagram of smart parking system [19]

SMART AGRICULTURE

System components

For the agriculture sector, it is known that farmers agricultural fields may be located many kilometers from their homes. Sometimes farmers have to go to their agricultural fields several times a day to start and stop the water (irrigation pumps). They cannot protect the crops from unconditional rain every time. In order to overcome these practical difficulties, a system is designed by Krishnan et al. [20] to take care of all these problems automatically. The general block diagram is shown in Fig.3. The monitoring system consists of four main units: the end device node, the coordination node, the webserver node, and the mobile (control unit). The end device node includes an Arduino controller, a GSM, a motor, a plant leaf image soil moisture sensor, a temperature sensor, and a humidity sensor. The microcontroller device is also used as the end device as a coordinating device in the wireless sensor network. It is used for data communication in the network. Data is continuously collected from the sensors and then transmitted to the node coordinator, which is connected to the web server system via the serial RS232 data bus. Data acquisition is done in the

web server for real-time monitoring of farmland parameters. From the server, the data can be obtained and displayed on the Android phone. Then the signal control is automatically sent to the coordinator node Whenever the end device receives a signal from the coordinator node, it acts according to the received signal whether the motor is turned on or off. The on-off process of the motor for irrigation is framed using fuzzy logic. The controller is programmed based on fuzzy rules.

SMART HEATHCARE

System components

Continuous online monitoring of patients and patient room status is the main idea of the system proposed by Islam et al. [21]. The system is implemented using a combination of hardware components. All the hardware components are assembled in the implementation phase. The circuit diagram of the developed system is shown in Figure 5. All sensors are connected to ESP32 using physical pins. ESP32 is used as a processing device as it has a built-in Wi-Fi module. The user prototype is shown in Figure 5 where the system is tested with a user and the data is displayed on the webserver. Figure 5: Architecture of smart healthcare system [21] 5.2 Discussion Islam et al. [21] have proposed a system of healthcare monitoring in hospitals. Healthcare monitoring systems with emerging technologies are now becoming a great concern for many countries around the world. The advent of the Internet of Things (IoT) technologies is facilitating the progress of healthcare. The smart health system proposed by Islam et al. [21] in the IoT environment it can monitor the health status of a patient as well as the status of the room where the patients are in real-time. In this system, five sensors are used to capture the data from the hospital environment called heart rate sensor, body temperature sensor, room-temperature sensor, CO2 sensor and Co sensor.

According to the analysis of the IoT application proposed by Islam et al. [21], it is found that it is important to keep the information of a patient's medical statistics in the cloud [23], as it can be extremely beneficial in the future. Keeping the records will allow the patient to make many of the choices such as whether they want to lose weight or not, which medications are mainly allergic to the patient, and much other necessary information [24]. This database should also help the doctor to interpret the patient's physical problem and its origin, to provide a better diagnosis. In order to show the overall workflow, Fig. 6 is proposed.

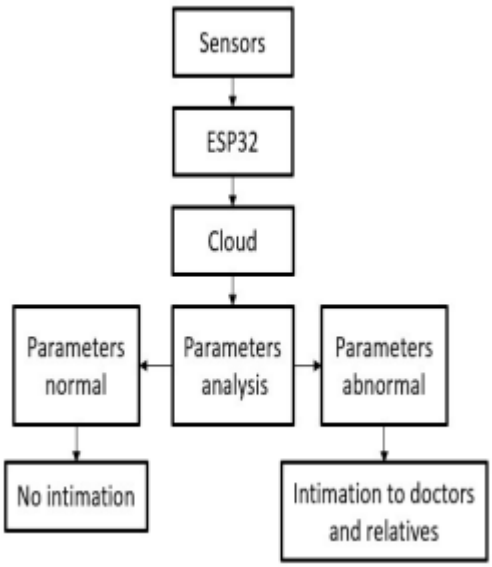

Figure 3: Diagram of smart healthcare system [21]

To improve this system in the future, the analysis of part of the design can be developed by applying machine learning and artificial intelligence algorithms.

ISSUES AND LIMITATIONS

According to our study of the three areas of smart agriculture, smart healthcare, and smart parking, much has been done and much remains to be done. The following table summarizes some of the shortcomings of the three prototypes studied previously and suggests improvements.

TABLE 1: SUGGESTS IMPROVEMENTS

Article	Application IOT	Gaps	Improvements	Techniques and tools
Balhwan [19]	Smart parking	The absence of an online booking system with payment.	Add an online booking system.	Develop a secure web application managed by the administrator. Develop a secure mobile application managed by the user. A barcode to get an entrance to the parking area.

Krishnan [20]	Smart agriculture	The lack of safety in agricultural fields.	*Detect intrusions into agricultural fields.*	*Detect the intrusion using a passive infrared (PIR) sensor.*
Islam [21]	Smart healthcare	The absence of machine learning algorithms and artificial intelligence	Analyzed the design part of the application	Using machine learning algorithms and artificial intelligence

CONCLUSION

In this paper, we focused on the study of the three domains (Smart City, Health, and Agriculture) of IoT. we showed the weaknesses and strengths of each and proposed improvements for each IoT application. In the future this work will help researchers to improve their work with the latest technologies, tools, and techniques. Future research should focus on the development and implementation of new IoT application models based on the above recommendations for each IoT application, which are mainly aimed at minimizing errors and improving the efficiency of each IoT application. In the next work, we will propose a new IoT application model in the field of agriculture that enters into the framework of enhancing the use of IoT in the development of our country MOROCCO.

REFERENCES:

[1] D. O. Vermesan et al., « Internet of Things Strategic Research Roadmap, in Internet of Things: Global Technological and Societal Trends, vol. 1, pp. 9–52, 2011. », p. 45. [2] I. Pena-L ˜ opez, « ITU Internet Reports 2005: The Internet of Things, 2005 ». https://www.itu.int/osg/spu/publications/intern etofthings/ (consulté le juin 06, 2021).

[3] M. Chen, « Machine-to-Machine Communications: Architectures, Standards and Applications », KSII TIIS, 2012, doi: 10.3837/tiis.2012.02.002.

[4] A. Zanella, N. Bui, A. Castellani, L. Vangelista, et M. Zorzi, « Internet of Things for Smart Cities », IEEE Internet Things J., vol. 1, no 1, p. 22-32, févr. 2014, doi: 10.1109/JIOT.2014.2306328.

[5] K. L. Krishna, O. Silver, W. F. Malende, et K. Anuradha, « Internet of Things application for implementation of smart agriculture system », in 2017 International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), févr. 2017, p. 54-59. doi: 10.1109/ISMAC.2017.8058236.

[6] P. P. Ray, « A survey on Internet of Things architectures », Journal of King Saud University - Computer and Information Sciences, vol. 30, no 3, p. 291-319, juill. 2018, doi: 10.1016/j.jksuci.2016.10.003.

[7] A. Khanna et R. Anand, « IoT based smart parking system », in 2016 International Conference on Internet of Things and Applications (IOTA), janv. 2016, p. 266-270. doi: 10.1109/IOTA.2016.7562735.

[8] H. Wang et W. He, « A Reservation-based Smart Parking System », in 2011 IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS), avr. 2011, p. 690-695. doi: 10.1109/INFCOMW.2011.5928901.

[9] T. N. Pham, M.-F. Tsai, D. B. Nguyen, C.-R. Dow, et D.-J. Deng, « A Cloud-Based SmartParking System Based on Internet-of-Things Technologies », IEEE Access, vol. 3, p. 1581-1591, 2015, doi: 10.1109/ACCESS.2015.2477299.

[10] M. Fraifer et M. Fernström, « Smart car parking system prototype utilizing CCTV nodes: A proof of concept prototype of a novel approach towards IoT-concept based smart parking », in 2016 IEEE 3rd World Forum on Internet of Things (WF-IoT), déc. 2016, p. 649-654. doi: 10.1109/WF-IoT.2016.7845458.

[11] D. Thakur, Y. Kumar, A. Kumar, P. Kumar, et V. Singh, « Real Time Monitoring of Valeriana Jatamansi Plant for Growth Analysis », Procedia Computer Science, vol. 132, p. 507-517, 2018, doi: 10.1016/j.procs.2018.05.003.

[12] A.-J. Garcia-Sanchez, F. Garcia-Sanchez, et J. Garcia-Haro, « Wireless sensor network deployment for integrating video-surveillance and data-monitoring in precision agriculture over distributed crops », Computers and Electronics in Agriculture, vol. 75, no 2, p. 288-303, févr. 2011, doi: 10.1016/j.compag.2010.12.005.

[13] V. S. Jahnavi et S. F. Ahamed, « Smart Wireless Sensor Network for Automated Greenhouse », IETE Journal of Research, vol. 61, no 2, p. 180-185, mars 2015, doi: 10.1080/03772063.2014.999834.

[14] D. Thakur, Y. Kumar, A. Kumar, et P. K. Singh, « Applicability of Wireless Sensor Networks in Precision Agriculture: A Review », Wireless Pers Commun, vol. 107, no 1, p. 471-512, juill. 2019, doi: 10.1007/s11277- 019-06285-2.

[15] A. D. Acharya et S. N. Patil, « IoT based Health Care Monitoring Kit », in 2020 Fourth International Conference on Computing Methodologies and Communication (ICCMC), mars 2020, p. 363-368. doi: 10.1109/ICCMC48092.2020.ICCMC-00068.

[16] S. Trivedi et Alice. N. Cheeran, « Android based health parameter monitoring », in 2017 International Conference on Intelligent Computing and Control Systems (ICICCS), juin 2017, p. 1145-1149. doi: 10.1109/ICCONS.2017.8250646.

[17] M. J. Gregoski et al., « Development and Validation of a Smartphone Heart Rate Acquisition Application for Health Promotion and Wellness Telehealth Applications », International Journal of Telemedicine and Applications, vol. 2012, p. e696324, janv. 2012, doi: 10.1155/2012/696324.

[18] S. P. Kumar, V. R. R. Samson, U. B. Sai, P. L. S. D. M. Rao, et K. K. Eswar, « Smart health monitoring system of patient through IoT », in 2017 International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), févr. 2017, p. 551-556. doi: 10.1109/I-SMAC.2017.8058240.

[19] S. Balhwan, D. Gupta, Sonal, et S. R. N. Reddy, « Smart Parking—A Wireless Sensor Networks Application Using IoT », in Proceedings of 2nd International Conference on Communication, Computing and Networking, vol. 46, C. R. Krishna, M. Dutta, et R. Kumar, Éd. Singapore: Springer

Singapore, 2019, p. 217-230. doi: 10.1007/978- 981-13-1217-5_22.

[20] R. S. Krishnan et al., « Fuzzy Logic based Smart Irrigation System using Internet of Things », Journal of Cleaner Production, vol. 252, p. 119902, avr. 2020, doi: 10.1016/j.jclepro.2019.119902.