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Artificial intelligent smart home automation with secured camera management-based GSM, cloud computing and arduino

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ABSTRACT

Home management and controlling have seen a great introduction to network that enabled digital technology, especially in recent decades. For the purpose of home automation, this technique offers an exciting capability to enhance the connectivity of equipment within the home. Also, with the rapid expansion of the Internet, there are potentials that added to the remote control and monitoring of such network-enabled devices. In this paper, we had been designed and implemented a fully manageable and secure smart home automation system based on a cloud computing system with an ESP Arduino system. The security of home had been improved by adding a complete camera system with a GSM communication technique to connect the Arduino output data to an external specified number if there is no internet provider. We used three sensors for temperature, gas, and motion measurements. The ESP8226 Wi-Fi device programmed the sensors to maintain the sensors measurements and transfer them to the cloud server database which is programmed to the web server via Appatshy and Mysql formats. The system implemented with high time response so that all readings updated and appeared spontaneously. The designed system should be effective, a secure, and rapid response real-time smart home system should be achieved.

Keywords: Cloud computing, Smart home, Home automation, Arduino ESP, GSMAndroid

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1. Introduction

The environment of cloud computing can present different services and resources such as hardware, databases, storage, networks, and applications of software to customers as order service. It makes available for use remarkable financial benefits for the institution, persons, and ventures while presenting high-level cooperation possibilities [1,2].As an Internet-based process, Cloud service presents a reliability, openness, wide network access, location self-rule, application agility, voluntariness, elasticity, distribution, scalability, dynamicity, high speed services modification, less capital expenses, doubts, and pooling of resource for a domain of applications [3,4]. One of the best areas of information technology (IT) is the Cloud computing, which is published for many years and will stay the required area for a few years then it completely developed. Saving institutions from the many burden by decreasing infrastructure cost is the main goal of cloud computing [2]. Cloud computing is not outlying evolution. in the field of computing, over years the technology of Cloud has been matured with constant progression. The beginning can be return it to a time when the time-shared computing system of remote access became a reality. The cloud computing realization is closely related to many other later developments in the field. A comprehensive discussion on the development of cloud computing can never be overlooked Continuous inventions in the field of electronic and computer equipment. As the hardware technology evolved, As well as the software. Additionally, with advances in communication protocols, network communication technology as well as the Internet have also played a vital role in this process. the innovation of grid computing concept for network computing was a major step towards the future of computing. But in the cloud it has the ability to expand in real time that is one of major advantages of the cloud at variance grids, computing Resources

in the cloud can be added in real time to meet the demand for computing. This has become Possible as a resource. There are a three type of cloud computing as shown in figure below:

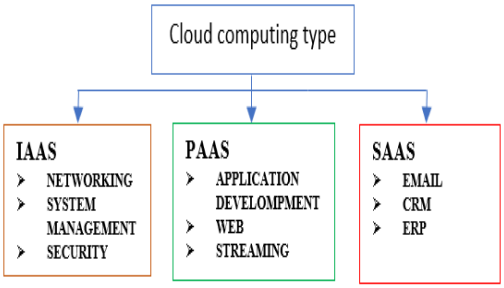


Figure 1. Type of cloud computing

Infrastructure as a Service (IaaS) represents one form of the cloud computing dominant, permit cloud consumers to provide virtual computing resources in an on-demand fashion. While IaaS provides managed and virtualized IT infrastructure components such as servers, storage, networking. Consumers can also use Platform as a Service (PaaS) for developing and hosting software applications without managing virtual infrastructure components, as well as ready-to-use web applications in form of Software as a Service (SaaS)[3]. Nowadays, companies more and more move their traditional IT architectures into cloud environments [4]. Many companies build microservice architectures, instead of building monolithic systems, where application services are wrapped in a hosted and container on a virtual machine provided by clouds as IaaS. In this way, every application service becomes highly scalable, but requires certain computing resources can be defined by the virtual machine type. While cloud providers offer almost unlimited computing resources, the range of offered virtual machine types, differing in computing capacities and prices per hour, is continuously developing and leads to an agony of choice. This implies a high complexity when decision-makers have to determine an efficient cloud infrastructure configuration for hosting a large set of application tasks (such as micro-services hosted in containers) with different requirements, including resource and governance requirements, as recently reported in one of the largest global IT leadership surveys. In contrast to traditional IT outsourcing, public clouds permit these services for an on-demand use with flexible scaling options and pricing schemes thus enabling violent reduction in capital and operation expenses for consumers. Given such complexities, it becomes nearly impossible to select the right resources, satisfying the applications requirements, without any decision support. Having intelligent systems and approaches associating assigning the right resources to the application by minimizing a given objective function is therefore required. After defining an appropriate set up, another progression of clouds is the ease of consumption: the use of cloud services does not demand in-person interactions so that it only takes seconds to minutes from the initial request to the final deployment [5]. Cloud vendors can provide the Cloud computing services via public clouds (which be their data centres) and client organizations (will be end users) by utilizing private clouds which done by installing cloud software on their own data centres or can utilize hybrid clouds by install on their own and other cloud vendors' data centres. The community clouds are a different type of cloud service that can be described as new contingent increment to the rest of modes of delivery for cloud computing-depend on ICT. The services of cloud in clouds of community may be achieved of ten times by one institution and used by sets of institutions in businesses or professions like that of the same institution [4]. There are two essential technologies that backup cloud computing, virtualization and computing of grid. The technology of virtualization is disguising the physical features of resources belongs to computing like server or PC or, to ease the method in which many applications, systems or end-users that interact with them. This technique can be also enabling single physical resources such as a storage device, server, an application, or an operating system, look as many logical resources.While grid computing, comprise of the utilize of software to merge computational energy belongs to many several computers, communicated in a grid, for solving a single problem, which is in many times need to great deal with computer processing power. Moreover, web computing also can use a software for divide and including pieces of a program to as many as several thousand computers. [6]. The IT services taken by CC are based on web and can be released with less effort of management. In comparison with traditional IT, CC presents "a fundamental change "in how IT services are developed, maintained, and paid. If applied properly, CCSs can achieve many advantages for numerous institutions containing those in the industry of healthcare that achieve care services and goods as well as for home automation or smart home [7]. The smart homes are the prelude of technology in the home to

reinforce the goodness of living, through frugality of many services, like multimedia entertainment, telehealth and, energy conservation. In other words, the purpose of home automation is to orchestration the digital devices in order to the convenience of users together with the capability and security to observe multiple dwellings. The traditional systems of home automation include controlling on digital devices to provide tasks such as shading, lighting and heating. Because of the quick development of modern entertainment systems and information technology in recent years, these primary functions are required to be reinforced with additional services. We can list the advantage of smart home as of power saving, safety comfort, and communications. [7]. Across the world the smart home systems are presently deploying in many societies as part of modernization initiatives. We can generate a massive worthy amount of data from the connected smart devices and appliances belong to these houses with an IoT system [3]. By analyse these data in near real-time and off-line we can obtain various information which has a significant effect on health, our society's safety, and the economy [5]. The application of Real-time IoT permits manufacturers to analyse data continuously and determine an instantly exchange malfunction equipment. IoT applications appear the advantages of analysing the data belongs to smart home [8]. Homes enhance the approach to individual lives by providing various services, and a reasonable or automated home. It aims to provide free time and simple work. The smart devices in the modern world, like smart televisions (TVs), smartphones, smart refrigerators, smart sensors and smart washing machines, it is involved in every aspect of people's daily life. as in figure 1, smart devices are able to communicating and interacting with each other to constitute a smart environment [10].

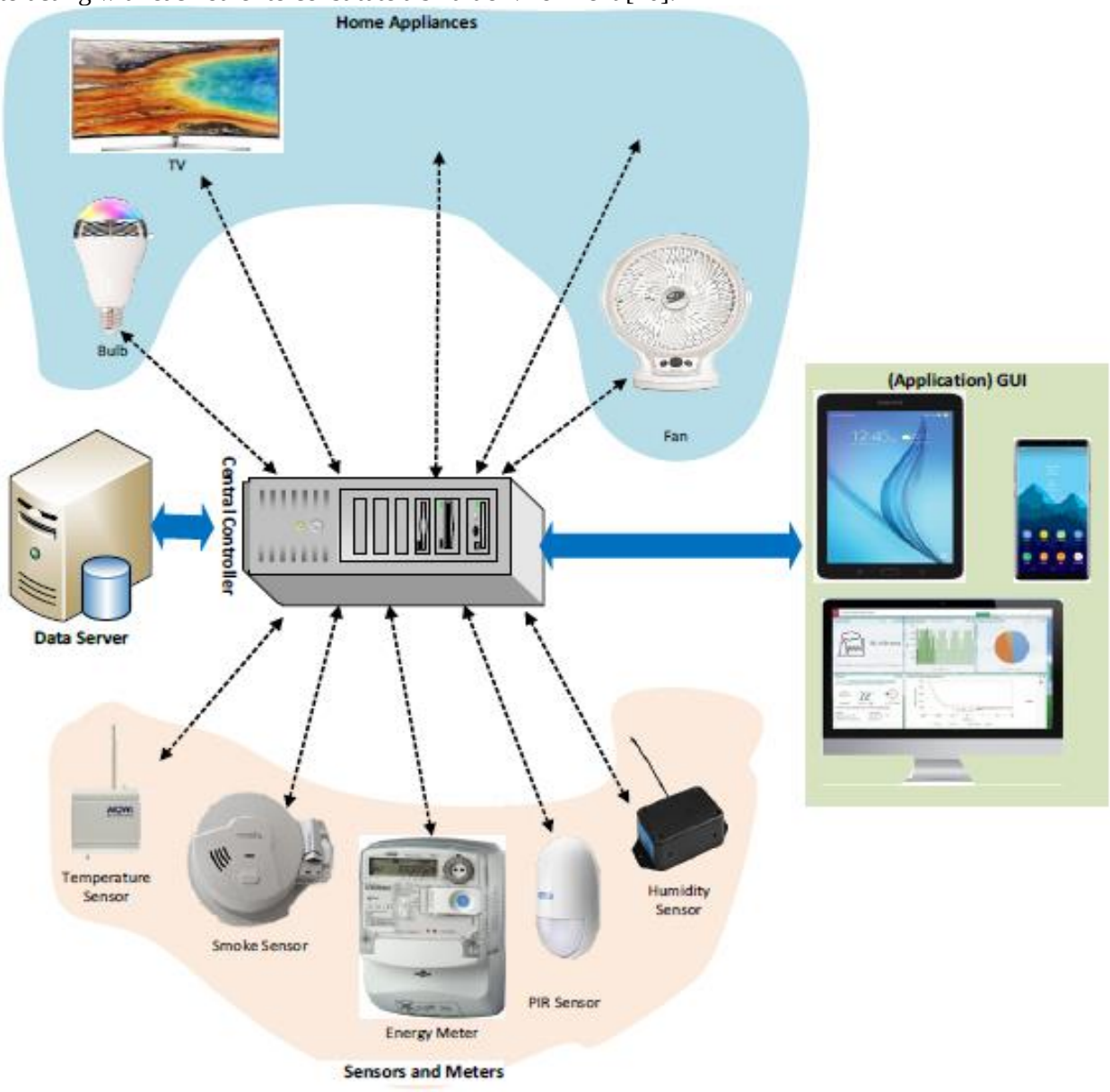


Figure 2. Environment of SH [9]

The main goal of this project is to design a smart home with controlling devices through best utilization by implementing real time cloud computing used to receive the data from Arduino senses that placed at home through WIFI, these sensors are for motion, temperature and gas.

2. Previous work

A lot of research and various ways that deal with smart home systems. In spite of the fact that controlling home machines by means of various strategies isn't new, there is a need to re-evaluate the administration of homes automation .We can see add that the designed systems to the research of home automation by entering many useful technologies such as cloud-computing and enabling Android applications. The large amounts of works that had been published on smart home may ensure the values in this field. There are different types of technologies and protocols in smart home's field. The technologies and protocols are either standard so that they are proposed by verified organizations, or they are designed by special companies. Sometimes, they are proposed for communications using wires, or systems with wireless communications. Every one of them shows a several benefits and drawbacks by presenting different building scenario. In the previous years, many researchers have submitted a lot of applicable smart home systems depending on the implementing devices with more than one technology. Some researchers [11] investigate the different wireless techniques (GSM/GPRS, Wi-Fi, ZigBee) in smart home climate. Specially, the publishers used a PC based on Lab-View- that behaved like a coordinator of ZigBee to maintain data from several sensors (light, humidity, temperature) and that is capable of controlling some actuators (for example, irrigation or lighting). Multi transceivers have many examples (EIB Serial, ZigBee, Bluetooth, X10, GSM/UMTS/GPRS, DTMF, and CAN) which presented in [12]. In this article, the researches discuss a protocol of IP-based messaging and an indoor ambient intelligence platform to connect the controller of smart home with remaining of the equipment.
The previous works are shown in the following tables. The tables are show the different between characteristics of main HAS applicable academic systems.

Table 1. Different between characteristics of main HAS applicable academic systems (part 1)

(System)	Main goal	Protocol of Messaging	Capabilities of Actuation	Open-Source Code	Required Cost	Challenges/ Features /Relevant
[12]	Monitoring of Intelligent housing	Ad-hoc)	Exist	NA	Low cost	Delays caused by SMS-based orders
[13]	Monitoring of Indoor ambient intelligence	Ad-hoc)	Exist	NA	Cost-effective	many scenarios, center of alarm control
[14]	HAS with IoT services	Ad-hoc	Exist	NA	Not specified	sensor readings for Basic GUI
[15]	Monitoring energy efficiency of Smart home	Ad-hoc CTP routed messages	Exist	NA	Not exist	manager of decision-making and integration of many application
[16]	HAS with MQTT-based	MQTT	Exist	NA	Not exist	Use a module of ESP8266 Wi-Fi
[17]	MAC/PHYs	MoCA(R)	Exist	NA	Low cost	facilitates end-to-end quality of service (QoS), establishing secure connections
[8]	Distributed cloud platforms and services of Google	Android application interfaces	Exist	NA	Cost-effective	volunteers on running prototype
[18]	IoT support home safety with autonomous operation	Message Queuing Telemetry Transport (MQTT)	Exist	NA	Low cost	reduces energy consumption, provide convenience, safety, and security
[19]	embedding intelligence into sensors and actuators	HTML5,JSON	Exist	NA	Low cost	It achieves more feasibility and efficiency for HAS
[20]	MQTT-based HAS	(MQTT)	Exist	Open HAB	Low cost	High flexibility, interoperability and scalability

Table 2. Different between characteristics of main HAS applicable academic systems.(part 2)

Ref.	Hardware of home controller	Com. Transceivers	Topology of Communication	Actuators and sensors	Hardware of node
[12]	Personal Computer	ZigBee, Wi-Fi and GSM/GPR	"Star"	"Relays and temperature sensor"	WN-USB module of ZigBee
[13]	MC with 32-bit ARM	(EIB Serial, ZigBee, Bluetooth, X10, GSM/UMTS/GPRS, DTMF, and CAN)	"Star"	"Multiple I/O pins for attaching sensors and actuators"	32-bit ARM MC for Proprietary board
[14]	"Board of Cubiet"rack (Cortex A7-ARM)"	ZigBee, Wi-Fi	"Star"	"Temperature, light and current sensors (ACS712). Relays and dimmers"	"Xbee, ESP (8266)"
[15]	-	(IEEE 802.15.4)	"Tree"	-	"(MICAz) motes"
[16]	Personal Computer	Wi-Fi	"Star"	"Luminosity sensor (LDR), LED and buzzer"	ESP (8266)
[17]	-	IEEE OUI, an XML-formatted document	"Tree"	"actuator and sensors with Multiple I/O pins"	IEEE OUI and an XML-formatted document
[8]	MX53 embedded board.	Android, GSM	"Tree"	"Temperature, light and current sensors (ACS712). Relays"	MX53 embedded board.
[18]	Smart Devise mobile and PC	Wi-Fi	"Tree"	"radio-frequency identification, ultrasonic, temperature, humidity, gas, and motion sensors"	NodeMCU
[19]	PC	Wi-Fi, ZigBee	"Tree"	"ZigBee actuator"	ZigBee module
[20]	Model B Raspberry Pi	ZigBee, Wi-Fi	"Mesh"	"Current sensors, humidity, Temperature, TMP36, luminosity, and motion sensors "	Xbee Series 2, NodeMCU

3. Research method

The figure below shows the proposed cloud system:

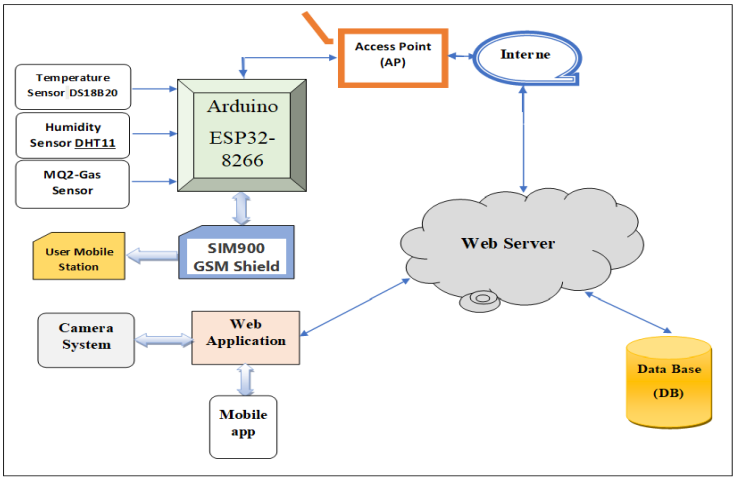


Figure 3. Proposed cloud system

In this system we designed a full secured home automation system. The proposed system used several sensors and systems to achieve a several objectives. Temperature, humidity, gas sensors and camera system are used for smart home automation and they are shown in the figure 4.

(a) (b) (c)

Figure 4. (a) DS18B20 temperature sensor, (b) MQ2-gas sensor, (c) Humidity sensor DHT11

The sensors connected to an esp8266 Wi-Fi type Arduino and programmed using c++ language. The esp. Arduino connected to Router which acts as an access point to the internet. Json programming language format used for connecting Arduino to the access point and internet, then to the web server. If there is a problem in the internet service, we added a GSM shield system to send a massage to specified number about any change in the reading of sensors

Figure 5. Request Sensor Data via SMS using Arduino and SIM900 GSM Shield. Zmodo ZP-IBI13-WiFi camera was connected to the main web application to view the home view. This camera can be controlled by designed android mobile application that will show the whole sensor readings and camera view to the user.

Figure 6. Zmodo ZP-IBI13-W Wi-Fi camera

4. Results and discussions

For the proposed HAS system we utlize three sensors for temperature, gas and motion, each one of them programmed by ESP 8226 Wi-Fi Arduino with their required codes. The ESP 8226 Wi-Fi Arduino programmed with many libraries to be compatible with designed system. Then the readings of sensors are ready to be uploaded to cloud server data base through an access point (we used home router as default access point). The designed cloud data base designed by using two formats, the APACHE and MYSQL formats. The data base location and web server had been placed in personal computer hard disk. The data base connected to web server which is programmed by http server by http request which takes the measured information values and display them on the web server by two stage the first stage is collecting the data and the second stage is display the results on a category using Json format display method. The displayed information will give the instant values of the sensors. Each 1 second the information will be updated to represent a real time system. The results show fast response of sensors and designed system. The figure below shows the implemented system for home automation.

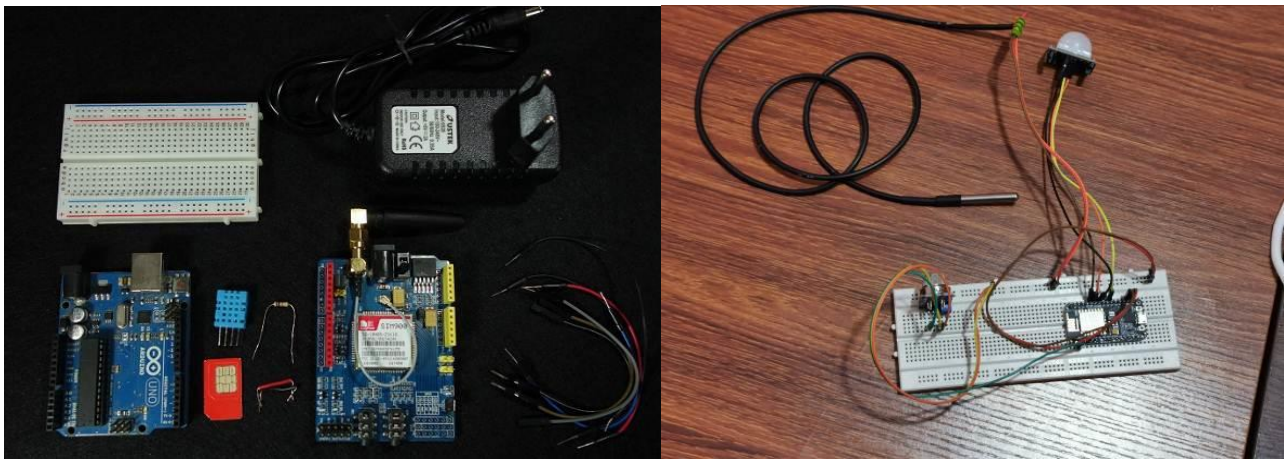
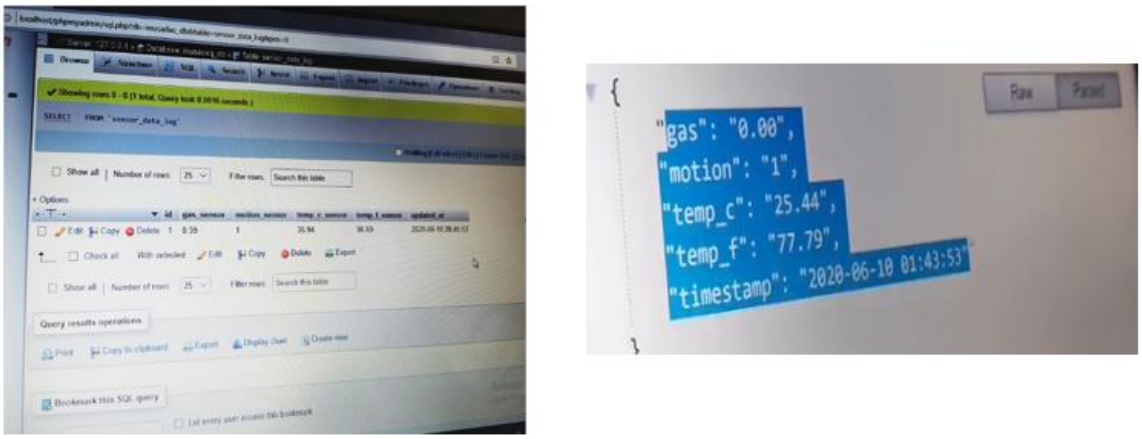


Figure 7. The implemented system for home automation with ESP8226 Wi-Fi Arduino.

We added the Wi-Fi camera system to obtain full secure home system. The camera programmed in the web server directly and connected to android application to obtain live video for home environment. The designed system tested in different environments to see the update of results to be appeared in web server. Figure (8) shows a real time response of web server page with the updated values of system sensors.



(a) (b)

Figure 8. Real time response of web server page with the updated values of system sensors

In the future we plan to design smart home talk system able to take orders and change any stuff in the home by speech orders using rose berry devise. There are many applications and ideas still on the way in the development of smart homes.

5. Conclusion

The security home can be provided and improved by adding a complete combination of important sensors devices and controlling systems with speed time response and relatively low cost. In addition to these components, adding camera system with GSM communication technique is considered as best choice to secure the home and see what is happen in live video in android application the Arduino output data to external specified number if there is no internet provider. Three sensors had been used for temperature, gas and motion measurements. The ESP8226 WiFi device programmed the sensors to maintain the sensors measurements and transfer them to cloud server data base which is programmed to web server via Appatshy and Mysql formats. The system had been implemented with high time response so that all readings updated and appeared spontaneously. The designed system had been presented very good time response with an effective and secure and rapid response real time smart home system should be achieved.

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References

[1] H. El-Sayed et al., "Edge of Things: The Big Picture on the Integration of Edge, IoT and the Cloud in a Distributed Computing Environment", IEEE Access, vol. 6, pp. 1706-1717, 2018

[2] L. Rajabiona, et al.," Healthcare big data processing mechanisms: The role of cloud computing", *International Journal of Information Management*, Vol. 49, pp.271–289, 2019.

[3] A. Yassine, et al.," IoT Big Data Analytics for Smart Homes with Fog and Cloud Computing", Future Generation Computer Systems, Vol. 91, pp. 563-573, 2019.

[4] M. A. Therib et al.," Smart Digital Bi-Directional Visitors Counter Based on IoT", *Journal of Physics: Conference Series*, Vol. 1530, No. 1, p. 012018, 2020.

[5] Adeel Akbar Memon et al," Cloud government- a proposed solution to better serve the nation", International Conference on Cloud Computing and Internet of Things , pp. 39-44, 2014.

[6] N. Hussien, I. Ajlan, M.M. Firdhous, and H. Alrikabi, "Smart Shopping System with RFID Technology Based on Internet of Things," international journal of interactive mobile technologies, vol.14 ,no.4, pp.17-29, 2020.

[7] N. Sultan," Making use of cloud computing for healthcare provision: Opportunities and challenges", *International Journal of Information Management*, Vol.34, pp.177–184, 2014.

[8] I. Korkmaz, et al. ," A cloud based and Android supported scalable home automation system", Computers & Electrical Engineering, Volume 43, April 2015, Pages 112-128.

[9] L. R. ion," Healthcare big data processing mechanisms: The role of cloud computing", *International Journal of Information Management*, Vol.49, pp.271–289, 2019.

[10] O.H. Yahya, H.T. Alrikabi, R. Al_Airaji, and M. Faezipour, "Using Internet of Things Application for Disposing of Solid Waste," international journal of interactive mobile technologies, vol. 14, no. 13, 2020.

[11] W. A. Jabbar, et al., "Design and Implementation of IoT-Based Automation System for Smart Home," in International Symposium on Networks, Computers and Communications (ISNCC), pp. 1-6, 2009.

[12] A. Nedelcu, et al., "Wireless-based Remote Monitoring and Control of Intelligent Buildings". In Proceedings of the IEEE International Workshop on Robotic and Sensors Environments, Lecco, Italy, pp. 47–52, 2009.

[13] Zamora-Izquierdo, et al., "An Integral and Networked Home Automation Solution for Indoor Ambient Intelligence". *IEEE Pervasive Computing*, Vol. 9, No.4, pp. 66–77, 2010.

[14] G.V. Vivek, M.P. Sunil, "Enabling IoT services using WIFI-ZigBee gateway for a home automation system". In Proceedings of the IEEE International Conference on Research in Computational Intelligence and Communication Networks (ICRCICN), Kolkata, India, pp. 77–80, 2015.

[15] C. Farias, et al., "A control and decision system for smart buildings". In Proceedings of the IEEE 10th International Conference on Ubiquitous Intelligence, Sorrento Peninsula, Italy, pp. 256–261, 2013.

[16] R.K. Kodali, and S Soratkal, "MQTT based home automation system using ESP8266". In Proceedings of the IEEE Region 10 Humanitarian Technology Conference (R10-HTC), Agra, India, pp. 1–5, 2016.

[17] ALRikabi Haider Th Salim, Alaidi Abdul Hadi M, and Abed Faisal Theyab, "Attendance System Design And Implementation Based On Radio Frequency Identification (RFID) And Arduino," *Journal of Advanced Research in Dynamical Control Systems*, vol. 10, no. SI4, pp. 1342-1347, 2018.

[18] W. A. Jabbar, et al., " Design and Fabrication of Smart Home with Internet of Things Enabled Automation System", *IEEE Access*, Vol.7, pp.144059-144074, 2017.

[19] M. Soliman, at al., "Smart Home: Integrating Internet of Things with Web Services and Cloud Computing". IEEE International Conference on Cloud Computing Technology and Science, vol. 2, pp. 317-320, 2013.

[20] I. Froiz-Míguez, et al., "Design, Implementation and Practical Evaluation of an IoT Home Automation System for Fog Computing Applications Based on MQTT and ZigBee-WIFI Sensor Nodes". Sensors Journal, Vol. 18, No.8, p.2660, 2018.

[21] M. J. Mohsin, et al.," Performance analysis of image transmission with various channel conditions/modulation techniques", *TELKOMNIKA Telecommunication, Computing, Electronics and Control*, Vol. 18, No. 3, pp. 1158-1168, 2020.

[22] A. N. Hassan, et al. ,"Discrimination of ECG signal based on S-interpolation and Quantum Neural Network" , *Annals of Tropical Medicine & Public Health*, Vol. 23 , No.10, 2020.

[23] Duha. Al-Malah, H. Th. S. Alrikabi, "The Interactive Role Using the Mozabook Digital Education Application and its Effect on Enhancing the Performance of eLearning," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 15, no. 20, pp. 21-41, 2020.

[24] D. Singh, el al.," A survey of Internet-of-Things: Future Vision, Architecture, Challenges and Services", IEEE World Forum on Internet of Things (WF-IoT), 2014.

[25] S. Namasudra, et al.," Towards DNA based data security in the cloud computing environment ", Computer Communication, Vol. 151, No.1, pp. 539-547, 2020.

[26] L. A. Abdul-Rahaim and A. M. A. Ali ,"Remote wireless automation and monitoring of large farm using wireless sensors networks and internet", International *Journal of Computer Science & Engineering Technology*,Vol6,No.3, papes 118-137, 2015.

[27] L. A. Abdul-Rahaim ,"Enhancement lte system based on dwt and four stbc transmit antennas in multichannel models", American Journal of Networks and Communications,Vol4, No.2, ,pp.10-20, 2015.