RESEARCH ARTICLE   OPEN ACCESS

Home Automation using Android Application and Predictive Behaviour Implementation

Mrs. Latha A.P.,Pratik Agarwal (8th Sem), Rishabh Rajgarhia (8th Sem), Shashank Sinha (8th Sem), Nafiya Monis (8th Sem), Department of Information Science and Engineering, Dayananda Sagar College of Engineering, Bangalore.

Abstract:

Technology is always evolves. To be able to design a product using the current technology that will be beneficial to the lives of others is a huge contribution to the human community. This paper presents the design and implementation of a low cost but yet flexible mechanism using a smartphone based home automation system. With the rapid expansion of the Internet, the owners have been requesting remote control and monitoring of these in-home appliances. This leads to networking these appliances to form a kind of home automation system. An Android based home automation system allows users to control the appliances by an Android application or through a website is presented.

Keywords: - Home automation; android; arduino; automation; smart phone.

1. Introduction

Home Automation is the residential extension of building automation. In this paper, Home Automation Technique is used to design and implement a remotely controlled, energy-efficient and highly accessible Smart Home. It provides the residents with basic features that maintains the comfort.Home automation for the elderly and disabled can provide increased quality of life for persons who might otherwise require care giver or institutional care.It includes centralized control of lighting, kitchen appliances and other household systems. A home automation system integrates electrical devices in a house with each other. The techniques employed in home automation include those applied in building automation as well as the control of domestic activities such as home entertainment systems, houseplant and yard watering, pet feeding and the use of domestic robots. This paper uses the applications of a home automation system and presents to the user. A central control system is established which helps regulates the functionality of home appliances. As a central controller, an Arduino microcontroller is used that communicates with an android application. The web server is used as an interface by android application, this server can be used as a regulatory mechanism for the connected devices. This Home Automation system presents a Predictive Behaviour which adapts a change in the system to its user's behaviour. The automation system changes its pattern as per the user's change its usage pattern. It finds out a variation in the pattern and implements a new functionality for the change. This enables the automation system to act on their own accord and provide the user with the necessary comfort and ambience. This paper will describe the approach which is applied to control various home appliances with Android smart phone.

2. Related Work

As per our analysis currently there exists no system at cheaper rates. Some of the systems are hard to install, challenging to use and maintain. Existing systems are generally patented and closed, not very customizable by the end user.

N. Sriskanthan [10] explained the model for home automation using bluetooth via PC. But

unfortunately the system lacks to support mobile technology.

Muhammad Izhar Ramli [8] designed a model electrical device control system using Web. They also set the server with auto restart if the server condition is currently down.

Hasan [7] has developed a telephone and PIC remote controlled device for controlling the devices pin check algorithm where it was designed with cable network but not wireless communication.
Pradeep G [4] proposed home automation system by using Bluetooth which saves lot of power and time using mechanism to save the preloaded list by not making it to setup connection all the time when required.

Al-Ali and Al-Rousan [9] presented a design and implementation of a Java-based automation system through World Wide Web. It had a standalone embedded system board integrated into a PC-based server at home.

Amul Jadhav [3] developed an application in a universal XML format which can be easily ported to any other mobile devices rather than targeting a single platform.

R.Piyare [5] have introduced design and implementation of a low cost, flexible and wireless solution to the home automation.

Jitendra R. [6] showed that with the ZigBee network how to remove the problem of wiring in case of wired automation. There is also considerable amount of power saving possible, operating range is more than Bluetooth.

Google and Microsoft have recently entered the home automation domain. At 2011 I/O conference, [11] Google announced Android@Home. Google's first standard for Android devices to communicate with external hardware. The Android Open Accessory Standard and the Accessory Development Kit (ADK) is the key for communicating with hardware and building external accessories for Android devices. Android powers hundreds of millions of mobile devices in more than 190 countries around the world. It's the largest installed base of any mobile platform and growing fast every day another million users.

Microsoft is similarly working on a project called HomeOS, [12] an operating system for the home.

3. Implementation

Android

Having a huge market and open source we are using android platform for the application used in this home automation system .Android is a software for mobile devices that includes an operating system, middleware and key applications. The Android Operating System is based on Linux developed by Google. With a user interface based on direct manipulation, Android is designed primarily for touchscreen mobile devices such as smart phones and tablet computers. The Android Software Development Kit provides the tools and Application Program Interfaces which is necessary for developing applications on the Android platform using the Java programming language. The application used here is programmed in java using the Android Studio IDE (Integrated Development Environment). Using Android in home automation system makes the outsourcing of resources even easier, since it is an open source. The android application used here will work on versions 4.4 and onwards.

Cloud Server

A cloud server is a logical server that is built, hosted and delivered through a cloud computing platform over the Internet. Cloud servers hold and demonstrate similar skills and functionality to a typical server but are accessed remotely from a cloud service provider.

The benefits of using a cloud server are:

- Freedom to modify all the server software to your needs.
- Stability and security because a software problem is remote from and to the

environment. Other cloud servers can't harm you and you can't harm others. Also, if other users overload their cloud servers this will have no impact on yours because resources are dedicated and your stability is guaranteed.

- Cloud servers probably hold the best stability cost ratio performance. They do not suffer from the usual server hardware problems and they have all Cloud computing, benefits, i.e. they are stable, fast and secure.

- Cloud servers are economically more efficient than the standard dedicated servers. For a similar price, with cloud servers you will receive more resources and your server will be faster. In web hosting terms, your site will run faster on a cloud hosting server if you compare it to an old style server with similar price.

- Cloud servers scale very well. It is very simple and fast to add upgrades (CPU, Memory, disk space) to a cloud server just as it is more reasonable.

That's why cloud servers are very popular and sometimes preferred to traditional dedicated servers.

Arduino

Arduino is a tool which is used in computers to sense and control the physical world. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software in the board. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer.

There are many other microcontrollers and microcontroller platforms available for physical computing. These tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantages:

- Inexpensive - Arduino boards are inexpensive compared to other microcontroller platforms.
- Cross-platform - The Arduino software runs on Windows, Macintosh OSX, and Linux operating systems. Most of the microcontroller systems are restricted to Windows.
- Simple programming environment - The Arduino programming environment is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well.
- Open source and extensible software- The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries.
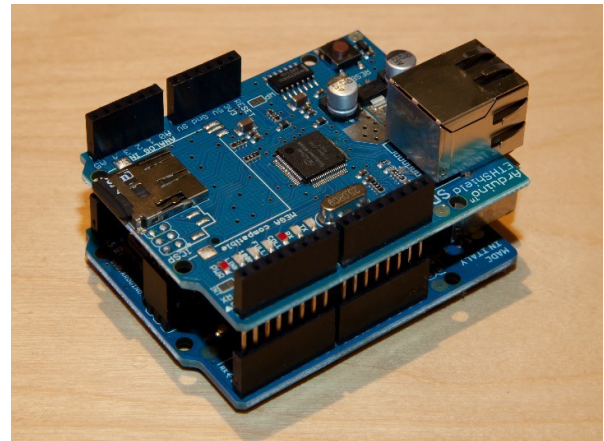

Fig 1: Arduino Uno with Ethernet Shield mounted

Design

As discussed, we are developing android application. This application consists of a list of appliances and electronic device which are being used for automation. When the application starts the user will be navigated to the main screen where we have the list of appliances in the network which user can select any one function which the user wants to control. After selecting a function the user will be able to see the current status of the particular device.

We are using a smart interface in which the system will predict the behaviour of the user after a period of continuous use of particular device by maintaining a log in the cloud server. The Server is implemented on the Google APP engine. This cloud server will store all the logs of when the user has switched on a device or has been turned off by an android smartphone. And after a certain period of time the home automation system will automatically turn the device on/off at the same period of time since the user wants it to be in that state or it can be controlled manually later.

The Arduino (local microcontroller) is connected to a web server via an Ethernet shield which is mounted on the Arduino. The Ethernet shield offers the microcontroller with internet access which allows it to toggle the application's interface. This way it controls all the devices which are connected to the board. It takes input from the switches or sensors and controls variety of devices and other physical outputs. The devices or the electrical appliances have a relay attached to them which instantiates and forwards the response and instruction to the appliances.
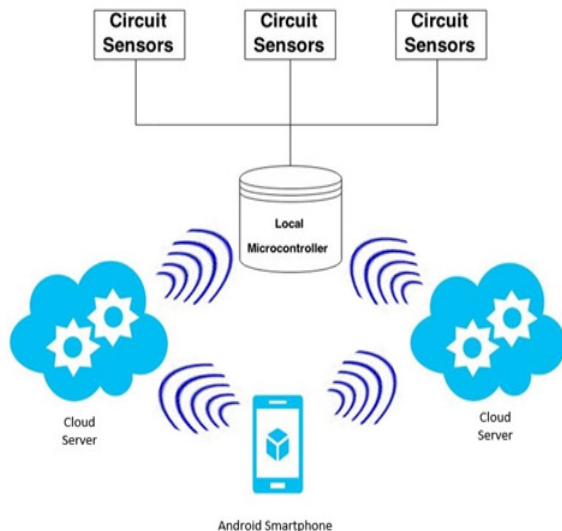

Fig 2. Basic framework of the proposed model

4. Testing and Results

Before the implementation of this project on a said home, the testing of the system was carried on a separate electricity board which had connections for bulbs and other socket ports. The Board was connected to the relay which with the help of a bread board was attached to the microcontroller with Ethernet shield mounted. The Ethernet shield was provided a local host network which contained the server interface. The smart phone was connected to the local network and the Android application was accessed to toggle the interface.

The Android Application interface was toggled and the changes on the external electricity board were noticed. The appliances connected should the exact response as that of the user's input on the application.

5. Future Work

Observing the present situation we can build cross platform system that can be set up on various platforms like iOS, Windows. Restriction to control only several devices can be removed by extending automation of all other home appliances. To observe activity around a house or business Security cameras can be controlled by the user. Security systems can include motion sensors that will detect any kind of unauthorized movement and notify the user. Scope of this project can be expanded to many areas by not restricting to only home. It will be flexible to support various wired as well as wireless technologies like Bluetooth, Zigbee, Wi-Fi, World Wide Web.

6. Conclusion

This is an ongoing project. The main objective of this project is to develop certain system which assists the lifestyle of the people. This paper gives basic idea of how to control various home appliances using Android phone/tab. This project is based on Android and Arduino platform both of which are FOSS (Free Open Source Software). So the overall implementation cost is very cheap and it is affordable by a common person. We have discussed a simple prototype in this paper but in future it can be expanded to many other areas.

Acknowledgement

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