A Home Automation System using Internet of Things

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ABSTRACT: In modern times, people prefer more of automatic systems rather than manual systems. With the influence of Internet in people's life lots of new technologies are coming up. One of the latest, emerging and trending technologies is the 'Internet of Things'. This technology is expected to rule the world within a few years. Home Automation System uses the technology of Internet of Things for monitoring and controlling of the electrical and electronic appliances at home from any remote location by simply using a Smartphone. Implementation of a low cost, flexible home automation system is presented. It enhances the use of wireless communication which provides the user with remote control of various electronic and electrical appliances.

KEYWORDS: Internet of Things, Smart Home, Home Automation, Android Smartphone, Arduino

I. INTRODUCTION

IoT is a world, where real, virtual and digital environments combine to create a smart environment which makes life easy. It is a new era of computing technology in which machines interact and communicate with other machines, objects and environment. This new technology has unlimited potential to improve our lives by using a "command-and-control" strategy. It is a revolution of the Internet in which objects make themselves recognizable. Objects can communicate information among them and can take necessary decisions whenever required. Communication has been extended via internet to all things around us. When objects can communicate with each other, via the internet, we need to take complete advantage of remote access. The ultimate goal of IoT applications is to automate systems rather than using manual systems, to improve the quality of living.

In today's world, Internet serves to be a popular means of communication. From the end user's point of view, Internet based Home Automation System is very convenient, easy flexible and cheap. Many devices now have Wifi and can connect to Smartphones or home computers. But these devices cannot communicate with each other or else need additional devices to do so. Thus, these devices need to be unified, such that they can be monitored and controlled using one single program or device, e.g. controlling lights, fans, air-conditioners, oven, refrigerator, TV etc. by using an application on the Smartphone. This gives the user more control of their home and can simplify many manual actions.

II. LITERATURE SURVEY

N. Sriskanthan and Tan Karand in their work have presented an application of Bluetooth Technology for Home Automation. The Bluetooth technology which emerged in late 1990's is used for implementing the wireless home automation system. Various appliances such as air conditioners, home theatres, cellular phones etc., are interconnected, thus creating a Personal Area Network in Home Environment. The communication between several client modules and the host server takes place through the Bluetooth module. A Home Automation Protocol has been developed to enhance communication between the host server and the client modules. The system also allows integration or removal of devices to the network which makes the system scalable. The wireless system aims at reducing the cost of Home Automation. But the system does not use the trending mobile technology. [1]

A. Z. Alkar and U. Buhur have developed an internet based wireless home automation system for multifunctional devices. A flexible, low cost, wireless solution to the home automation is introduced. The transformation of the initial simple functionality control mechanism of devices to more complex devices has been discussed. The home appliances are connected through a server to a central node. The system is secured from

unauthorized users by using SSL algorithm. During tests, the wireless communication was found to be limited to <100 meters in a concrete building. [2]

Muhammad Izhar Ramli, Mohd Helmy Abd Wahab, Nabihah developed a prototype electrical device control system using Web. They have developed a web based controller, for controlling electrical devices. Whenever the condition of server is down they also set their server with auto restart. The system does not use mobile technology. Being a web based system; this application is less effective since the use of headphones and Smart phones is increasing rapidly. [3]

E. Yavuz, B. Hasan, I. Serkan and K. Duygu have designed and implemented a telephone and PIC remote controlled device for controlling the home electrical devices. In this Pin check algorithm has been introduced where it was with cable network and not wireless communication. The system ensures safety as it cannot be used by unauthorized users as the system uses Pin-check system. The architecture is very complex, but it gives an idea of remote handling of home automation system. [4]

Shahriyar, E. Hoque, M. M. Akbar, S. Sohan, I. Naim, and M. K. Khan presented a GSM based communication and control for home appliances. Different AT commands are sent to the Home Mobile for controlling different appliances. The drawback of this system is that a Graphical User Interface (GUI) is not provided to the user. Different AT commands have to be remembered by the users to control the connected devices. Also, the system supports Java enabled mobile phones. The system thus becomes less functional as now-a-days the use of Java enables phones are reducing and the use of Android phones are increasing tremendously. [5]

Jitendra Rajendra Rana and Sunil N.Pawar in their paper have implemented a zigbee based home automation system. Zigbee is a high-level communication protocol used to create personal area network. It supports any kind of micro-controller. The system eliminates the complication of wiring in case of wired automation. Considerable amount of power saving is also possible. Operating range is more than Bluetooth. But the system does not allow remote monitoring and controlling of appliances. [6]

R. Piyare and M. Tazil have presented the design and implementation of a low cost, flexible and wireless solution to the home automation. The system uses Bluetooth technology where the cell phone is used for interaction between the host server and the client modules. This system can be used by any appliances that require On-off switching applications without any internet connection. The drawback of this system was that the wireless communication system was found to be limited to a range less than 50m in a concreted building and maximum of 100m range in an open range. The system supports only the symbian OS cell phones. [7]

Amul Jadhav, S. Anand, Nilesh Dhangare, K.S. Wagh developed a system which uses one of the operating systems for implementation of the Home Automation System. An XML document is created and placed over the server, which can be used by any other mobile device without any platform issue. The layout of the screen is controlled by a common XML format. Downloading of XML file from the server and its parsing needs to be coded on every platform. As the design part is coded only once, a lot of coding effort is reduced. The same file is used by every other platform. The main objective of the paper was to develop a system without operating system platform limitations for Universal Mobile Applications. [8]

Deepali Javale, Shreerang Nandanwar, Mohd. Mohsin and M. Shingate have used Android ADK for implementing a home automation and security system. It presents a system in which the devices are connected to a Bluetooth sub-controller physically. It does not require internet connectivity. The Smart phone is used to access and control the devices using built-in Bluetooth connectivity. Communication is established between the android mobile device and the ADK, by connecting the appliances to the ADK. However, the system restricts mobility and can only be controlled within the specified boundary due to limited range of operation (maximum up to 100 m). Thus the system does not support remote monitoring and controlling of appliances. [9]

S. V. A. Syed Anwaarullah presents the design and implementation of a low cost, compact and secure Android smart phone based home automation system. A single chip microcontroller real time operating system is integrated to the system, to improve the responsiveness of the system and make it more dynamic. The system uses Bluetooth technology. The Bluetooth module that is used is based on the Bluetooth V2.0 protocol and has a range of 10m operating at frequency of 2.4GHz with a maximum data exchange rate of 2.1Mbps. Similar to most of the existing systems, this system also does not support remote monitoring and controlling of devices. [10]

III. PROPOSED SYSTEM

Description of proposed System:

This project aims at developing a Home Automation System prototype which mainly focuses on monitoring and controlling household appliances through the Internet. The system consists of two main parts: A hardware interface module and a software communication module.

The Hardware interface module consists of: Arduino ATmega328 microprocessor, Wifi module and relays. The central device is the microprocessor that connects to the Wifi module and receives orders to monitor and control the appliances. The communication between the application and microprocessor is handled by the server, thus managing the users and the appliances. The software communication module uses an Android application as the frontend, which serves as an interface to the user to communicate with the microprocessor. It presents a list of devices with which the user can interact.
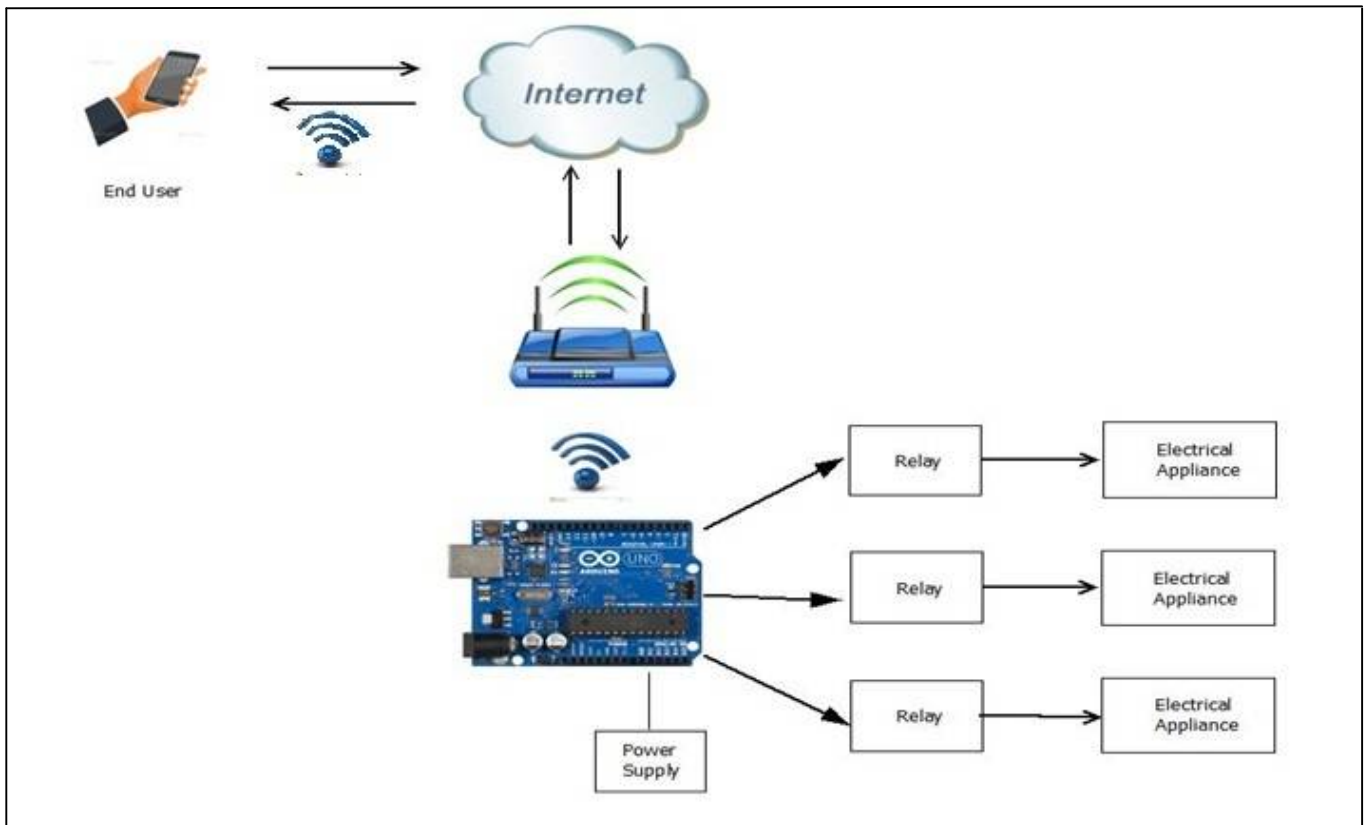

Fig: 1.1System Architecture

The system offers switching functionalities to control the appliances connected to the system, which includes Lights, Fans, Air-conditioners and various other appliances connected to the system. In India, the alternating current supplied to our homes is of 230V. Arduino Board is not capable of withstanding such high Voltages. Thus, Relays are used to convert this high voltage to low voltage i.e. less than 5V. The relay switches have capability to carry a maximum load of 10A at 240V.

To enable connectivity with the microcontroller Wifi module is used. It provides Internet connectivity, which allows Internet access and control from the Android Application effectively and efficiently. The Android application is a user friendly interface, which enables the user to view the status of applications at home and control it as per his/her requirement.

Description of components:

Arduino Uno Board: Arduino Uno is a single board microcontroller, for building digital devices and interactive objects that can sense and gather information from the physical world. The Arduino IDE Software can be used for programming.

Fig: 1.2 Arduino Compatible Freeduino

Wifi Module: Wifi Module is used to enable connectivity with the Internet.

Fig: 1.3 Wifi Module

Relay: Relay is a switch which is used to control a high power or high voltage circuit by low power. In India 1A (230W/230V) current flows through the device and wire. The Arduino board cannot withhold such high power or voltage. Thus we make use of relays for designing the system.

Fig: 1.4 Relay

IV. PSEUDO CODE

Step 1: Inorder to establish connection between the client and the server the Wifi option in the Smartphone is enabled.

Step 2: It is connected to the Wifi module of the system.

Step 3: Each electronic/electrical appliance in the system is connected to the digital pins on the Arduino Uno Board.

Step 4: A Relay is used for connecting each device to the Arduino, which helps in converting high Voltage supply to low voltage.

Step 5: A C-program is loaded on to the microprocessor chip on the Arduino Uno Board which specifies what action is to be performed on receiving particular inputs.

Step 6: An Android Application has been developed which enables the end user to monitor and control the appliances from any remote location.

Step 7: Socket Programming has been used to achieve client-server communication.

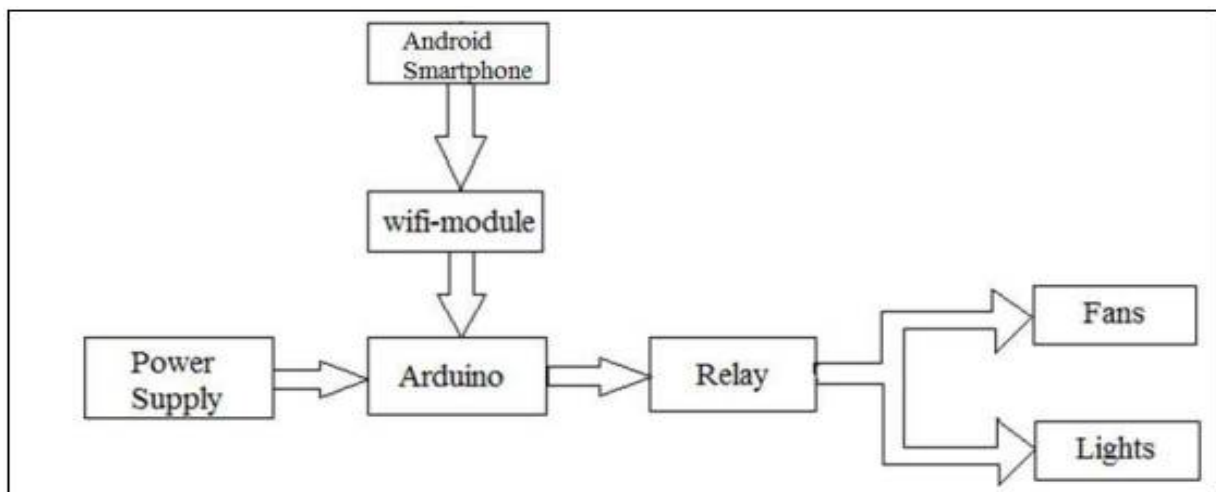Step 8: Successful controlling and monitoring of appliances.

Fig: 1.5 Block Diagram for Proposed Home Automation System

SOCKET PROGRAMMING:

The system consists of a server, client, and a communication medium. The part of the system that makes a request for service is called client and the part of the system that offers requested service from the client is called server. The communication medium can be wired or wireless network. It makes use of the services provided by the Transport Layer of the TCP/IP (Transport Control Protocol/Internet Protocol) stack.

The transport layer comprises two types of protocols: TCP (Transport Control Protocol) and UDP (User Datagram Protocol). The most widely used programming interfaces for these protocols are sockets. TCP is a connection-oriented protocol that provides a reliable flow of data between the client and the server. UDP is a protocol which does not guarantee reliable communication between the client and the server since the data transmission is in the form of packets.

Algorithm:

Algorithm for Server Program:
1. Open the Server Socket
2. Wait for the Client Request
3. Create I/O streams for communicating to the client

4. Perform communication with client
5. Close socket

Algorithm for Client Program:
1. Create a Socket Object
2. Create I/O streams for communicating with the server.
3. Perform I/O or communication with the server
4. Close the socket when done

V .SIMULATION RESULTS

We have developed an Android application using which we can switch ON/OFF the appliances connected to the system. Following are the screenshots of the Android Application "Home_IOT" developed during implementation of the system. Fig: 1.6 shows the status of application when the appliances connected to the system is in OFF state. Fig: 1.7 shows the status of application when the appliances connected to the system is in ON state.

Fig: 1.6 When the appliances are in
OFF state

Fig: 1.7 When the appliances are in
ON state

Fig: 1.8 represents the prototype model of the developed system when the appliances are in OFF condition. The bulbs and fan attached to the model switches ON when operated using the Android application. Fig.: 1.9 represents the model where the appliances are ON. These appliances can be again switched OFF using the application. Following are the screenshots of the implementation of proposed system:

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Fig: 1.8 System in OFF state
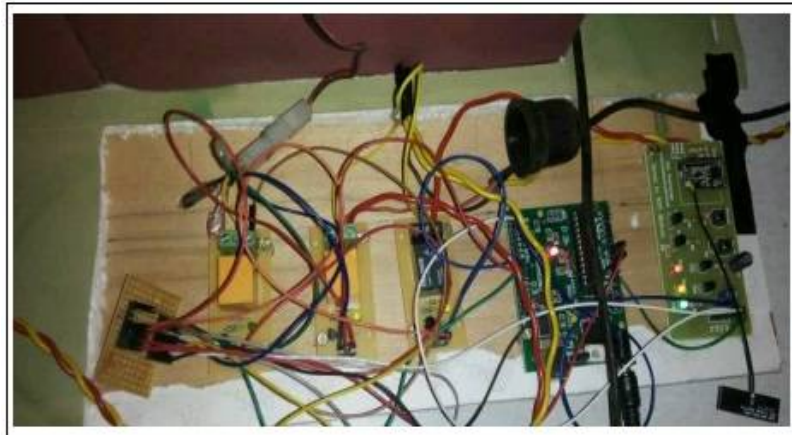

Fig: 1.9 System in ON state

Fig: 2.1 Arrangements of Hardware Components

VI. CONCLUSION AND FUTURE WORK

From the end user's point of view, Internet is a means of Communication which is easily available and affordable. Android Phones and Android applications are already a part of human life. Thus, a combination of these technologies will make life more simple and easy to live.

The potential of the system can be improved to a greater extent by combining technologies such as cloud computing, big data, robotics etc. Even though these technologies are not new to the Industry, combination of these technologies with the Internet of Things (IoT) will do miracles in human life.

VII. ACKNOWLEDGE

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BIOGRAPHY

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