ISSN: 0067-2904

Cloud-based Voice Home automation System Based on Internet of Things

Zainab Malik Jasim, Ayman Dawood Salman
Informatic Institute for postgraduate studies, University of technology

Received: 2/6/2021 Accepted: 5/7/2021

Abstract

The rapid development of automation industries and technologies has shown incredible prospects for transforming our homes into a smart home automation system, which are more secure than a simple home. This paper proposes a home application based on voice and text called the Automated Control and Monitoring System (ASCM). This application can be utilized by both normal and vision-impaired people by using with a mobile phone.

The application allows users to send voice commands through Google Assistant installed on Android to control the appliances. They can also have complete monitoring by logging onto the ThingSpeak dashboard, which displays a device status indicator and sends alert messages in the event of danger. The NodeMCU development board based on the ESP8266 and a combination of sensors, modules and actuators were used to create a "control system" for home appliances based on the Internet of Things (IoT). This work mitigates the challenges that faced the design of smart homes based on (IoT). The control and monitoring system is using voice without the need to use programming languages. As well as the automation process is not only on / off but also querying the status of any device sensors. In addition, this application dispenses with IFTTT(If-This-Then-that) services to send alert messages because their number is limited during the month, compared to the alerts provided by the Blynk app, which is unlimited. Mobile phones and robotic homes will make life easier and more enjoyable for the elderly and differently abled people who are unable to manually turn the items ON/OFF.

Keywords: Home Automation, NodeMC, IoT, ThingSpeask, VoiceFlow, firebase.

نظام اتمته المنزل الصوتي المستند الى السحابة على اساس انترنت الاشياء

زينب مالك جاسم ، ايمن داوود سلمان

معهد المعلوماتية للدراسات العليا ، الهيئة العراقية للحاسبات والمعلوماتية ، بغداد ،العراق

الخلاصة

أظهر التطور السريع في صناعات وتقنيات الأتمتة آفاقًا لا تصدق لتحويل منازلنا إلى أنظمة أتمتة منزلية ذكية تستخدم أدوات ذكية يتم التحكم فيها لاسلكيًا عبر الإرسال اللاسلكي أو Bluetooth أو Wi-Fi. يقترح هذا العمل نظام التحكم والمراقبة الآلي (ASCM) نظرًا لوجود استهلاك كبير للطاقة المنزلية في القناتين الحاليتين. لقد تم اقتراح أن هناك العديد من الأشخاص من كبار السن والذين يعانون من مشاكل في الرؤية ، وهناك العديد من الأشخاص الذين ليسوا على دراية باستخدام تطبيقات وتقنيات الهاتف المحمول ويستفسر عنها باستخدام تطبيق Blynk المثبت على الهاتف المحمول.

*Email: ms201910526@iips.icci.edu.iq

استخدام الأوامر الصوتية مع Google Assistant المثبت على Android ، بالإضافة إلى المراقبة الكاملة عن طريق الدخول إلى لوحة معلومات ThingSpeak التي توفر مؤشر حالة الجهاز. وإرسال رسائل تنبيه في حالة وجود أي خطر. يتم استخدام لوحة تطوير NodeMCU القائمة على ESP8266 ومجموعة من المستشعرات والوحدات والمحركات لإنشاء "نظام تحكم" للأجهزة الإلكترونية المنزلية على أساس إنترنت الأشياء (IoT). من خلال هذا العمل تم التغلب على معظم التحديات التي واجهت تصميم المنازل الذكية بالاعتماد على (IoT) ، وهي التحكم والمراقبة باستخدام الصوت دون الحاجة إلى استخدام لغات البرمجة ، بالإضافة إلى أن عملية الأتمتة ليست فقط على / إيقاف ولكن أيضًا الاستعلام عن حالة أي مستشعرات للجهاز والاستغناء أيضًا عن خدمات (IFTTT (If–This–Then–Tha لإرسال رسائل تنبيه لأن عددها محدود خلال الشهر ، مقارنةً بالتنبيهات التي يوفرها تطبيق Blynk ، وهي غير محدود. ستجعل الهواتف المحمولة والمنازل الآلية الحياة أسهل وأكثر إمتاعًا للأشخاص ذوي القدرات المحدودة وخبرة قليلة مع التطبيقات الذكية.

Introduction

The internet of things (IoT) is a concept that uses the internet to access, control, and monitor elements automatically. One approach that works well in this situation is home automation. Smart houses make use of technology to improve comfort, security, and energy efficiency within the home. IoT is a network of connected computing devices that can be easily recognized and incorporated into everyday life [1].

Smart homes provide users with a trendy way of life where they can control their entire home by turning off devices such as the fan, air conditioner, or lights before leaving the house to save energy [2]. The architecture of the Internet of Things differs from one system to another depending on how it is implemented. The Internet of Things in general is depicted in Figure 1. It is made up of microprocessors, sensors, and microcontrollers that send and receive data from the server and microcontrollers.

Although there are quite a few voice-controlled home automation systems on the market, most consumers cannot afford them. Voice-enabled home automation systems will benefit those with physical limitations, the elderly and others unfamiliar with using smart apps, making their lives easier [3].

The project is reasonably low-cost because it uses least cost equipment’s like the VoiceFlow platform's API and does not require the usage of specialized programming languages. [4] The intended project is implemented on Google Assistant, which allows users to work with and query any product or scenario at home using voice commands, minimizing human involvement in the automated process and saves electricity consumption.

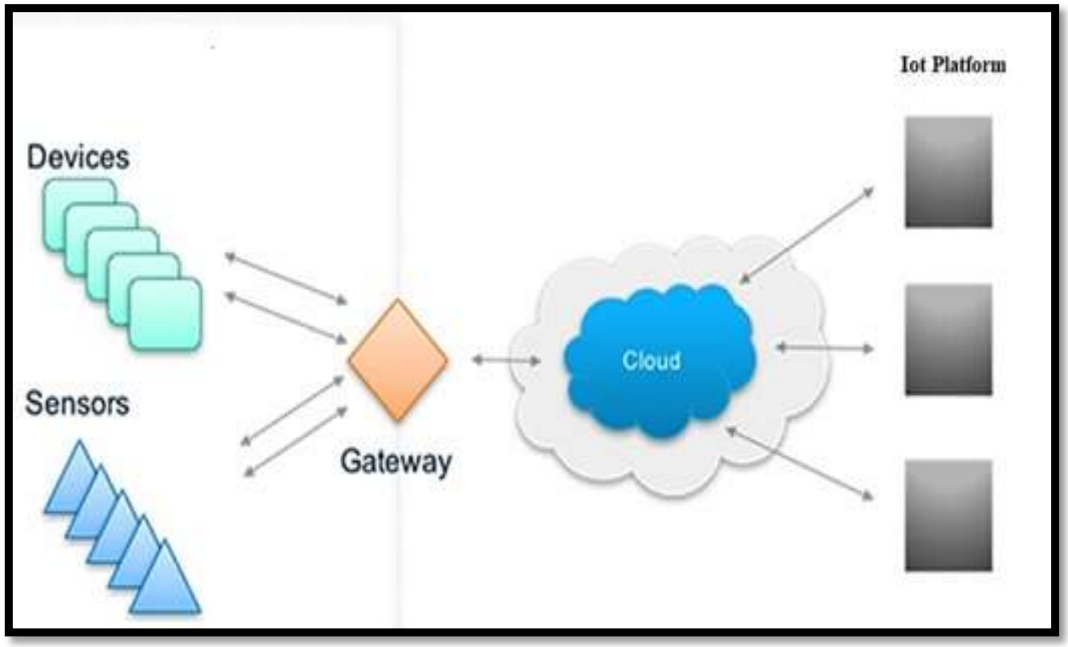


Figure1-General Architecture IoT

Related Work

In [5] a voice-activated technology is provided that eliminates the need for any typing. Aside from voice instructions, the system might also use sensors to automate specific appliances. The fundamental goal of this project is to make a consumer's life easier and to ensure that electricity is used efficiently. Since providing a voice-activated technology eliminates the need for any typing. Aside from voice instructions, the system might also use sensors to automate specific appliances. The fundamental goal of this project is to make a consumer's life easier and to ensure that electricity is used efficiently.

In [6] article, a microcontroller-based voice-controlled home automation system using smartphones was described. Users would be able to manage any gadget in their home with their voice using the system. All that is required of the user is an Android smartphone, as well as a control circuit. An Arduino Uno microcontroller serves as the control circuit, processing user commands and controlling device switching. Bluetooth establishes a connection between the microcontroller and the smartphone. The system's biggest disadvantage is that it can only control home appliances that are within Bluetooth range.

The paper [7] concentrated on the creation of a smart assistant, particularly for blind people who use voice instructions. This low-cost technology was created to ensure both security and virtual assistance in real time. In this project, a voice recognizer accepted the users' spoken orders and converted them into appropriate instructions using Python-interpreted software. The following are the instructions. These instructions ensured that users could write and receive emails, as well as access daily online news and weather forecasting, among other things.

Authors in [8] proposed a framework for building home automation while keeping smart house security. The project's creators tried to come up with a technique to provide an audio visualization framework that would allow them to track down authorized users while limiting illegitimate ones. In addition, this paper discussed an important method for managing household appliances. A software program installed on a PC operated as a home assistant. Also, this paper focused on low power consumption, making this study more environmentally cordial.

In [9] operated on the embodiment of an intelligent system. The goal was to build a project that could be controlled with a remote controller as well as voice commands. To construct more intelligent systems, the authors attempted to incorporate numerous characteristics such as sensor control, facial recognition, and voice pattern recognition.
The authors of [10] created a system with multiple sensors. The Intel Galileo uses the Wi-Fi module to connect to the internet, and once linked, it begins reading sensor values. Set the threshold levels for each sensor after that. The data from the sensor is transferred to a web server, which is subsequently stored in the cloud. The temperature and motion-sensing data are stored in the cloud. The cooler will automatically switch on when the temperature climbs beyond the stated limit and turn off when the temperature falls below it. An alarm is raised, and a warning sound is broadcast if there is a gas leak in the building.
In [11], the paper proposed a dual-mode IoT-based device for monitoring and controlling home appliances. Two modes of service for the device to track and control appliances. The first mode employs a mobile app interface, and the second is chat-based, which monitors and controls home appliances using text or audio commands with natural language processing. The proposed system allows for the addition and removal of rooms on demand. They used the Raspberry Pi as the controller, as well as Blynk and IFTTT, to develop a voice-controllable home automation system.
In [12], They utilized a microphone to record the spoken commands that go along with the basic tasks. Because they didn't have a large dataset to grasp each instruction, it was limited in its utility. Even though similar work has been done, Google Assistant has been integrated with current systems to enable voice control.
In[13], The authors proposed a thermal monitoring system, using sensors that must collect data in order to effectively control the HVAC system. They focused specifically on Radio Frequency Identification (RFID) and Bluetooth, which are two well-known wireless technology standards used by commercial electronics but also suitable for pervasive Internet of Things systems. These technologies are discussed and compared from several points of view, i.e., flexibility, reliability, battery life and system cost. The theoretical results are supported by an empirical analysis based on the implementation and testing of two different systems, one using RFID and the other using Bluetooth technology.
[14], proposed to use of the electronic learning booklet with Cloud computing that aims to be simple and intuitive. It creates interaction and makes it possible to strengthen the links of the trinomial (Student, Educational tutor, supervisor on a training) using an online platform tool using Cloud Computing Technology to overcome the limitations of the "paper" learning booklet.
In[15], they proposed to distribute across multiple layers, which also increases the latency. Time-sensitive Internet of Things (IoT) applications and services, usually in a cloud platform, are running over various virtual machines (VM's) and possess high complexities while interacting. They face difficulties in the consolidations of the various applications containing heterogenetic workloads.

Proposed system

We are proposing an Automatic System for Control and Monitoring (ASCM). to the system provides the ability to inquire about the status of any connected home device. It supports voice control to reduce costs and eliminate human participation, which makes the system accessible to the general public and compatible with their needs. The system used the Google Assistant voice assistant, which would make the interface more easy and accurate in use and there is no need for manual use. The hardware and software components of the system can be separated into two categories. The hardware and software components of the proposed system are shown in Figure 2 as a block diagram.

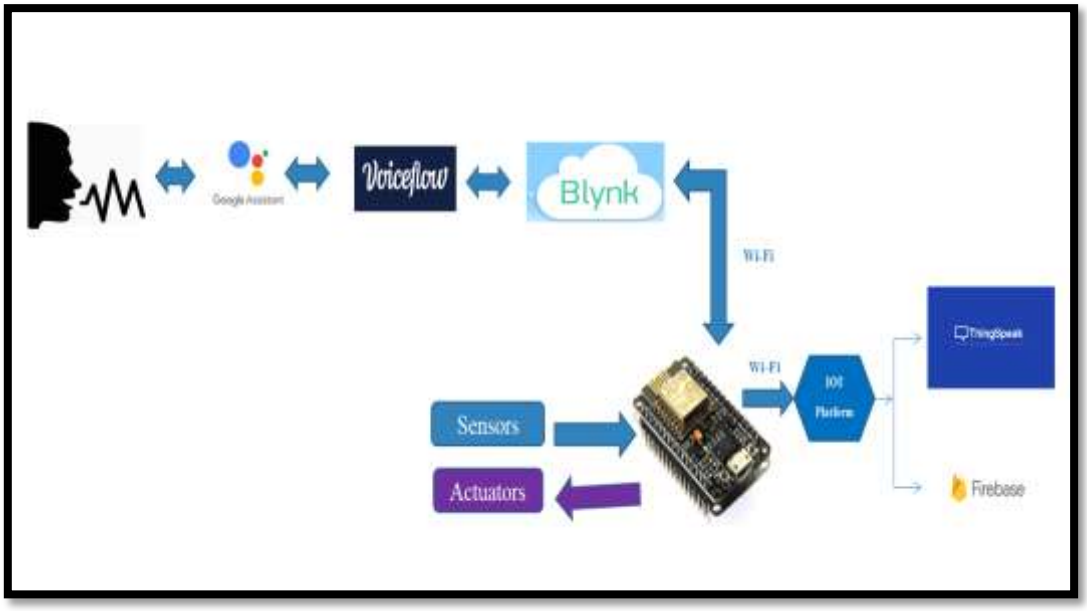


Figure 2-General Block diagram of the proposed system

Hardware

Several sensors are connected with the microcontroller (ESP8266) [16]; The power source (5 V 4 A) is one of the components of the devices that provide energy to an electrical device, such as the temperature and humidity sensor and the gas sensor, in addition to various actuators. It takes energy from an electrical outlet and converts it to direct current from alternating current (alternating current) (direct current). It was used in the system to supply the microcontroller with power. In our proposed system a servo motor was used, which is an electrical gadget that can precisely push or twist anything. A servo motor is used when you wish to rotate an object at certain angles or distances. It is made from a simple motor that is controlled by a servo mechanism. If a DC (Direct current) servo motor is used, it is referred to as a DC servo motor. If an AC (Alternating Current) servo motor is used, it is referred to as an AC servo motor. Our high torque servo motor may be packaged in a small and light container. Because of these characteristics, they are used in many applications such as toy cars, airplanes, robots, machines, etc.

A 4-channel relay, which consists of an electromagnet (coil), a switch, and a spring that opens and closes under the direction of another electrical circuit, is utilized. The switch is held in place by the spring until current passes through the coil, which provides a magnetic field that moves the switch. The relay is used to connect electrical devices to enable on and off switching because it can control an output circuit with higher power than the input circuit. The relay is used to connect electrical devices to enable on and off switching because it can control an output circuit with higher power than the input circuit.

A push-button switch is employed in the proposed system, which is a simple type of switch that regulates movement in a machine or some form of activity. Plastic or metal buttons are commonly used. The push-button design might be curved to accommodate fingers or hands for ease of use, or it can simply be flat. It all depends on the individual's design. The push-button, which is used to ring the doorbell in this method, can be opened or closed normally. Figure 3 depicts a hardware connection circuit schematic.

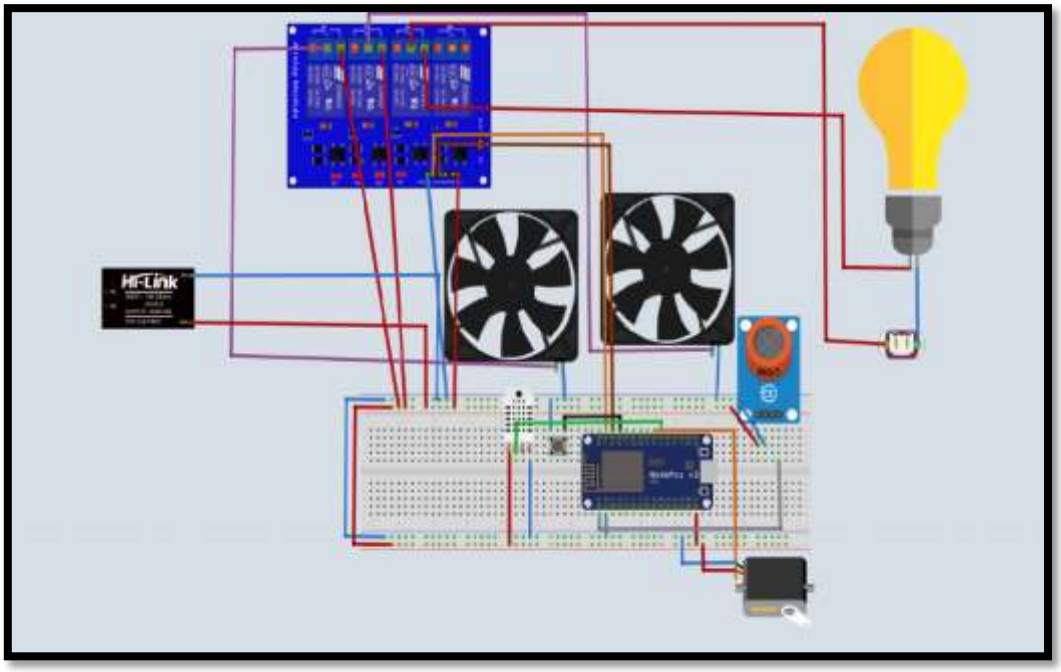


Figure 3-The circuit diagram of hardware connection.

Software

The software used for the system is:

the first is the Blynk platform [17]: an internet of things platform that uses iOS (iPhone operation system) and Android apps to allow users to operate electronic equipment remotely. It includes a dashboard that allows users to construct a graphic interface by combining various widgets. Sensor data can also be stored and displayed by Blynk. Blynk has libraries for most common hardware platforms, including Arduino, ESP8266, Raspberry Pi, SparkFun, and others. The Blynk cloud was employed in this suggested system; the App, cloud, and libraries are the three most significant components of Blynk. The app can assist in the creation of the interface. All communication between the app and the hardwires are handled by the cloud. And libraries allow hardware to communicate with the server via commands. We may use the Blynk app to control all devices that are connected to the Blynk Cloud. Different buttons have been added to the Blynk app and may use those buttons to turn on and off the switch.

the second software used in the system is the VoiceFlow platform, which allows anyone to make voice apps without coding and utilizes voice as a primary input interface. The Voice App for a Conversational Experience takes up the challenge of enabling non-coders to design and build their voice-commanded apps. The idea behind VoiceFlow is to democratize the creation of voice apps the same way WordPress made blogging accessible for the masses or how Photoshop made image editing a more intuitive experience.

VoiceFlow lets you build voice apps for Amazon Alexa, which is on more than 100 million devices, and Google's Assistant, which is on at least a billion. These apps (called Skills with Amazon and Actions with Google) are functions that can be taught to perform tasks within their respective devices.An easy example would be asking your voice app to, "turn on the lights," to electronically flick on a light switch [17][18].

The final piece of software is ThingSpeak, an open-source Internet of Things (IoT) platform that allows you to gather, save, investigate, imagine, and act on data from sensors and actuators such as Arduino, Raspberry Pi, Beagle Bone Black, and other devices.

The Google Firebase database is utilized in the system as a free platform where all types of apps (Android, iOS, Web app) can be produced. The Firebase console platform has numerous features, including the ability to save sensor data in a database and a real-time database. The

real-time value is stored in the real-time database. The received data from the sensors is programmed using the Arduino IDE, and the data is then uploaded to the Blynk cloud, the Firebase database, and the ThingSpeak dashboard.

Implementation

The imaging of smart homes based on the Internet of Things will be discussed in this section. To make this system more reliable and energy consuming, we use home automation. The process of home rectification in the proposed system can be summarized in the following:

Step1.Users must ensure a Wi-Fi connection for smart homes to operate. A person can easily control all the electronic components, such as a light bulb or fan, or lights, by speaking to the smart assistant in English.

Step2.In the proposed system, a sensor node planted inside the house was used, and the node contains a temperature and humidity sensor DHT22, and a gas sensor MQ2 to sense the presence of gas or smoke, in addition to the fan, a puller. Each sensor is given a threshold value, for example, when the temperature rises above 30C°, the air conditioner turns on automatically and when the temperature drops below 20C°, the heating is turned on. For heating, the smoke and gas sensors with a sensor reading value above the threshold value, the air puller is turned on in the rooms of the house. Figure 4 shows the proposed system implementation algorithm (a) for MQ2 gas sensor (b) DHT22 sensor for IoT-based smart home.

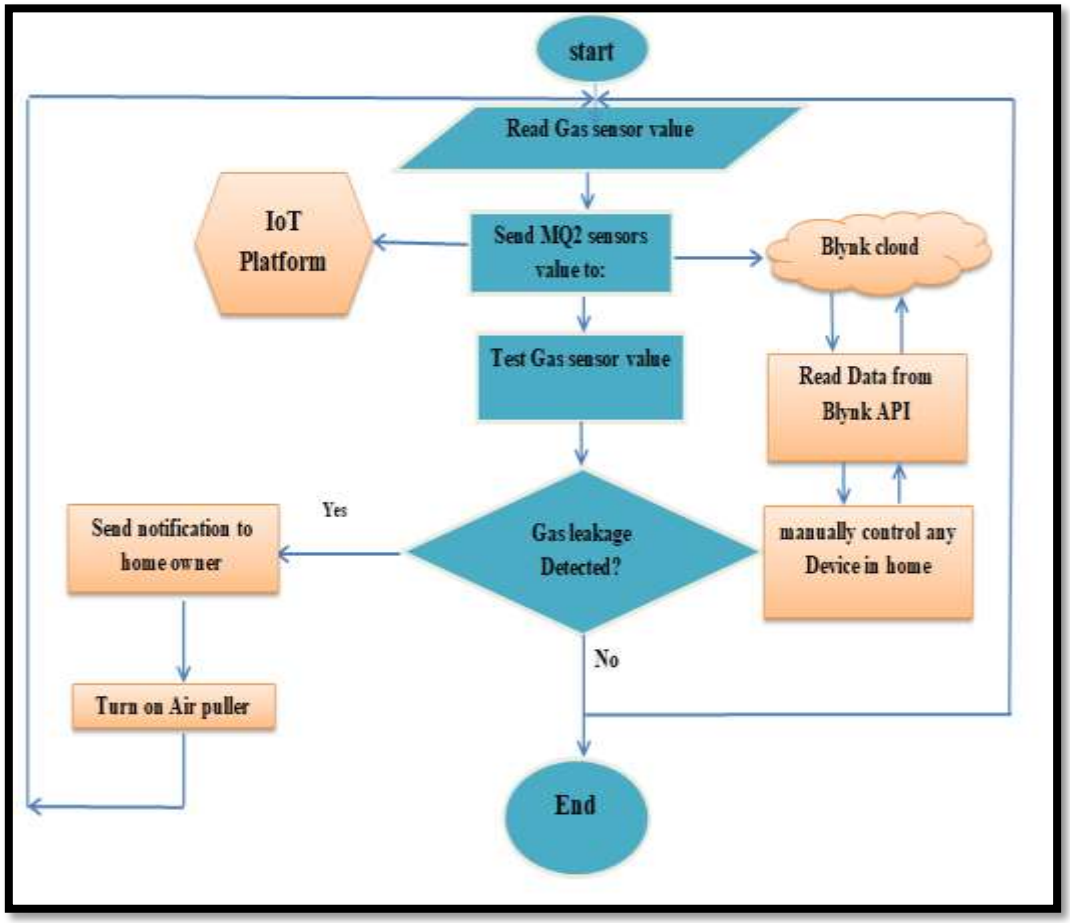
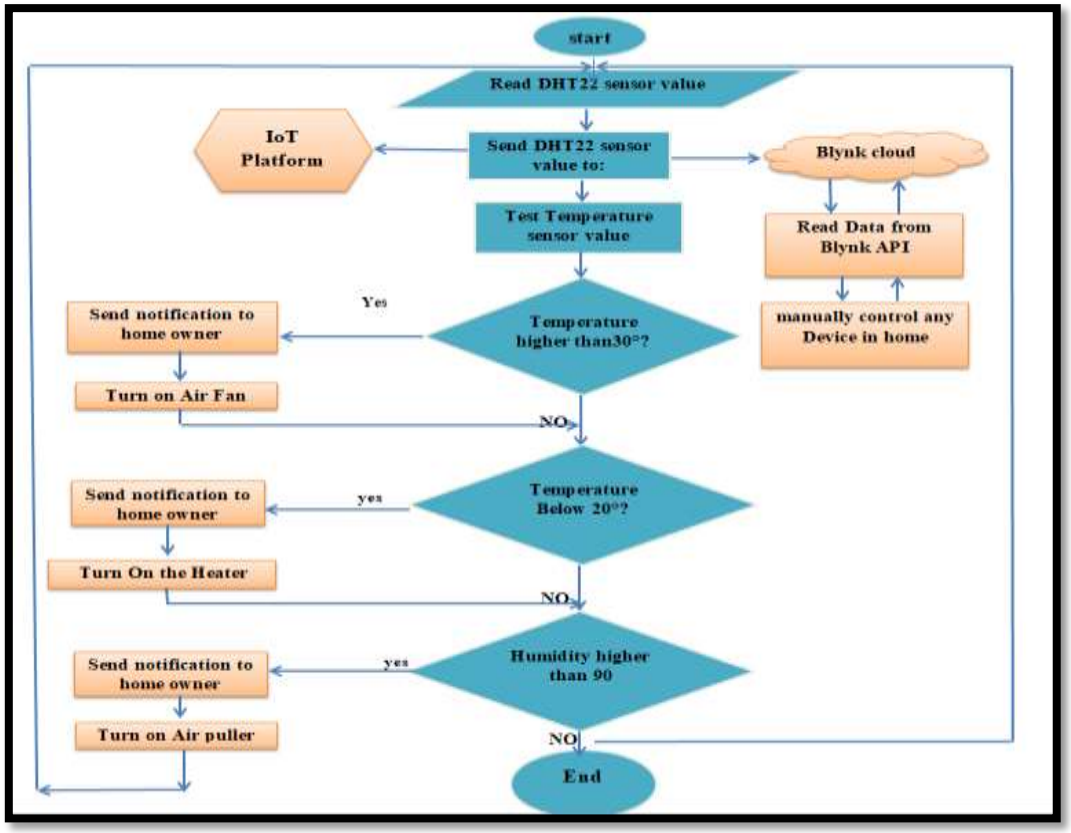


Figure 4-The Algorithm of proposed system **(a)**MQ2 Gas sensor.



(b) DHT22 sensor algorithm

Step3.The data from the sensors was programmed using the Arduino IDE (Integrated Development Environment).

Step4.Sensor data readings from DHT11 and MQ2 are uploaded in real time to the Blynk cloud and ThingSpeak IoT dashboard by programming live data visualization and analysis. as Also, sending sensor values and trigger status to a Firebase database for the homeowner to view records of the readings that can determine the period Storage as desired by the homeowner. In the proposed work the readings are stored for a month.

Step5. As for the free VoiceFlow platform, it contains a set of APIs (application programming interface) and blocks through which the voice skills related to the proposed system are built. These skills are deployed in the Google Assistant, and the entire system is converted into voice commands. After logging in to the above platforms, the user will be presented with a list of rooms and devices connected to the IoT system that they can control from the displayed panel. Users can change the design of their home at any time to suit their needs by adding and deleting rooms and devices.

Result And Discussion

Blynk makes it simple for us to use the proposed system (ASCM). The Blynk dashboard is shown in Figure.5 with the help of a project-specific authentication key. By coding the project in the Arduino IDE, we have an authentication key that functions as a form of address for Blynk's development board, allowing him to select where to send the command. A voice-activated command interface module has been developed to interact with a number of home equipment, allowing a remote homeowner to contact, control, and differentiate them using Google Assistant. In terms of the system, A word is assigned to each relay, allowing Google Assistant to control it. When a certain phrase is typed into Google Assistant or given as a voice command, Google Assistant reacts and is triggered based on the phrase. It also transmits

a command to the Blynk server by leveraging the VoiceFlow to send a URL-based Web request to the Blynk server. Figure.6 Shows the voice command in Google assistant

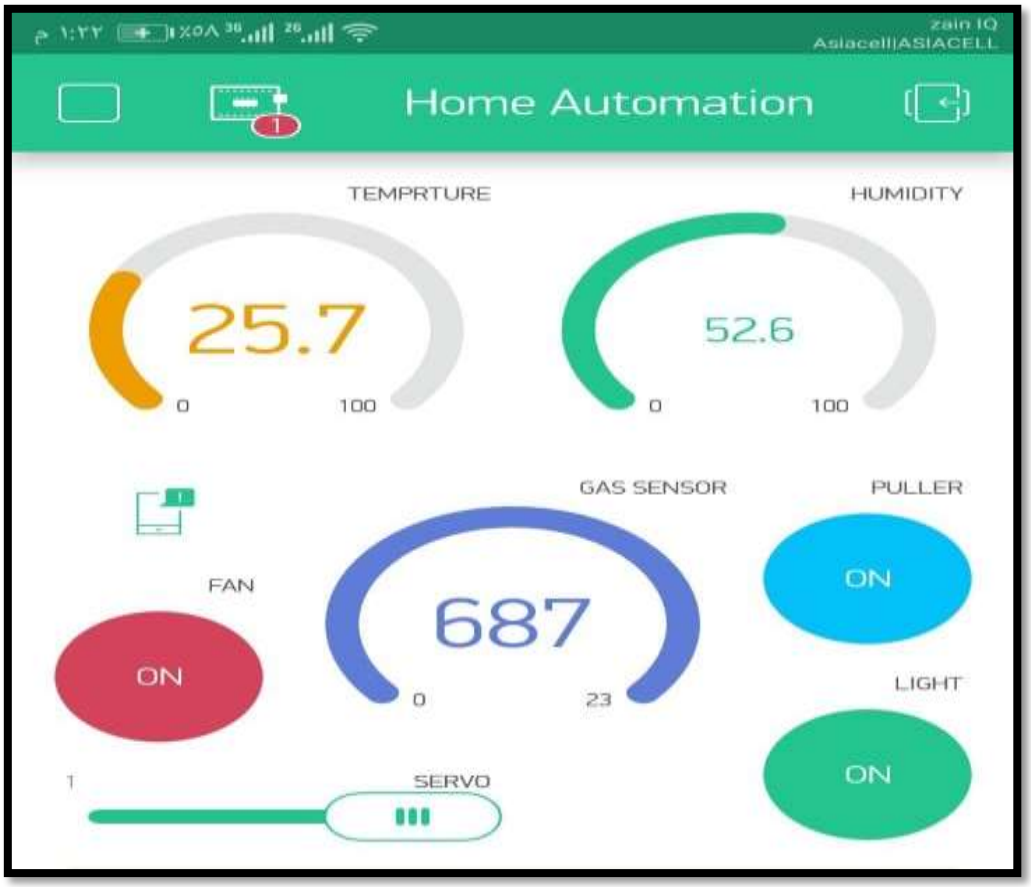


Figure 5-Blynk Dashboard

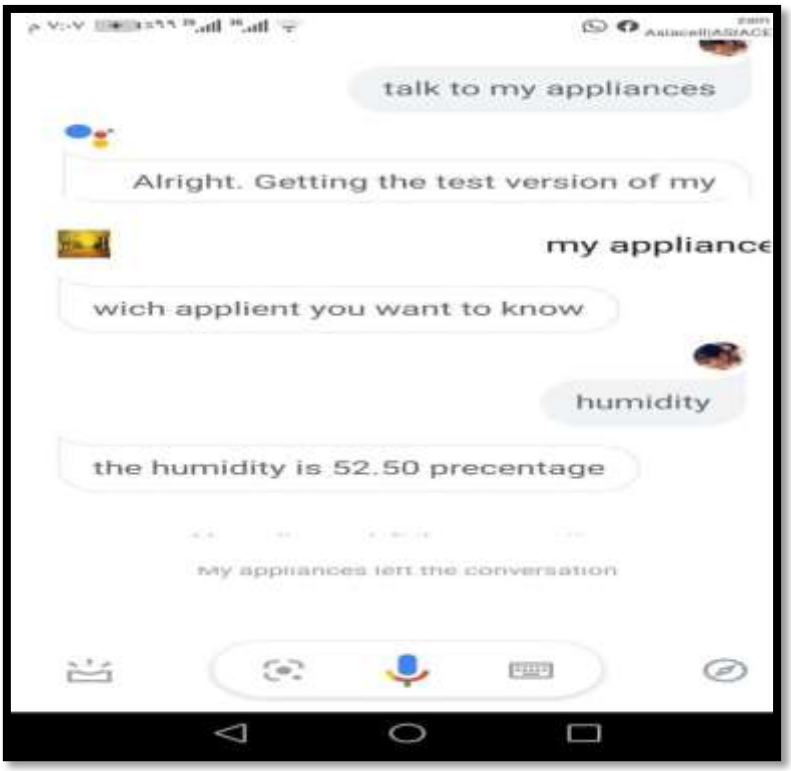


Figure 6-Google Assistant command

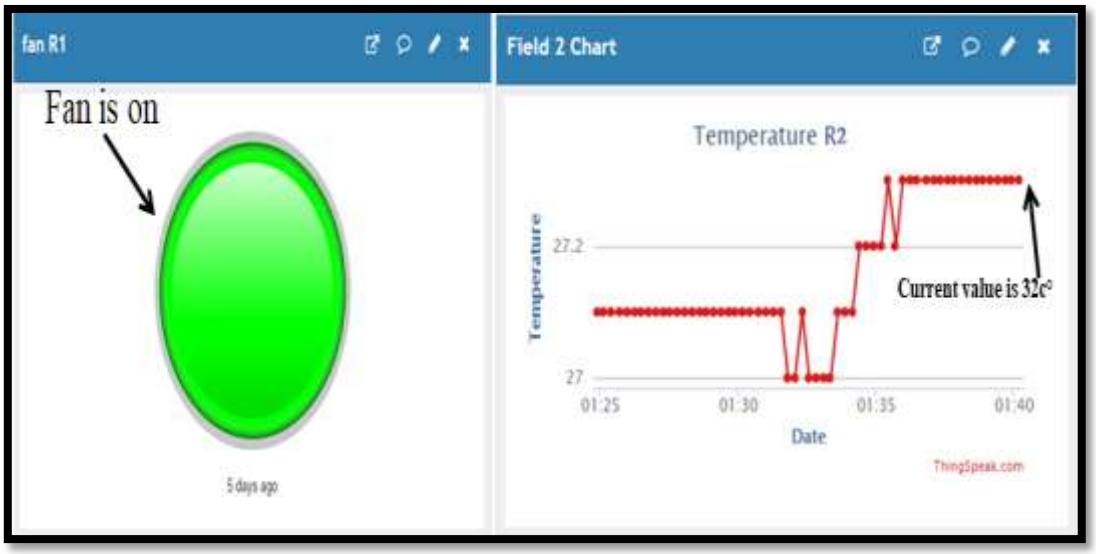


Figure 7-ThingSpesk Dashboard of temperature Reading

The image in Figure 7 above shows the output of the dashboard ThingSpeak of the temperature reading, and the state of the Fan are displayed. In the case where the temperature rises above the threshold value, the Fan is turned on. Data is transferred using the ESP8266 Wi-Fi module and the command programmed into the Arduino IDE. The user can modify the refresh rate to send data to the server specified in the code. The update in our proposed system happens every minute. The values of readings and sensor states are stored for an entire month in the Firebase database and when the values are updated is also determined by programming the code.

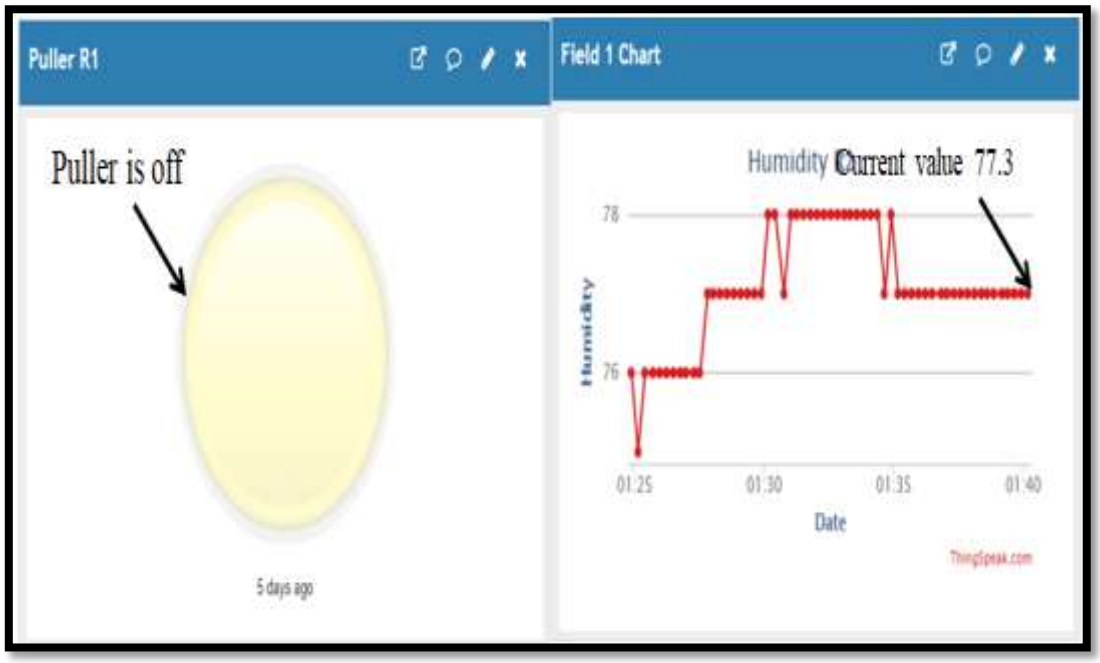


Figure 8-ThingSpesk Dashboard of Humidity Reading

Figure 8 above shows Humidity reading. Through the interface, the values of the humidity readings are displayed. In case the humidity exceeds the specified value, the light of the Puller is illuminated, which indicates the operation of the Puller. Figure 9 shows the reading of the gas and the light that indicates its puller status.

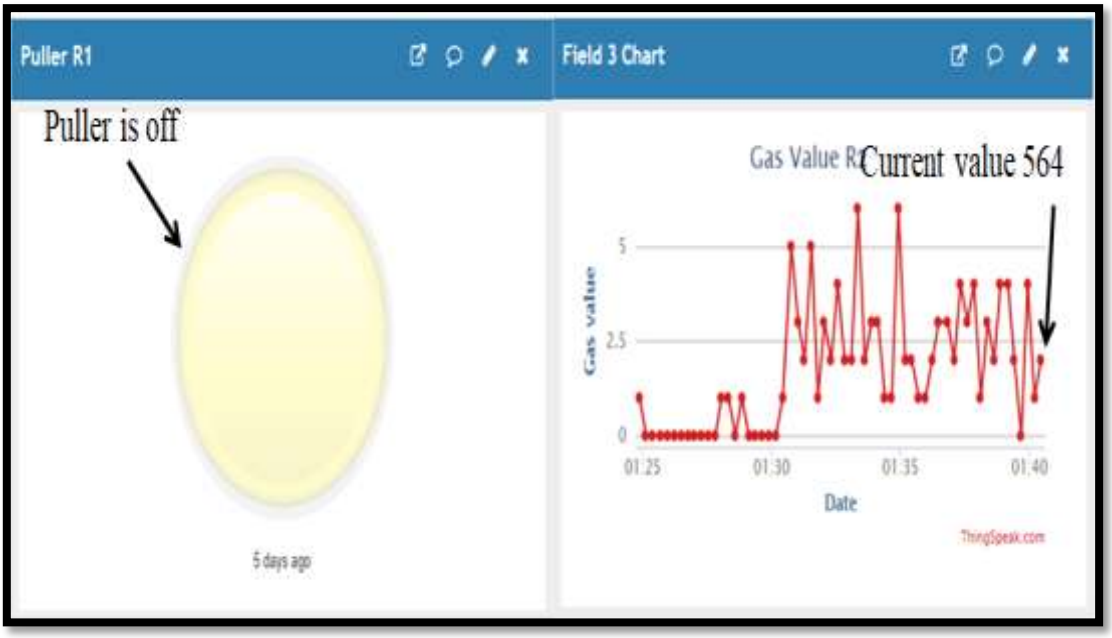


Figure 9-ThingSpesk Dashboard of Gas Reading

Conclusion

Because of the development of communication technologies, computers, software, and intelligent systems, future connected homes are no longer hard to make a reality. This has given a new boost to the comfort of people in their homes. Thus, several new services are offered, among them ensuring the safety and protection of people, Improving comfort, and energy saving.

Google Assistant is connected with existing systems in this paper to make it manageable and to ask about any device in the home by speech, in addition to manual control using the Blynk. Furthermore, the supplied method eliminates the requirement for any additional software to be installed on the user's mobile phone for it to be voice-controlled Because Google Assistant is one of the pre-installed apps for Android phones. According to the literature, most home automation applications are based on the Android operating system, which makes it difficult for users of iOS mobile devices to handle the systems. The Blynk software utilized in this article allows an iOS user to use the Blynk interface to control the switching of home devices. By installing the Google Assistant software on their phone, even an iOS user may operate devices with voice commands. However, the Blynk app still has restrictions in that we can only execute basic functions with it.

References

[1] M.Aldossari, A. Sidorova," Consumer acceptance of Internet of Things (IoT):smart home context", Journal of Computer Information Systems, Vol 60,Issue 6, pages 507-517, 2020.

[2] M.Asadullah, A. Raza, "An overview of home automation systems", International Conference on Robotics and Artificial Intelligence (ICRAI),pages 27-31,2016.

[3] M.Ruman, M.R., Das,S.Das,S.Istiaque Mahmud , "IoT based smart security and home automation system", Asian J. Convergence Technol (AJCT), 2019.

[4] VoiceFlow,Available:. https://www.voiceflow.com/, 2021. [Online].

[5] A.Jain, P.Tanwar et al.," Home Automation System using Internet of Things (IOT)" , International Conference on Machine Learning, Big Data, Cloud and Parallel Computing (COMITCon), Faridabad, India , 2019.

[6] T.Pranay, G.Bhavani,P.SivaSravani,"Intelligent voice controlled home automation system", nternational Journal of Mechanical Engineering and Technology, Vol 9, Issue 1,page 640-645, 2018.

[7] P.Bose ,A. Malpthak, U.Bansal, A.Harsola ,"Digital assistant for the blind", International Conference for Convergence in Technology (I2CT), pages 1250–1253, 2017.

[8] K.Balasubramanian, A.Cellatoglu,"Improvements in home automation strategies for designing apparatus for efficient smart home". IEEE Trans Consum Electron, 2008.

[9] V. Chayapathy, G.Anitha, B.Sharath "IOT based home automation by using personal assistant",International Conference on Smart Technologies for Smart Nation (SmartTechCon), 2017.

[10] M.Al-Amin, S.Aman , "Design of an Intelligent Home Assistant", International Conference on Intelligent Systems, Modelling and Simulation (ISMS), pages 69–71 . https://doi.org/10.1109/ISMS.2016.34, 2016.

[11] O. Hamdan, H.Shanableh, I.Zaki, T.SHanbleh,"interactive dual mode smart hame automation" In 2019 IEEE Internatonal Conferener Goner Eletrnic CCE Lax Vegas, pages 1-2 , 2019.

[12] A.Maharaja, A.Ansari, "Voice controlled automation using raspberry pi", International Conference on Advances in Science & Technology (ICAST), 2019.

[13] E.Giusto,F.Gandino,N.Greco et al, "“An investigation on pervasive technologies for IoT-based thermal monitoring", ensors (Switzerland),vol 19,Issue 3,2019.

[14] Jenifer, D.Aravindhar, "Iot based air pollution monitoring system using esp8266-12 with google firebase" , Journal of Physics: Conference Series, Vol 1362,Issue 1, 2019.

[15] H.Duani.M.Sheth,M.Vaghasia, "Smart Automated Home Application using IoT with Blynk App",Proceedings of the International Conference on Inventive Communication and Computational Technologies, ICICCT,2018.

[16]VoiceFlowAvailable:https://crm.org/news/voiceflow-the-voice-app-for-a-conversational-experience,2021,[online]