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Design, Analysis and Development of IoT based Home Automation Using Arduino Board

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Abstract

As energy consumption rises, there is an urgent need to reduce energy usage in all conceivable methods. Home automation is one of the ways that everyone may improve their lives at home by using this motorised technology; it lowers human work and stress, uses energy efficiently, and saves time, resulting in a modern house This smart house or home automation technologies advancement has been incredible in the past, and it will continue to increase dramatically in the future as their wants, requirements, and benefits change. Automation is quickly arriving on a global scale. Automation is a simple way to handle any machinery or equipment that will operate to our criteria because people have less time to handle any work. The goal of this article is to create and construct a Bluetooth module and Arduino-based home automation system. A home automation system offers a straightforward and reliable technology with Android app. Home appliances like fans, lighting, air conditioners, and automated door locks may all be controlled by an Arduino Uno equipped with a Bluetooth module. The article primarily focuses on the monitoring and control of smart homes using Android phones, as well as providing a security-based smart home while humans are not there. The goal of this article is to control home appliances in smart homes in a user-friendly, low-cost, and easy installation manner.

This article provides a realistic method and execution of a dependable, conveniently accessible, economical, small, and inexpensive system. With just one click on the Android mobile app, an Android phone-based home automation system can operate household appliances.

Keyword: Energy, Automation, Economical.

Introduction

One of the most essential and fascinating disciplines nowadays that has a significant impact on daily life is automation technology. Automation technologies used in the control of lighting, automated aircraft, automated automobiles, automated appliances, PLC-based automation, security, and tracking are only a few examples of industrial automation and smoke detection are just a few of the many uses, benefits, and applications for automation technology. Automation technology tailored to the needs of the aged and disabled. The home automation system is making significant development at the moment. Energy consumption in houses tends to rise in direct proportion to the number of heavy household equipment such as air conditioning, freezers, and heaters, among others. To reduce carbon dioxide emissions, energy consumption must be adequately improved. The primary goal of this system is to provide an easy-to-use interface appliance. The household appliances are simple to monitor, manage, and regulate. Everyone can engage with the system thanks to a user-friendly interface. Home automation may improve the quality and convenience of everyone's life. Home automation technology develops into a simple smart home strategy and an energy consumption controller. User comfort, a user-friendly interface, and user enjoyment are the key features. A simple pairing consisting of two cell phones and an

integrated system of ana Bluetooth devices, an Arduino module, and a relay module makes up the designed system. This study recommends an efficient, affordable, and user-friendly interface for home automation systems. The Bluetooth connection device makes the entire system wireless. The system is easily customizable to assure reliability with only minor alterations. The majority of electrical devices in homes still use basic manual controls .However By developing an autonomous and programmable control system, this issue might be solved. Have you given We can easily control all of our home appliances with a simple smartphone app or programmable remote according to the Home Automation (HA) system any thought? Obviously, sure! But how much are these accessible systems going to cost? If you said "no," this research provides the answer. This article describes a ground-breaking Bluetooth wireless connection and Arduino-based home automation system. With this inexpensive Arduino-based technology, users can control any electrical device with a single click using a smartphone app. It also delivers precise operation. As demand and requirements grow, home automation technology innovations are gaining popularity. A recent survey indicated that several technologies, including the IoT (Internet of Things) and GMS systems, may be used to create this home automation system.

Many devices may now interact with one another thanks to recent technical developments that enable the use of Bluetooth and Wi-Fi. By doing away with the necessity for physical connections between the Arduino board and computer, lowers expenses and enables it to work as a stand-alone device. As a gateway for the Arduino to connect to the internet, the Wi-Fi shield has to be connected to the internet through a wireless network or hotspot.

Literature Survey

Wireless communication first appeared in the 1880s. In 1898, Nikola Tesla proposed the use of remote controls for vessels and automobiles. The concept of home automation is developed further through the research of electrical equipment. A.R.Al-Ali and M.Al-Rousan were the first to use Java programming to create a home automation system. It primarily utilised Wi-Fi as a communication method between software and hardware components. The biggest disadvantage was the limited range of Wi-Fi, which required the user to be inside the range. Then, Android-based home automation was created. It used the internet instead of Wi-Fi, and its downside was the Internet's unavailability. [4] A strategy for embedded smart house management was described.

A. "An elegant home automation system using GSM and ARM-based architecture", V.L.K.BharadwajManda, VoonaKushal and N.Ramasubramanian 0278-6648/18©2018IEEE.

Recently, home automation systems have been created employing a variety of technologies, among others, voice controls, Bluetooth, wireless networks, and the Internet. Our proposed study offers a low-cost method for tracking and managing the condition of different home appliances. The main processing component of this system, which employs the Global System for Mobile Communication (GSM) technology and was designed primarily to prototype inexpensive USB devices and other battery-powered applications, is the NXP LPC11U24 microcontroller unit (the ARM "mbed" microcontroller). The following are the unique benefits of alerting the consumer by SMS as opposed to email or another Internet-based message method:

1) Text messages are delivered quickly and straight to the user's mobile phone, which they carry almost constantly. A delivery confirmation that appears on the sender's smartphone after a message has been delivered gives them confidence. Issues like spam or other e-mail arise while using an Internet-based messaging system, and message delivery delays can also occur..

2) This technique can be applied everywhere and is not geographically constrained. It may be used everywhere a GSM network exists. Despite the fact that this situation is the same as the Internet, the recommended system does not depend at all on an Internet connection, in contrast to existing systems that need continual connection and result in extra costs. As a consequence, the recommended approach is more widely used and economical, satisfying the needs of each typical person.

3. Having a higher security architecture, or ensuring maximum dependability as others cannot monitor the information sent or received, is another important advantage of employing GSM technology in the field of home automation. However, this is not true for Internet-based messaging because the network is subject to assaults. Though there are certain industry-proven approaches for dealing with particular risks, adding these into a home automation system makes it highly complicated and increases costs. The research presented here intends to investigate the possibility of establishing SMS-based home appliance management utilising GSM technology without attempting to contact other local networks.

B. "Smart Home Automation System Using Bluetooth Technology", Muhammad Asadullah 978-1- 5090-3310-2/17/$3\.00 ©2017 IEEE

As a result, the system is a real-time application. In this work, an Arduino board, Bluetooth module, smartphone, ultrasonic sensor, The employment of a moisture sensor and a temperature sensor results in the creation of an affordable and simple remote-controlled home automation system. The suggested method takes use of a smartphone app that gives users control over up to 18 devices, including sensors and home appliances, using Bluetooth. The majority of conventional home automation systems on the market today are made to do particular jobs, however the recommended system is a multipurpose home automation system.Which are readily implementable in existing homes.The proposed system has additional functions than traditional home automation systems, such as an ultrasonic sensor for water level sensing and a soil moisture sensor for autonomous plant watering. This document also outlines the system's hardware and software architecture, as well as future development and scope. The planned prototype of the home automation system was developed and tested on hardware, and the results were precise and predicted.

C. "Smart Home Automation and Security System using Arduino", Siddharth Wadhwani1, Uday Singh2, Prakarsh Singh3, Shraddha Dwivedi4 Volume: 05 Issue: 02 | Feb-2018

With the development of technology, a growing reliance on smartphones, and a growing need for quick, easy fixes to common issues, it is essential to have a technology that can control IOT-based residential and commercial applications. In our paper, "Sensing and controlling the world around you with Arduino and IOT," we discuss embedded technologies as well as IOT with Arduino, which uses embedded block and script programming for Arduino and sensors like the flex sensor, accelerometer, flame sensor, magnetic sensor, and WI-FI module.

In this study, we provide a home automation and security approach. Arduino will be connected to the sensors. A wireless module will transfer the status of our home appliances to a cloud platform. The wireless network should connect our system and mobile device. Our sensors will have the ability to enable or disable the user-managed sensors. The flex sensor will control the appliances with the movements of our fingers. The magnetic sensor will increase the door's security. Users of cloud systems like THINKSPEAK may access all of this data. This article will show how IoT applications could simplify our lives.

Proposed System

The fundamental block diagram of the smart home system is shown in Figure 1. In order to gather data on the status of the body, a microcontroller needs sensors that are connected to it. For instance, the temperature sensor measures temperature while the gas sensor looks for smoke and cooking gas to put out fires. The automatic lighting is turned on and off by the Light Dependent Resistor (LDR), which gauges the brightness of the daylight. Our solution combines a motion detector with a passive infrared sensor to detect activity within the house while the security system is turned on (PIR). Security is greatly increased by this feature. The electrical component that controls on and off receives control signals from the microcontroller through a relay switch.

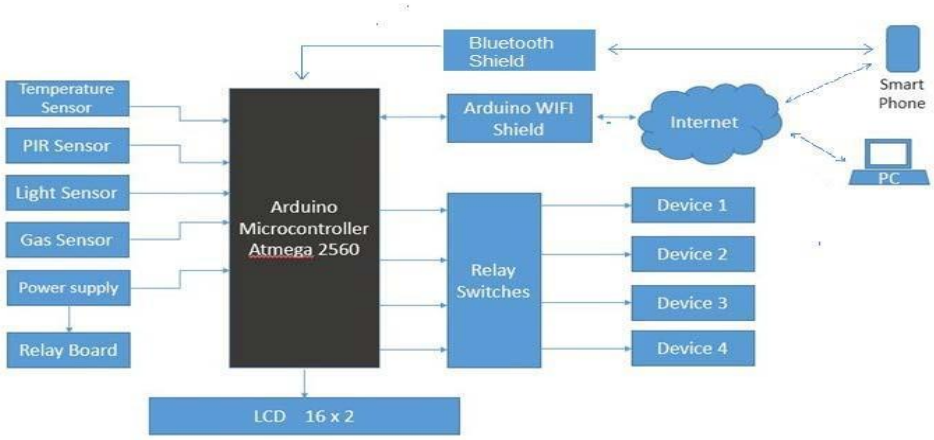

Figure 1: Block Diagram of the Smart Home System

The system is made up of two parts: hardware and software. Each of them is shown below. There are implemented ways of automated house control that utilise the Internet, as well as methods of automatic house control that do not use the Internet.

Design and Implementation

We provide a smart home solution that is affordable and functional in our design. The software communication module and the hardware interface module are this system's two major components. The Arduino Mega 2560 microcontroller serves as both the system's brain and the interface for all of the hardware, acting as a microweb server. The microcontroller in this system is in charge of all communication and control. Figure 2 demonstrates that the smart home system has features including the ability to monitor the surroundings using temperature, humidity, gas, and smoke

sensors. Additionally, it includes switch capabilities for relay system-connected lights, fans, air conditioners, and other household appliances.

Figure 2: System architecture of the smart home system.

Hardware Module

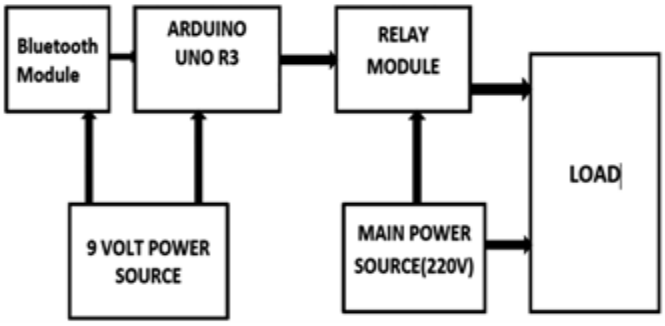

Figure 3: Shows a block diagram.

According to the illustration, the main microcontroller in the system is the Arduino. Arduino controls the Bluetooth module and smartphone app. All home appliances may be controlled by the user using the C++ programming scripts that come with the Arduino UNO. The main elements of this home automation system are as follows:

A. Arduino UNO

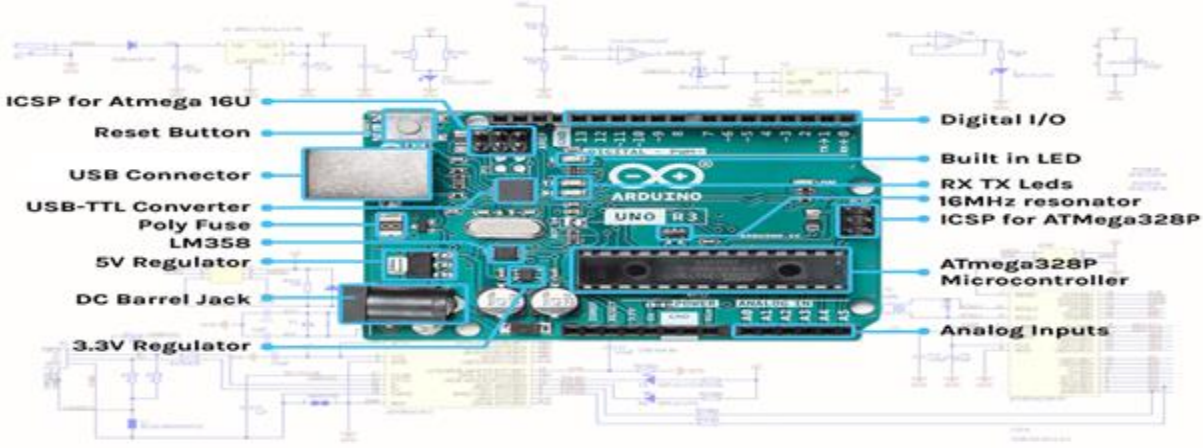

Figure 4: Arduino UNO

An 8-bit AT Mega (328p) processor powers the Arduino UNO. This is in charge of overseeing the several parts of the system, including the Bluetooth Device and Relay Network. The Arduino processes each command before putting it into action on the relay board.

B. Bluetooth (HC-05) Module

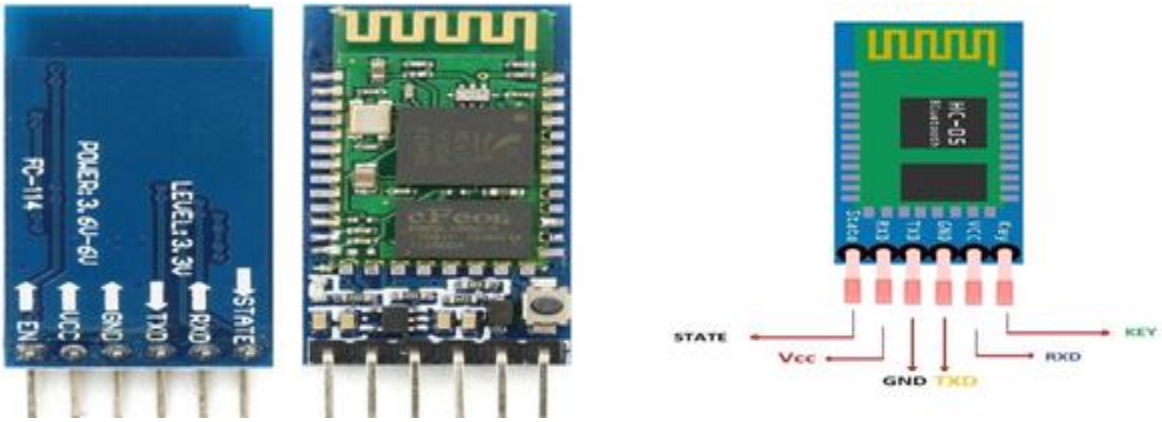

Figure 5: Bluetooth (HC-05)

The system's interaction with Android m The Android mobile app and the system interact through Bluetooth. It serves as the wireless medium for the system. Because Arduino includes programming, this links the Arduino signal to the mobile app. It has a small field of effect; however such fields may be increased.

C. Relay Module

Figure 6: Relay Module (4 Channel)

All appliances' AC supplies are connected to the relay module, which serves as an electrically operated switch, as shown in the block diagram.

D. Android Mobile APP

All appliances are controlled through a mobile app. In the app, all of your appliances may be turned on or off with a single tap from anywhere in the house.

Figure 7: Bluetooth Connectivity

Simulation Method

This circuit's architecture is constructed to resemble a sample home automation system. The following are the component tools:

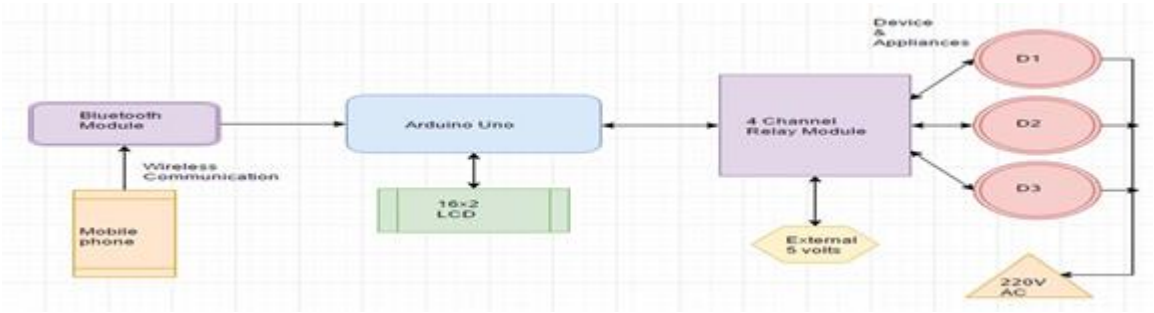

Figure 8: Simulation

The system's proper operation was initially noticed in the simulation. Before implementing the hardware, the working and processing of the

The simulation design's outcome met expectations in that the system operates with high precision and rapid execution. The system operates at a high level of efficiency. The software for Arduino is exclusively created in C++ for the unique function of the home automation system. The programming language for Arduino is known as Processing. The Arduino UNO is programmed using the Arduino IDE software [7]. The official Arduino website makes it simple to download the Arduino IDE.

Above Figure depicts the system's simulation design, which uses an Arduino as the microcontroller and a Bluetooth module (HC-05) for wireless communication.

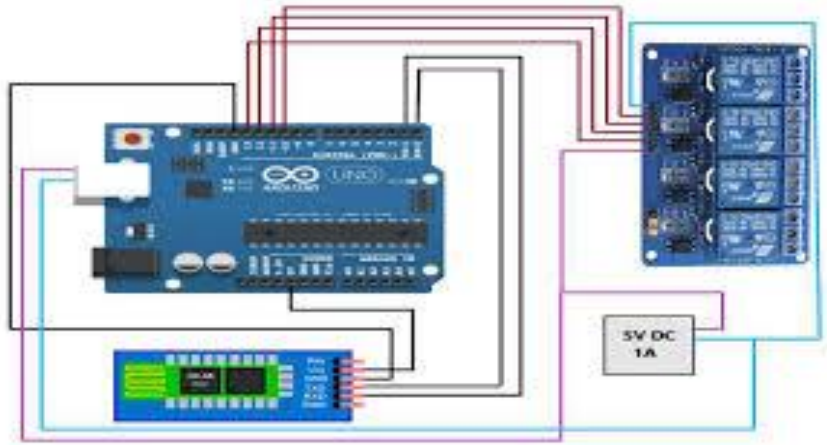

Figure 9: Simulation

Hardware Design

An Arduino Uno serves as the device's microcontroller in a hardware implementation. The Arduino is made up of six power pins, fourteen digital pins, and six analogue pins [6]. We use the Bluetooth module Hc-05 to offer wireless connectivity because Arduino does not come with a built-in wireless connection. Bluetooth is used for communication between the Arduino Uno and a mobile application. After analysing the command from the smartphone application, the Arduino subsequently turns on the relay module. The relay module serves as the system's electrical switch. Our system has four relay channels for different loads. Our hypothetical home automation system's hardware is created in the following manner:

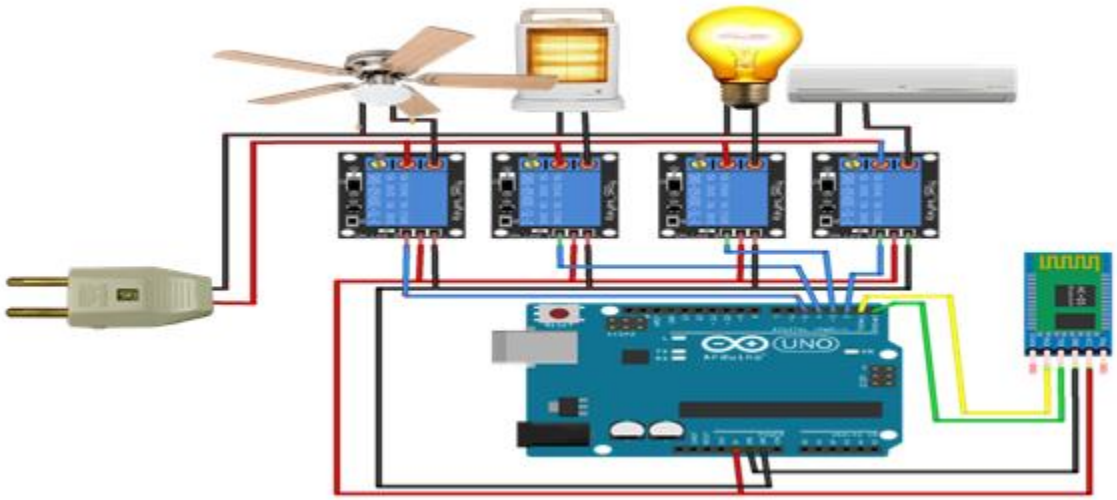

Figure 10: Hardware Design

Result

This system has a lot price, convenience of use, and simplicity over alternative home automation solutions. Due to the usage of a Bluetooth module, this system has a range limit, making accessing it safer and more practical for the user. Because many of the currently available smart home automation technologies have issues and are rather expensive, a new technology was created so that everyone may automate their jobs or duties.

When a user types a command into the app, the Smartphone software [6] sends a the Arduino board is physically attached to a Bluetooth device, which receives the signal. The smartphone app provides access to each device's specific GUI options.

The Bluetooth device transmits the signal from the smartphone application to the Arduino board for further processing after receiving it. The Arduino board serves as the system's controller and controls all of the appliances. Bluetooth is used to link the Arduino UNO and Relay Module [4]. The Arduino Uno manages the relay board order to turn on and off the appliances.

Relay boards function as on/off switches[3]. The relay board connects the primary power supply of all home appliances.

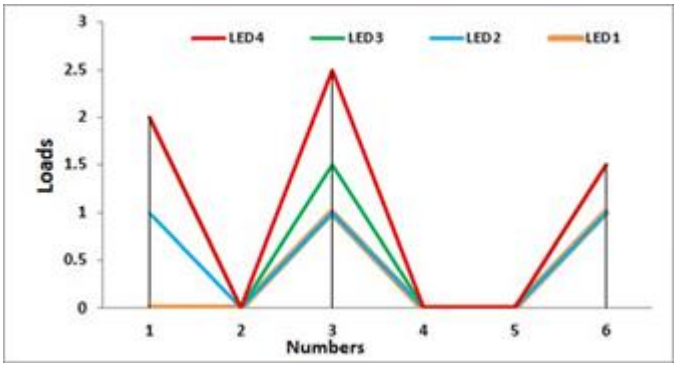

Figure 11: Shows the graph of the obtained results.

Conclusion

This study's solution for household appliances is low-cost, secure, efficient, easy to use, and automatically controlled. When compared to other systems, this one is fairly flexible and inexpensive. It combines intelligent work with energy conservation, safety, comfort, and convenience. The goal of the research's innovative technique was to remotely manage the appliances, and it achieved that goal.

The system is easily adaptable and expandable with new features in accordance with user requirements. This interface enables the technology to be utilised in both old and modern dwellings.

In the future, IoT and cloud technologies would allow for remote system modification.

Wi-Fi technology could be an ideal substitute for Bluetooth technology to increase range and speed.

Smartphones with Wi-Fi capabilities can interact with and manage home automation systems. Mobile cellular networks like 3G or 4G can be used to connect to the system if Wi-Fi is not accessible. Because the system also makes use of Google's speech recognition engine, no additional voice recognition module is needed. Future projects might include adding SMS and phone notifications, minimissing electrical modifications to allow the suggested system to be installed in existing homes, and creating a wireless network within the house to operate and monitor the smart home environment.

References

1. Ajah, G, David, N, Abioye, A, Web Based Security System, Sch. J. Eng. Tech, 1(3):112-116, 2013.
2. Mahmood, S M, Abdulsattar, M, Firas, A Y; Home Automation Management with WLAN (802.11g) and RF Remote Control, Raf. J. of Comp. & Math's, 6(1), 2009.

3. Aru O E ,Ihekweaba G, Opara F K, Design Exploration of a Microcontroller Based RF Remote Control 13amps Wall Socket, IOSRJCE, 11(1), 56-60, 2013.
4. David, N, Design of an Internet Based Security System, NIJOTECH, 29(2) 118-129, 2010.
5. Diaa, M F, Mahmood, B M, Data Acquisition of Greenhouse Using Arduino, Journal of Babylon University/Pure and Applied Sciences/ No.(7)/ Vol.(22), 1908-1916, 2014.
6. Robotics D, "DHT11 Humidity & Temperature Sensor", 2010, www.micro4you.com/files/sensor/DHT11.p df
7. Anandan, R, Karthik, B, Kumar, K, WIRELESS HOME AND INDUSTRIAL AUTOMATION SECURITY SYSTEM USING GSM, JGRCS, Volume 4, No. 4, 126-132, 2013.
8. Asif, O, Hossain, B, Hasan M, Rahman, T, Chowdhury, M, Fire-Detectors Review and Design of an Automated, Quick Responsive Fire-Alarm, 2014.
9. Violino, B, The 'Internet of things' will mean really, really big data, InfoWorld, 2013. http://www.infoworld.com/article/2611319/computer-hardware/the--internet-ofthings--will-mean-really--really-bigdata.html.
10. Shinde, H.B., Chaudhari, A., Chaure, P., Chandgude, M, and Waghmare, P., 2017. Smart home automation system using android application. System, 4(04).
11. M.Van Der Werff, X. Gui and W.L. Xu, "A Mobile basedHome Automation System, Applications and Systems", 2005, 2nd International Conference on Mobile Technology, Guangzhou, pp.5.
12. A. Alheraish, "Design and Implementation of Home Automation System", 2004, IEEE Transactions on Consumer Electronics, Vol. 50(4), pp. 1087-1092.
13. Home Automation System via Bluetooth Home Network", 2003, SICE Annual Conference, Fukui, Vol. 3, pp. 2824 - 2829.
14. Farooq, A., Malik, Z., Sun, Z., & Chen, G. (2015). A Review of non- isolated high step-down Dc-Dc Converters. Int. J. Smart Home, 9(8), 133-150.
15. Kumar, D., Singh, S., and Sinha, N., Home Automation via Bluetooth using Android Application. An International Journal of Engineering &Technology, Vol. 4, No. 4 (April 2017)
16. Kumar, N. and Singh, P., 2017. Economical Home Automation System using Arduino UNO. Advances in Computational Sciences and Technology, 10(6), pp.1861-1866.
17. David, N., Chima, A., Ugochukwu, A., &Obinna, E. (2015). Design of a home automation system using arduino. International Journal of Scientific & Engineering Research, 6(6), 795-801.