

# AN EFFICIENT IOT BASED SMART HOME AUTOMATION SYSTEM USING ARDUINO AND SMS

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**ABSTRACT:** Every day we aim for a relaxed routine and technology makes it happen through automation. A home automation system is a solution that enables automation of home appliances.

Real world entities can be remotely connected with an effective and booming technology, IOT. Internet of Things (IOT) is one of the easiest and the most effective technology that anticipates the idea of remotely associating and observing the real-world objects using Internet.

This paper intends to focus on the design and implementation of a cost-effective yet flexible, adjustable and secured home-based automation system using a Smartphone in order to enable the authorized user to control the home appliances in on/off, to regulate the output power, and to set the usage timing which would be based on an Android App. It contains the commands like switching on/off the AC, Fan, Washing machine, etc. Along with this, we use GSM technology which controls the devices by sending a single SMS in the absence of internet connectivity.

**Keywords:** Home Automation, Internet of Things, Micro controller, SMS, GSM, ARDUINO, Relay

## I. INTRODUCTION

In the recent decade, the explosive growth in cellular mobile communication is constantly changing the way people used to live and work. Nowadays, mobile handsets are handheld computers with the capabilities of integrated mobile radio communication. Applications are mobile compatible which makes the mobile phones a real intelligent device.

Internet of Things (IOT) is growing rapidly as a topic of conversation both in the workplace and beyond. New innovative concepts take birth from this technology which leads in development of smart homes automation to provide intelligent, comfort, secure and improved quality of life.

This system is accomplished by an Android mobile phone, a GSM modem, and a controller board incorporating a microcontroller. The mobile phone serves as a remote controller through which a user can interact with the home appliances. The controller board resides at home and works as a home server, which carries out the task of operating and monitoring the home appliances. The home server communicates with the remote control through Internet connectivity.

The user-friendly graphical user interface is provided on the mobile phones. This App characterizes the process of accepting the commands from user in order to control different appliances that could be connected via internet. When a user chooses any option like ON or OFF, the respective device connected to the controller board will be turned on or off depending on the command that is given.

The main advantage of this system is a normal SMS can be sent to the GSM Modem in case of internet connection failure and in the absence of Android Mobile phone.

## II. RELATED WORKS

Self-contained electric or gas powered home appliances became viable in the 1900s with the introduction of electric power distribution and also led to the introduction of washing machines, water heaters, refrigerators, sewing machines, dishwashers, and cloth dryers [1]. With advent of these appliances, the idea of home automation became more prominent.

In [14]. The authors proposed some approach called “ a Java-based Home Automation System” which is used Wi-Fi technology to support the communicated devices. The main disadvantages of this approach is the Wi-Fi range limitation.

A Bluetooth based home automation control is described in [7]. In [16] a GSM based system for home automation is described which uses voice commands for control. In [8], Voice command for home automation has been described.

The proposed system is developed using IOT technology for monitoring and controlling a wider range of appliances. This paper is mainly involved with the home appliances automation system. Here the medium for communication between the Android based mobile application and the home appliances connected to the system is an internet connection.

## III. MOTIVATION

The aim of this system is to investigate a cost-effective solution that helps in controlling of home appliances. The main objectives of this system are:

**Convenience:** To provide the user with comfort & convenience to control the connected home appliances from any remote device having internet connectivity.

**Real-time Control:** To facilitate the user in monitoring the real-time status of each of the connected appliances and make adjustments as & when he/she feels it necessary.

**Report Generation:** To allow the user to analyze the usage of the various appliances & the time of usage through a generation of detailed reports that gives the user a complete picture of the working & efficiency of each appliances.

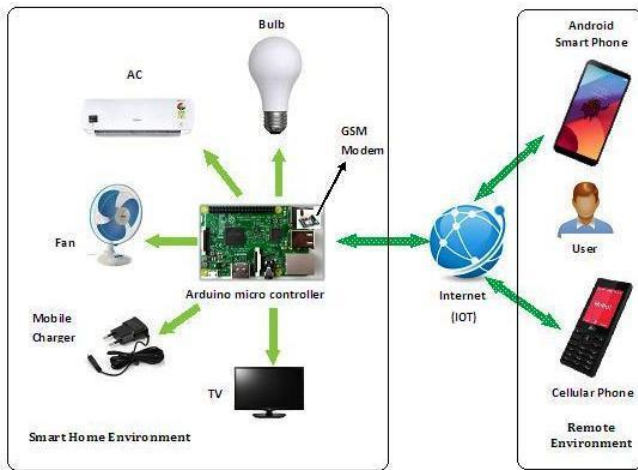
**Notifications:** To provide user appliance related notifications regarding a state of the appliance etc. as and when required.

## IV. SYSTEM DESIGN

### A. Proposed System Architecture

An efficient, a low-cost smart home appliances automation system for remotely controlling and monitoring the smart home

environment is summarized in the proposed system architecture shown in Figure 1.



**Figure 1: An efficient IOT based Smart Home Automation System using Arduino and SMS**

This system concept basically contains the smart home appliances like Fan, Bulb, TV, etc. in a home that can be controlled either by using android app installed in an android phone or by sending normal SMS using cellular phones.

The system contains an Android mobile phone compatible application which is developed with the help of an Android developing platform and Arduino Ethernet-based web-server. All the devices are directly interconnected with the Arduino Ethernet micro controller which acts as a master controller for an entire system. The Arduino Ethernet-based Shield and Arduino Mega 2560 incorporated with the master controller is used as a channel to communicate and coordinate actions between the devices connected within the home environment.

It is possible to remotely control and monitor the smart home environment with the help of the smart home app installed in an android mobile phone. Any internet connection through 3G/4G network or Wi-Fi can be used by the smart home app installed on the user device to interact with the micro web-server.

The mobile app that is created contains the commands like switching on/off the AC, Fan, Washing machine, etc. With the simple and single tap of our fingers on these commands, all the controlling and monitoring of the home appliances connected to the system can be done. It can be easily save precious time and experience more productivity.

This system consists of a specialized type of modem called GSM Modem which is also connected to the microcontroller board and it receives a Subscriber's Identifying Module (SIM) card, and operates just like a mobile phone on a subscription.

The mobile phone with active service SMS is used to send a normal message to the GSM modem in this system. The GSM modem will accept and read the SMS sent by the mobile phone. Again this modem will transfer these SMS to the microcontroller which is responsible for extract the message from the received SMS and control the respective relay module. Finally these relay will turn on / off the respective home appliances based on the command received by the owner. Here the main benefit of using these GSM modem and SMS technology is that the owner can provide more and more security to his home even in the unavailability of internet connection or even if he does not have an android phone and

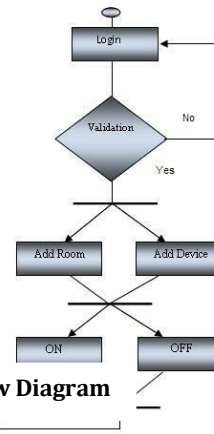
he can send a normal SMS to the GSM modem that control the connected home appliances.

**B. Proposed Methodology**

In today's technological era where a time is a valuable resource, the advent of automation for the control of home appliances through mobile application becomes the necessity.

This system will be powered with an internet connection via Wi-Fi or 3G/4G network making inter-connectivity between the devices and creating an internet of things.

The block diagram shown below (Figure 2) describes the flow of activities of the system.



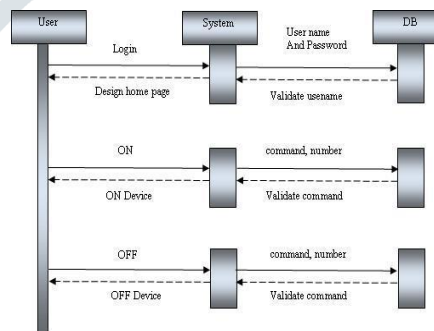
**Figure 2: Activity flow Diagram**

The user would be initially login into the system with his/her login credentials. In this system, an admin has the privilege to add a new device and room (Location of a device). For this, admin must log in to the system then input device name and location where the device is installed. Location can be Living room, Hall, Kitchen etc.

Main Purpose of this system is to control the Home Appliances with less effort. There will be switches created in the smart home android app to control the connected appliances.

After a valid authentication, user will be redirecting to the smart home application page where the number of options for controlling and monitoring the different home appliances connected to the system will be presented. On receiving the proper input from the user, the smart home application will convert this input into byte format and transmit it to the Arduino web-based microcontroller. The relays are used inter-connect the home appliances with the microcontroller.

A relay is a switch that is used to control and turn on/off much larger electric current devices connected to the microcontroller by using a small electric current. The microcontroller converts the received byte signal to an electrical signal and passes it to the relay that controlling the respective home appliance. The respective relay will switch on or off the appliances as a command received by the owner.



As shown in figure 3 , login page with user name and password will be used to authenticate the valid user.

**Figure 3: Sequence Diagram**

Database of Home Appliances Automation will be used for storing information related to admin and user registration and also for storing device-related information like device name, device location and unique commands to turn on or off the devices.

If the user is logged in successfully by entering the correct username and password after validation as per stored in the database, he/she can navigate to the modules that are only

accessible by the user. This is done for security purpose. So here after successful login, the user will be able to enter into the design home page which is created with the commands like switching on/off the AC, Fan, Washing machine, etc.

On receiving the input command the application will send these commands to the Arduino microcontroller. The microcontroller will read the command and checks whether it is valid or not. If it is valid then it converts it into an electrical signal and depending on the command received it sending again this signals to the respective relay that controls the individual device. As an end result the respective relay will do the a simple action like switching on / off the connected home appliances.

### C. Implementation Steps

```

Open app
Check if the device is on or off
Click on user option
  If device1 is on then
    Send command $1 to on device1
    Read command in microcontroller
    Check if a command is valid
    If valid then
      On the device1
      Display the acknowledgment
    End if
  End if
If device2 is on then
  Send command $3 to on device2
  Read command in microcontroller
  Check if the command is valid
  If valid then
    On the device2
    Display the acknowledgment
  End if
End if
If device1 is off then
  Send command $2 to on device1
  Read command in microcontroller
  Check if a command is valid
  If valid then
    Off the device1
    Display the acknowledgment
  End if
End if
If device2 is off then
  Send command $4 to off device2
  Read command s in microcontroller
  Check if a command is valid
  If valid then
    Off the device2
    Display the acknowledgment
  End if
End if

```

### D. Proposed System Components

The proposed system components are divided into two parts, namely; hardware and software components.

**i) Hardware used:** The hardware components used in the system are explained as follows:

**a) Microcontroller:** The microcontroller used here is the brain of the whole system. It receives the commands sent by the remote server environment and calculate the appropriate instructions to control the connected home appliances. In this system, Arduino microcontroller is used and that acts as a

master controller for entire systems. The Arduino Ethernet-based Shield and Arduino Mega 2560 incorporated with the master controller is used as a channel to communicate and coordinate actions between the devices connected within the home environment.

**b) Android Phone:** In this system, we are using an Android phone which is capable of running android app that is designed to control the devices and the home appliances

It also includes SIM (Subscriber's Identifying Module) card has a specific number through which communication takes place. The mode of communication is wireless and mechanism works on the GSM (Global System for Mobile communication) technology. Here, the user transmits instructions to the system to control the appliances in the form of single SMS in case of unavailability of internet connection.

**c) GSM Modem:** GSM (Global System for Mobile Communications) is the emerging technology which uses the strength of the SMS (Short Messaging Services) and is a cheap wireless control option that can be connected anywhere, where the GSM network is reachable.

A GSM modem is a specialized type of modem that receives a Subscriber's Identifying Module (SIM) card, and operates just like a mobile phone on a subscription.

**d) Relays for connecting home appliances:** A relay is a switch that opens or closes circuit electronically or electromechanically. The most common relay mechanism employs an electromagnet to mechanically operate a switch.

**e) Home Appliance:** The home appliances is nothing but electronic device like fan, bulb, AC and washing machine, etc. The pre condition for this system is that the all the appliances must be connected to the main power supply for providing home automation and ensure home security at all times.

**ii) Software used:** The followings are the software development environments used in this system.

**a) The Arduino Integrated Development Environment or Arduino Software (IDE):** This is the cross-platform application (for Windows, Mac OS, Linux) that is written in the Java programming language. The open-source Arduino environment helps a user to write code and then upload it to the I/O board. Text console, a text editor for writing code, the toolbar having buttons for common functions, message area, and, and a set of menus are the some of the contents included in the Arduino development environment. It connects to the Arduino hardware to transfer programs and interact with them. The features of Arduino is capable of compiling and uploading programs to the I/O Board with a single click.

**b) Software development of the Android platform app:**

Windows Mobile, Symbian, iOS and Android etc. are the some of the commonly used Smartphone applications developing platforms.

In the proposed system, the Android platform smart home app is developed and implemented by using Android Software Development Kit (SDK) along with Java programming language as most of the mobile phones and handy devices compatible with Android OS,

The Software Development Kit (SDK) consists of a set of development tools like the debugger, sample code, libraries, and a handset emulator along with documentation, and tutorials. An officially supported IDE (Integrated Development environment), Eclipse has been used on in conjunction with Plug-in called ADT (the Android Development Tools) to create the smart home app. [17] [12]

## V. RESULTS AND OBSERVATIONS

Experimental result analysis is observed through following screenshots:

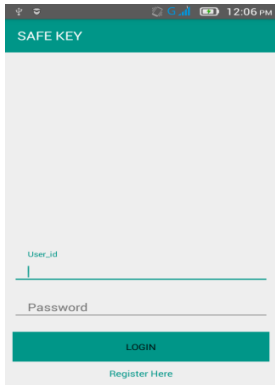


Figure 4: Home Page

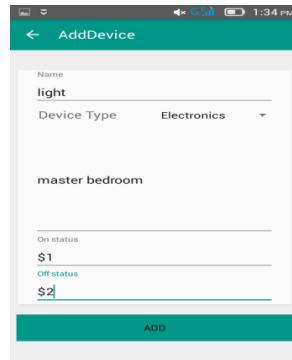


Figure 5: Add Device Page

Figure 4 is the first page in this application. This page provides two links. Login and Registration. On clicking the particular links it will navigate to the respective pages.



Figure 6: Device List Page



Figure 7: Snapshot of the System Working Model

Figure 5 is the page that shows the user access rights. The user has an option to add the device. In this user has to enter a device name, device type, device description and special characters for switching on and off the device

Figure 6 page shows the devices added in the application and the on or off status of the device through some images.

Figure 7 describes the Working Model of the proposed system, here a mobile charger is connected to the controller board. Initially the mobile charger is in off mode and module is waiting

for a command to execute. The final output response with mobile charger turned on accordance with the request from the mobile app as shown in figure 7.

### Smart home

Smart home automation is currently the talk of the town because of its enormous advantages for controlling the home appliances there by reducing human intervention. Home Automation advantage is that it adds safety for both family and home. It has the ability to control all the connected appliances with the simple tap of our finger on our favorite technological device that can easily save time and improve productivity.

The most beneficial impact of the system is on monthly utility bill. It also contributes to the economy by ensuring that the power will be utilized only when people are there at home.

This system also supports scalability that provides the capability to the users to add a home appliances for existing system with ease & simplicity by ensuring performance improvement.

Since the GSM technology is used here, the appliances can be controlled even in the absence of an Android phone by sending a general SMS. This provides more security to the home.

A home appliances automation system is the best investment for the people who usually bother about whether they have turn off or not all the home appliances before they leaving the home by increasing their peace of mind.

From the study made above, certain limitations to where the system cannot be extended are described below:

All the home appliances connected to the microcontroller must be connected to the main power supply at all times is the pre-condition for the smooth functioning of the system. If any of the appliances are disconnected from the main supply, the user not any more control that appliances and that part of the system would be considered as non-functional.

If the human does not handle the kit safely or if he/she does not use the correct keys to perform the operations, human errors may occur. Human errors also lead to destructions of the machine which will cause a huge system crash.

#### A. Future Enhancement

In the future, to increase automation and to make this system more user-friendly the Artificial Intelligence concepts could use more. It could also be designed to make it compatible for different languages other than English.

In the future, along with home automation, we can also implement a Home security system. Since the system is user dependent, hence a camera can be installed and connected to the microcontroller which can allow the user to analyze the situation and react accordingly [9] [10]. For example, if the owner identifies that the person entering his house is an unexpected guest but not an intruder, then the owner can make necessary preparation like opening the door, switching on various devices like fan, AC or TV etc. inside the house instead of triggering the security alarm., The captured picture of the intruder or guest after face detection can be mailed to the user.

The user can further forward the same photograph for security purpose to the police station if he wants.

## VI. CONCLUSION

In this paper, we have demonstrated the design and characteristics of an efficient Home Appliances Automation System that has a huge scope & almost endless application in today's technology-driven market. The chief aim of the system is nothing but to provide a more user-oriented and more and more secure and reliable system to the user, which would support the high degree of flexibility & control.

In this paper, an Internet-based smart home system that can be controlled remotely upon user authentication is proposed and implemented. The Android-based smart home app communicates with the Arduino microcontroller via the internet. The Smart Home App could be installed on any of the android devices to control the smart home environment.

Along with using Android applications to control the household appliances GSM technology is also used to provide a simple and easy way to control the household appliances with a single SMS in the absence of internet connectivity.

## REFERENCES

- [1]. Wikipedia link:  
[https://en.wikipedia.org/wiki/Home\\_automation](https://en.wikipedia.org/wiki/Home_automation)
- [2]. Prajwal N, Nithin P, Pavan S, Vignesh K "Speech Recognition Based Home Automation Using Arduino", National Conference on Communication and Image Processing (NCCIP-2017), 3rd National Conference by TJIT, Bangalore.
- [3]. Neng-Shiang Lian, Chao-Lin Wu, Li-Chen F.; "An integrated, flexible, and Internet-based-control architecture for home automation System in the Internet era," Proceedings ICRA2002.
- [4]. Thinagaran Perumal, Md Nasir Sulaiman, Khaironi Yatim Sharif, Abd Rahman Ramli, Chui Yew Leong, "Development of an Embedded Smart Home Management Scheme", International Journal of Smart Home, Vol. 7, No. 2, March, 2013.
- [5]. "U.S. Patent 613809: Method of and apparatus for controlling mechanism of moving vessels and vehicles". United States Patent and Trademark Office. 1898-11-08. Retrieved 2010-06-16.
- [6] J. C. Nunes and J. C. M. Delgado, "An Internet application for home automation," Electrotechnical Conference, 2000. MELECON 10th Mediterranean, Vol. 1, pp. 298 -301, 2000.
- [7]. N. Sriskanthan and Tan Karande, "Bluetooth Based Home Automation Systems," Journal of Microprocessors and Microsystems, Vol. 26, pp.281-289, 2002.
- [8]. Hsiao-Ping Lee, Jia-Ching Wan, Cai-Bei Lin, Jhing-Fa Wang, "Robust Environmental Sound Recognition for Home Automation," Automation Science and Engineering, IEEE Transactions on , vol.5,no.1, pp.25-31, Jan. 2008.
- [9]. M. N. Jivani, Sharon Panth, "Home Appliance Control Ad-hoc Network System using App Inventor", International Journal of Emerging Technologies and Applications in Engineering, Technology and Sciences (IJ-ETA-ETS), ISSN: 0974-3588, pp.40-45, Vol. 1, Issue 7. 2014.
- [10]. T. Ming Zhao, Chua, "Automatic face and gesture recognition, 2008. fg '08. 8th IEEE international conference on," pp. 1-6, September 2008
- [11]. Yuksekkaya, B.; Kayalar, A.A.; Tosun, M.B.; Ozcan, M.K.; Alkar, A.Z., "A GSM, internet and speech controlled wireless interactive home automation system," IEEE Transactions on Consumer Electronics", vol.52,no.3,pp.837-843, Aug.2006.
- [12]. O. N. C. S. A. P. B. Sahani, M, "Circuit, power and computing technologies (iccpct), 2015 international conference on," pp. 1-6, March 2015. [13]. D.Naresh, B.Chakradhar, S.Krishnaveni, "Bluetooth Based Home Automation and Security System Using ARM9", International Journal of Engineering Trends and Technology (IJETT), Vol. 4 Issue 9, September 2013.
- [14]. A.R. Al-Ali and M. Al-Rousan, "Java-based home automation system", IEEE Transactions on Consumer Electronics, vol. 50, no. 2, pp. 498-504, 2004.
- [15]. Subha, R. Anupriya, L. Bhuvaneshwari, P. Eyalisai Priya and R. Mahalakshmi "Voice Control Of Home Appliances using Bluetooth Module Hc05", International Journal of Advanced Scientific Research & Development, Vol. 05, Spl. Iss. 01, Ver. I, Mar' 2018.
- [16]. Yuksekkaya, B., Kayalar, A.A., Ozcan, M.K., Tosun, M.B., Alkar, A.Z., "A GSM, internet and speech controlled wireless interactive home automation system," Consumer Electronics, IEEE Transactions on , vol.52,no.3,pp.837-843, Aug.2006
- [17]. N. Sriskanthan & Tan Karande, "Bluetooth Based Home Automation Systems," Journal of Microprocessors and Microsystems, Vol. 26, pp.281-289, 2002.