

## Smart Homes Using Universal Remote Controller

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**Abstract** - The Internet of Things (IoT) is the future of networking that allows connection between physical and virtual world in highly unified and increasingly useful ways. The use IoT devices is to control and monitor the electrical, mechanical and electromechanical appliances used in many applications (e.g. industrial, offices, institutions, or residential). Today, the home automation area offers timer control and remote control for embedded systems and electronic devices such as light, heating, entertainment systems, ventilation, appliances, etc., to improve comfort, convenience, security and energy efficiency. However, the element of autonomous behaviour is lacking, this is where the smart homes come into picture. The categorization is done by the controlling mechanism through remote controls. These devices crave the user to be within the premises in order to operate the equipments. Applications such as Bluetooth, Radio, and other devices are coming in the vicinity or spectrum. In this project, the system uses android smart-phones as an interface for remotely controlling electronic appliances for home automation. Android platform being open-source, secure and ability for more user-friendly environment. System comprises of an ARM7 (LPC2148) hardware boards that connects the sensors and all electronic home appliances to automate control through remote controller. In addition to the android based user interface, the system is also integrated with a speech recognition system in order to accept voice commands from users to control appliances.

**Keywords** - IoT, Smart Homes, Automation, User-Friendly User Interface (UI), Wi-Fi, Relay

### I. INTRODUCTION

Internet of Things (IoT) is a network or connection of physical objects or "things" embedded with electronics, software, sensors, making these objects capable of collection of data. The basic idea of smart homes using universal remote controller is to broaden the working of a normal home automation system in such a way that the home appliances can be accessed pervasively. The universal remote controller is anticipated to enable the user to access the automation system remotely which is made possible through an android application to interact with the devices through only basic internet access.

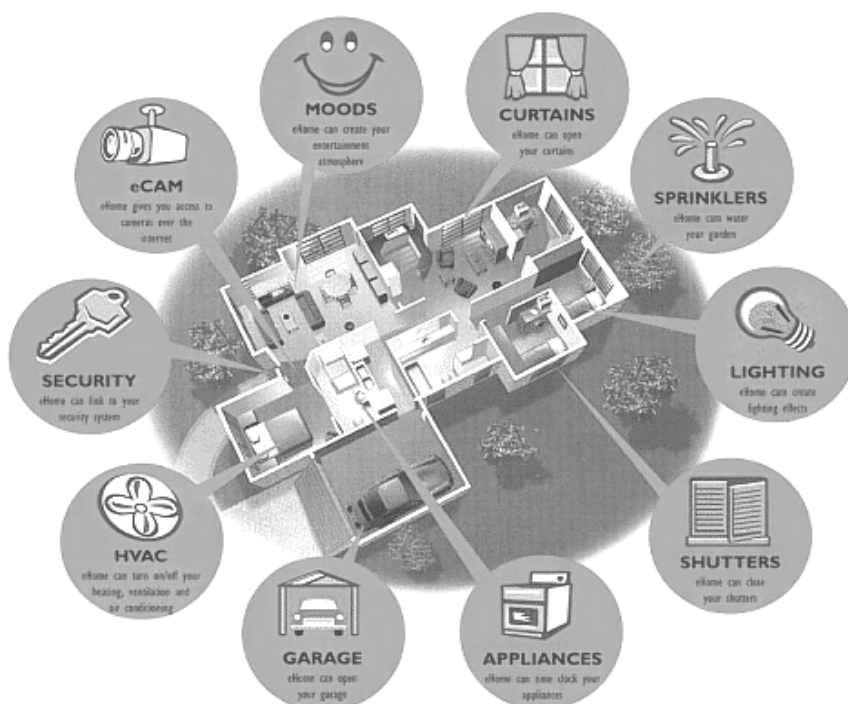


Figure 1.1 Features of home automation

## **II. RELATED WORK**

Most commercially available home automation systems are all-in-one solutions which require that all controllable appliances are from the same company, or must be approved as compatible with said company's system. Moreover these systems normally come with a proprietary, dedicated device which acts as the control center. To control the system from multiple locations, additional control devices must be purchased.

These complex systems usually need to be integrated when the building is constructed and must be planned in advance. They are also difficult to upgrade or replace once installed. The overall investment adds up considerably and is financially infeasible in most cases. These drawbacks hinder the popularity of such systems.



*Figure 2.1 Remote Controls For Different Appliances*

The proposed project is entirely based on the concept of IoT that facilitates the connection and control of system remotely. The implementation of IoT makes a great deal of emphasis on giving internet connectivity to the device, which is implemented using internet on chip microcontroller. This ability to access and use the internet is used to connect the home automation system to the mobile app/web app which will be the control point of user.

In this paper [1], to address these problems, an intelligent universal remote control system for home appliances named Point-n- Press is proposed. Point-n-Press addresses the directionality feature, which enables easy and intuitive control by pointing to the target device to display the target's control interface on the screen of the remote controller. By leveraging the state dependencies of home device/appliance operations, only functional buttons that are relevant to the current context are utilized. Two real prototypes are implemented to verify the feasibility of the proposed scheme. The evaluation results show that Point-n-Press is a useful and suitable control scheme for IoT-based smart homes.

In this paper [10], a platform was designed to connect sensor data with user's daily life. As an application of it, AnyControl - a home appliances monitoring and controlling system was implemented. This work proposes an approach to enhance old appliances and the controlling experience through an IoT based Home Appliance Controlling System. With sensors the appliances can be controlled environment condition trigger.

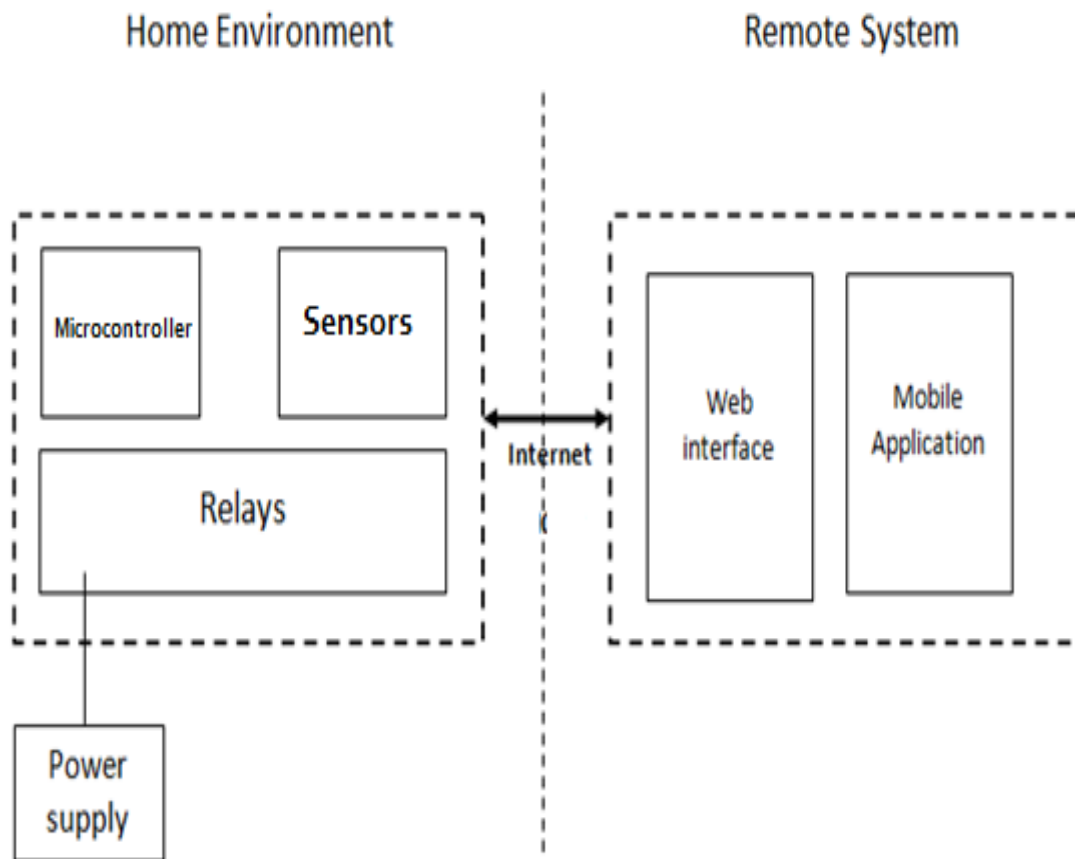
In this paper [11], it comes out a problem that how to manage and control these increasing various appliances efficiently and conveniently so as to achieve more comfortable, security and healthy space at home. In this paper, a smart control system based on the technologies of internet of things has been proposed to solve the above problem. The smart control system embraces the functions of appliance monitor, control and management, home security, energy statistics and analysis.

In this paper [12], the history and implementation of the Internet of Things and how it can be used in home automation. Smart homes can have great benefits for energy and water management, comfort and conveniences, and even for helping impoverished people save money on their basic needs, which will be explored later on in the paper. The conclusion of the paper reviews modern technology and determines how close implementation actually is.

In this paper [13], with more and more applications of Internet of Things in many domains, it also steps into Smart Homes. In this paper, we propose an Internet of Things-based smart home system for home comfort, leisure and safety. This system uses embedded system, 3G, and ZIGBEE technologies to overcome the drawbacks of current smart home systems such as discrete functions, poor portability, weak updating capability, and personal computer dependence. Moreover, the system architecture is presented, and the design of its gateway is shown in detail from hardware to software.

### III. SYSTEM ARCHITECTURE

#### A. PROCESS BLOCK DIAGRAM



*Figure 3.1 Architectural Design*

#### 1. MICROCONTROLLER:

A microcontroller can basically be described as a small computer (SoC) on a single IC which contains a processor core, memory, and programmable input/output peripherals. Also, a small amount of RAM is included on the chip. In this system a ARM7 LPC2148 microcontroller is used. Microcontrollers are basically designed for embedded applications as they are more efficient for embedded applications as compared to general purpose applications and computers where microprocessors work better.

#### 2. RELAYS:

A relay can be described in broad and general terms as an electrically operated switch. Many relays use an electromagnet to operate a switch mechanically. Relays are used where several circuits must be controlled by one signal. They can also be made useful where it is required to control a circuit by a low powered signal.

#### 3. MOBILE APPLICATION:

A mobile application is a computer program designed to run on devices which have mobility eg. smart phones and tablet computers. It mainly has a user interface to enable the user to interact with the system with minimal efforts. In this system an android based application is developed with better user interface to control and monitor home appliances on one touch.

#### 4. WEB INTERFACE:

The communication between a user and software which is running on web server is known as web interfacing. The user interface is the web browser and the web page it downloaded and rendered.

#### 5. POWER SUPPLY:

This unit is the provider of the crucial power to all the devices for operation without any overload or damage. Power supply is connected to the home environment because that is where the universal remote control system is. The system consists of non-fluctuating power supply with 12V, 5V and 3.3V as output voltages for operations of this system.

#### 6. HOME ENVIRONMENT:

Environment of a system is the surroundings in which it operates. In this system there is a fixed home environment which is accessed using the universal remote system. The home environment consists of the microcontroller, relays and power supply. This is basically the universal remote control system and electronic home appliances.

#### 7. REMOTE SYSTEM:

Remote system is used for accessing the system when user is not in the local vicinity. Remote system in our case consists of a mobile application (android) and a web interface. Remote system interacts with home environment via internet.

#### 8. INTERNET:

Internet is the global system of interconnected network of computers that employ internet protocol suite to link “n” number of devices universally. In our project internet is the main component because without internet there is no way for interaction to take place between the android application and devices controlled by the universal remote control system.

### B. ALGORITHM

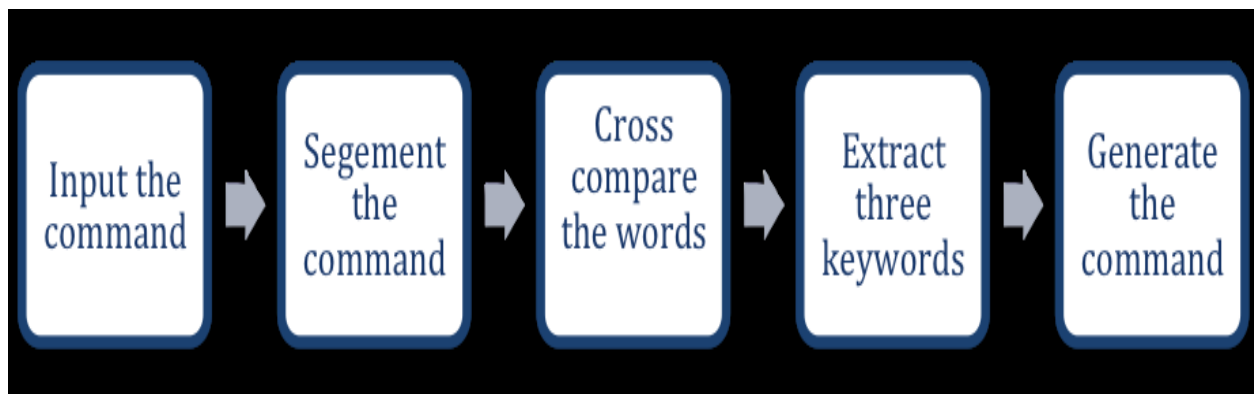
#### **Algorithm 1: The Keywords Extraction Algorithm**

As we know a command sentence usually consists of different kind of words. Some of the words in a command are important to the server while other words are not necessary. We use a word filter to extract some of the keywords from the command.

After analyzing the command sentences, we find that usually typical command contains three kinds of keywords, target, action and degree. Usually we use nouns to represent the target, we use verbs for action and we use adjectives or percentages for degrees.

Based on above we have three word pools, for target, action and degrees. Once a new word is input, the server segments every word and compares those words with words in the pool. If the words are same or share the similar meaning the server is able to extract the keywords.

The diagram is as follows:



*Figure 3.2 The algorithm of keywords extraction*

#### **Algorithm 2: The Smart Control Algorithm**

Sometimes understanding the commands needs not only the keywords, the priori knowledge is equally important. If the command is simply "turn on the light" which light should be turned on by the system? We know if it is dinnertime the light in the dinner room should be turned on, if it is bedtime the bedroom's light should be turned on.

Based on the huge number of records of user's command history the system is able to conclude the user's habits and based on the user's habits the system can do the right thing based on some very simple command sentences.

As it is mentioned before, the Server is linked to an Access database, which keeps all the action records. Based on the machine learning method we can try to build the algorithm based on user's habit.

We use three most important factors as the key feature in the algorithm: time, place and date. The main purpose of the algorithm is to sort the user's command and based on the command records to conclude some patterns.

For example, based on the user's command records of in the living room we get the following table.

Among all 300 cases		
Actions	Time	Sequence
Turn on the light	6:00am-6:00pm	0
Turn on the light	6:00am-8:00pm	270
... ..		

*Table 1 the statistic result of user's habit based on place*

From the table above we can see that there is a high possibility that the user will turn on the light in the living room between 6:00pm to 9:00 pm. So if the user's command is turn on the light and the time is between 6:00pm to 9:00pm the system will turn on the light in the living room based on the records.

**Algorithm 3: The Reminder Algorithm**

Based on the user's habit, we are not only able to make the system understand the simple commands in different time, we can even make the server able to predict user's command.

There are some fixed schedule in our daily life like we turn on the light in our bedroom at the bedtime and we turn off the light when we leave home. We are able to calculate the percentage of some special event. If the percentage of a certain event in a certain time is more than 90% we call it the high possibility event. The system will do these things automatically every day. Also the list of high possibility will be updated every day to make sure there will be less statistics mistakes.

**C. MATHEMATICAL MODEL**

Let S be the complete system is comprised of sets of I, O, F, Fc, Sc.

$S = \{ I, O, F, Fc, Sc \}$

I : Set of inputs.

O : Set of outputs.

F : Set of functions.

Fc : Set of failure cases.

Sc : Set of success cases.

Input :

Appliance 1....n switch on.

Appliance 1....n switch off.

Input from sensors to micro-controller.

Output :

Notification on android phone.

Appliance 1....n switched on.

Appliance 1....n switched off.

Functions :

On/Off

Sensing

Failure Cases :

Connection not established.

No operation performed.

Hardware non-responsive.

Command mapped inaccurately.

Success Cases :

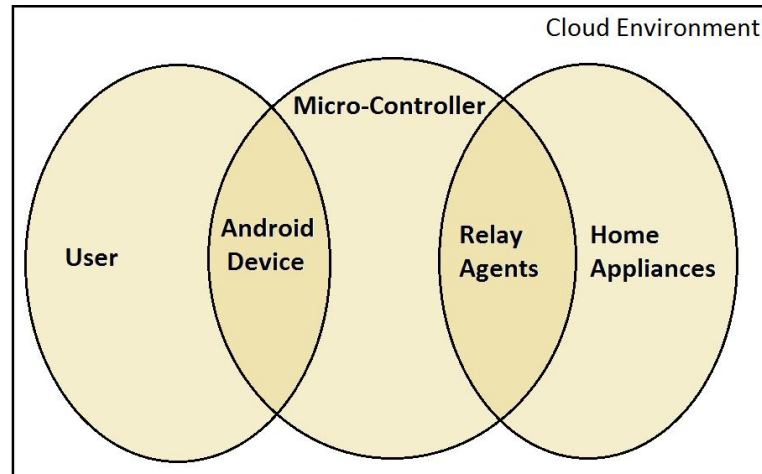
Appliance ON.

Appliance OFF.

DD = It is deterministic

NDD = If the connection between micro-controller and remote control fails, it is hard to determine

NP-Complete = This project is NP Complete



**Figure 3.3 Venn Diagram**

#### **IV. CONCLUSION AND FUTURE SCOPE**

By designing the Home Automation Using Universal Remote Controller in a modular manner, it was possible to create a system that was complete with sensors, running program, and status monitor for notification management. Building the system in this way made finding bugs early on an easy task to accomplish. After completing a group project like this, it becomes apparent that a strong emphasis on hierarchy and modularity early in the design process results in a clear specification. If, while constructing the system, any part failed to be realized, it was possible to work around the problem and still manage to implement a system that was working towards the final goal. The lesson learned is that more time spent designing results in less time wondering what went wrong with the implementation.

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