IoT based universal Remote Controller for Smart Home environment

Dr. S. T. Singh[1], Rounak Sharma[2], Manisha Gajare[3], Sudhir Botre[4]
[1]Campus Director/ Internal Guide, P K Technical Campus, Pune University, Maharashtra, India
[2, 3, 4] Student, P K Technical Campus, Savitribai Phule Pune University, Maharashtra, India
Email – rounaksharma17@gmail.com

Abstract: *The Internet of Things (IoT) is the future of networking that allows connection between physical and virtual 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 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, 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.*

Key Words: *IoT, Smart Homes, Automation, User-Friendly User Interface (UI), Wi-Fi, Relay.*

1. 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.

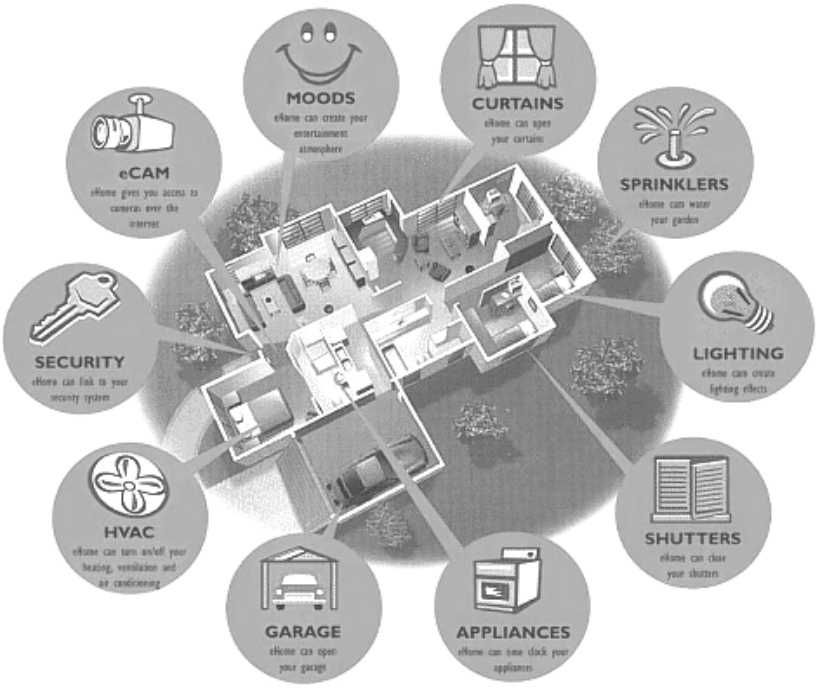


Figure 1.1 Features of home automation

2. MATERIALS:

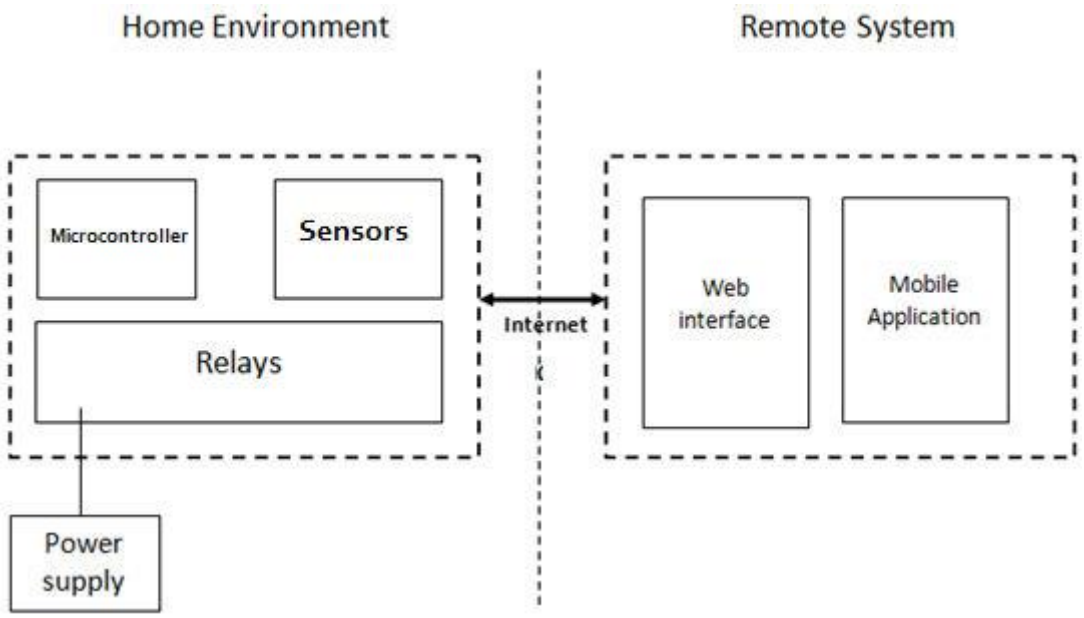


Figure 3.1 Architectural Design

2.1. 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.

2.2. 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.

2.3. 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.

2.4. 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.

2.5. 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. The IC's used for the considered amount of power-supply are LM7812, LM7805 & LM317 for 12V, 5V & 3.3V output voltages respectively.

2.6. 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.

2.7. 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.

2.8. 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.

2.9. SENSORS:

The system consists of 2 sensors viz, MQ6 (Gas Sensor) and LM35 (Temperature Sensor). The sensors detect gas leakage and environmental temperature and notifies the client on the mobile application.

3. METHOD:

The basic methodology of this system is explained below:

a. The system is an IoT based universal remote controller which takes inputs from android application of the user and operates the specific electronic home appliance from any part of the globe.

b. Inputs are the selection of home appliance, then control it from the universal remote control system and finally functionality required for that appliance. eg switch ON/OFF.

c. This system makes changes in the current state of selected device according to availability and selected functionality. eg. Devices like tube light have only functionality to switch ON/OFF.

4. ANALYSIS:

- **Algorithm 1: 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 2: 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.

- **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

5. FINDINGS:

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.

6. RESULT & DISCUSSION:

Home Automation & Control Systems Are Simple To Use!

Once installed a home control system provides you with the ability to easily control all security, heating, lighting, and entertainment via an android Smartphone or PC.

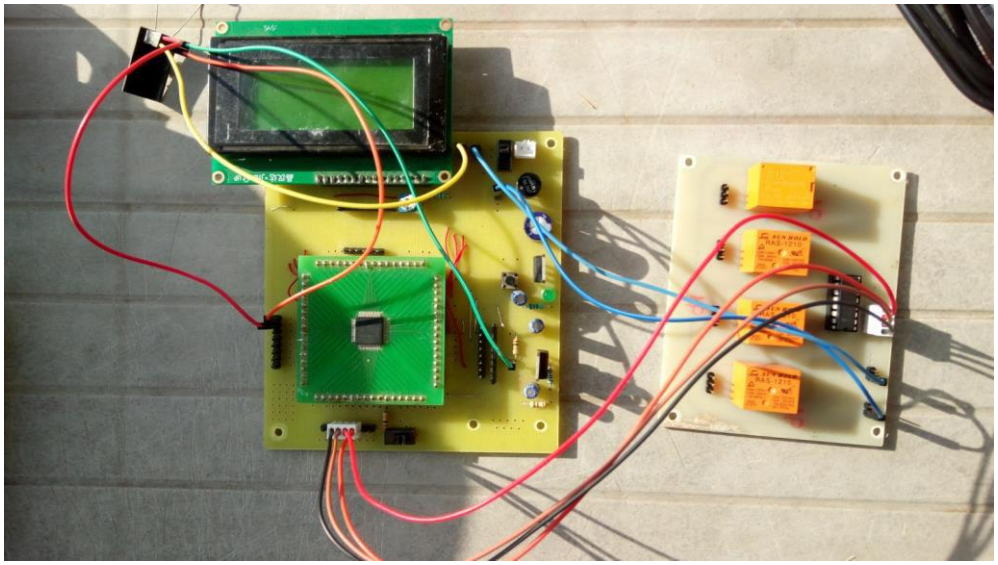
Save Energy, Stop Standby Consumption

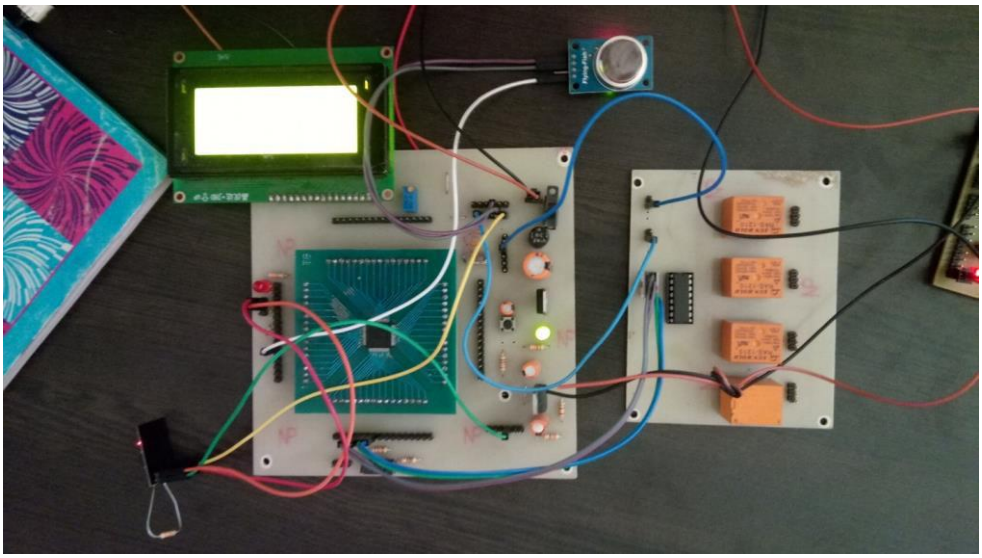
A smart Home Automation system allow you to save money and even save the environment. If you're like ordinary human being and getting forgetful, then use an automation system to switch off equipment and lights that are turned on and drawing some power.

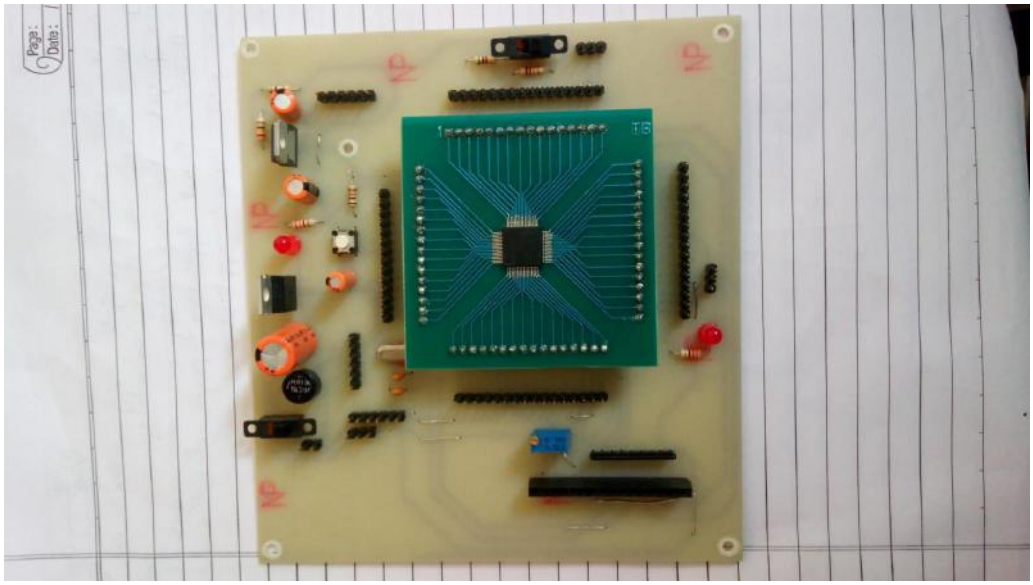
Proposed System will incorporate temperature sensor and gas sensor. These sensors are connected to the central system and once any of the sensors gets activated then system will send alert message. Smart Homes Using Universal Remote Controller is very practical. It can be used not only in the home environment but also in a business environment too. It can monitor the surrounds to not only protect our properties but also our lives. Besides, it can be highly customized to suit each one's need and preference. So Smart Homes Using Universal Remote Controller is very useful for us as well as other people. After successful implementation of the system it is expected that outcome of the system should be able to identify the human brain wave to control the home appliances with fast reaction and it is also expected that system should react at highest priority in case of critical conditions. The system will sense the signal from brain sensor of disabled person and follow the commands accordingly and he can comfortably operate or handle the home appliances.

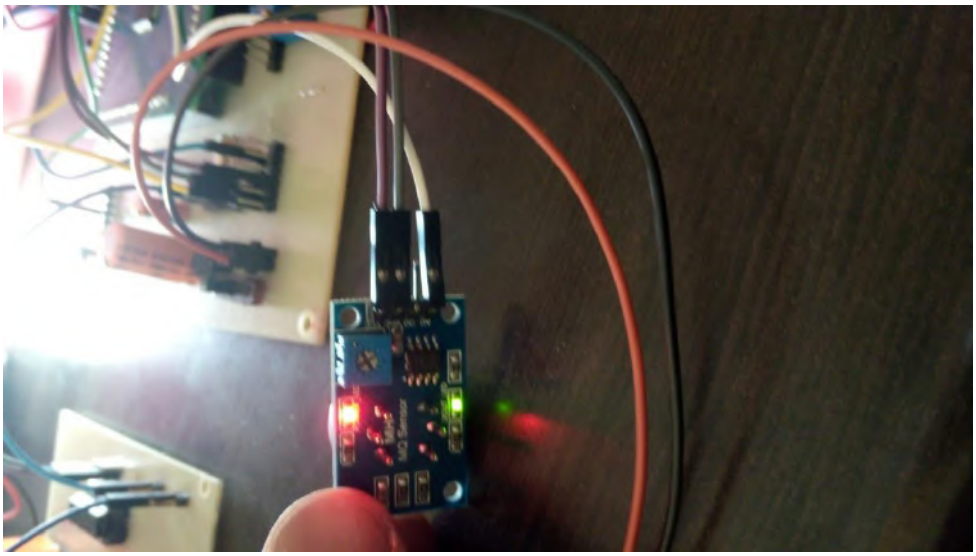
Complete system can be monitored externally by the person using android system as well as alert signal will also be provided.

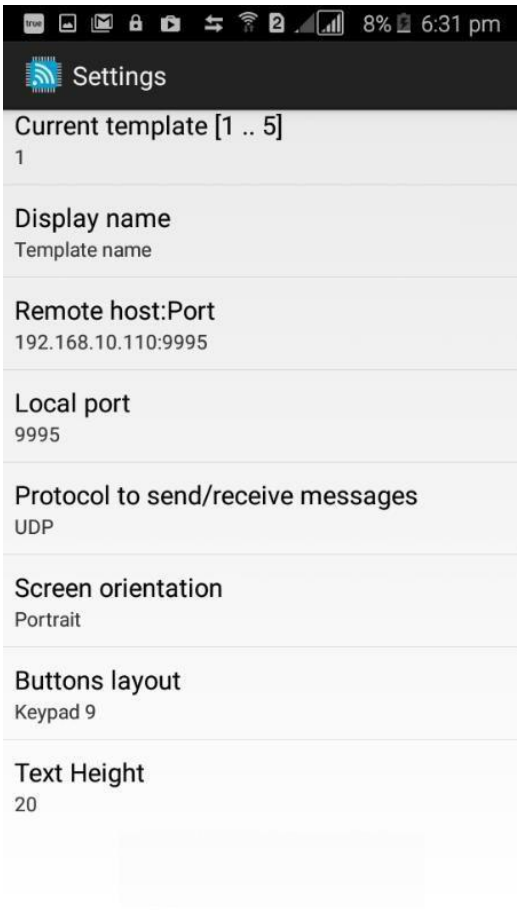
Implemented Prototype Snap Shoot:

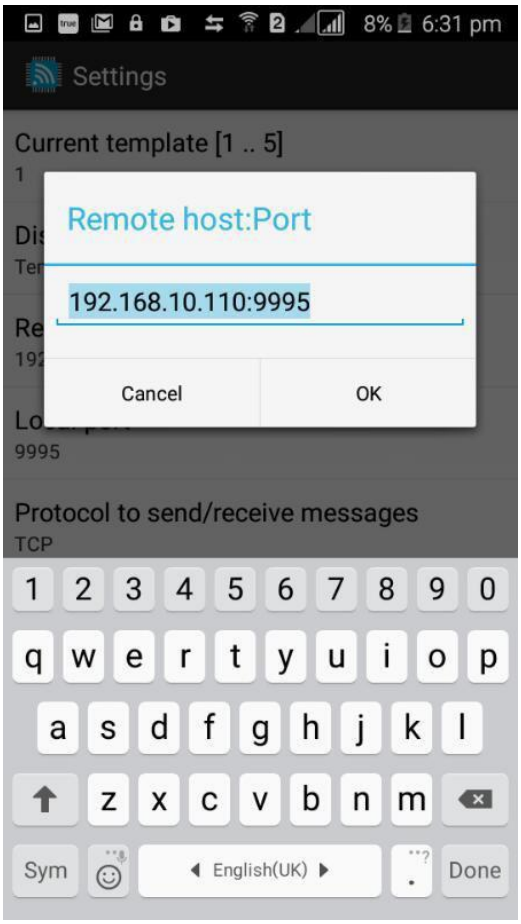












6. RECOMMENDATIONS:

Currently the prototype is only a single system application. In the next step, it would be applied into bigger scales from different rooms to buildings, even communities. The system may be employed in many places like banks, hospitals, labs etc. that dramatically cut back the hazard of unauthorized entry. Proof may be given to the safety department if any theft issue happens. To provide a service for real-time environment information sharing and analysis. Issues such as user privacy and security, also need more effort to work on.

7. CONCLUSION:

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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