

# Implementing Home Automation: Beyond Ideas and Possibilities

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**Abstract - Home Automation ideas are around since long time. This paper presents an effort giving shape to ideas by giving intelligence to home equipments and by controlling them remotely through application of emerging technologies. Although, description of level of intelligence incorporated into a smart home is highly subjective, we have worked on an Artificial Intelligent, flexible and scalable home automation system. The simulation has been done using android device to communicate with Raspberry-pi controller to control appliances connected to it. Commonly used home equipments such as lights, fans, temperature sensors etc. have been considered to demonstrate the robustness and applicability of proposed smart home. Experimental results show controllability of home services under standard circumstances. The smart home equipments can be controlled remotely via natural language processing of voice commands given by users of smart home.**

**Keywords:** Home Automation, Artificial Intelligence, Natural Language Processing, Pattern Matching, Smart Home, Home Assistant.

## I. INTRODUCTION

Home Automation refers to system which gives your home capability to act smart. Many a times, automated homes are also referred to as smart homes. A home is not said to be smart because it is built well or it is environment-friendly or it utilized the floor area at its best. It is because it is equipped with interactive technologies and it exhibit features that fulfill the user's needs in today's fast life. The word Smart has been recently used in various fields due to technologies like Artificial Intelligence and IoT. By calling anything smart, it automatically refers to something which is close to human intelligence. A smart home represents a house equipped with intelligent and remotely controllable equipments. Although it seems contradictory when terms like intelligence and controllability are used simultaneously, but these are meaningful in some situations. It purely depends on the amount intelligence provided to equipments in the house and at the same time user control over the equipments. Different users

have different expectations from an automated home, but forgetfulness is common with everyone.

Mobile phones have become smarter these days due to apps with interesting functionalities like understanding voice inputs, converting voice to text commands etc. These apps can transmit data inputted by user over the network for further processing. The user can give input to mobile device either by typing command on the keyboard or through voice instructions. Lot of equipments and electric appliances like light, fans, television, printer etc. can be controlled through mobile devices.

In this paper, we have tried to provide most commonly expected functionalities from an automated home. We have done a study to understand which common smart but most basic features are expected by users in their home. This gave us a motivation to work in this direction to try to fulfill expectations of the users. Giving intelligent and controllable equipments to the users give them a feel that they are living in an automated home.

## II. EXISTING WORK

Home automation has been of interest to the research community since years. Researchers in past few years have worked on different ways of proposing a smart home. In [1], a smart home intelligent oven has been described as a device which can cook healthy food based on a selected recipe provided by a family member. The smart oven can also communicate with other appliances like cell phone, fire alarm and smart fridge, from which it can check the availability of ingredients. A smart home controller strategy for managing electric energy in a domestic environment is presented in [2]. The authors have modeled the problem as a binary linear programming problem to find the best time to operate appliances, within the virtual power threshold constraints.

The paper in [3] discusses about a system which uses Wireless sensor networks enabled smart home environments to create pervasive and ubiquitous applications to offer scalable services. Smart home defined in [4] is based on the work on the DTI Smart Home Project, a dwelling incorporating a

communications network that connects key electrical appliances and services to allow them to be remotely controlled, monitored, or accessed. Studies in [5,6] are based on developing automated home using cloud and mobile devices connecting and communicating through it. In [7], a study is done to determine the effects of appliances and environment. The authors have used a goal-oriented requirement language to understand the properties of the environment and the functionality of the appliance considering its side effects.

In study by [8], an Internet application is studied which allows local and remote monitoring and control of a home. The application is based on object-oriented approach which considers every home automation device as an object. Work presented by [9,10] have considered home controlling and monitoring system using smart phones. The devices within the house are controlled and monitored using Bluetooth. Authors in [11] have performed a review of Smart Homes as considered by different academic projects done by institutions across the world. The paper by [12] presents a low-cost Smart Living System for controlling home appliances using Android based User Interface. Connection to the smart living system is done through Bluetooth or internet connection for home security and alert system.

### III. OUR APPROACH

An android smart phone has been used to control various appliances in house like lights, fans, television, and other appliances in the house. A user authorization is performed before these actions can be performed. This can be done because the system is trained to recognize the user through his speech. Hence, when the system identifies the user by recognizing his speech, further commands from that user are accepted for controlling the house appliances.

#### a) Remote Controllable Appliances

Life has become very fast for people. They sometimes don't have time to check whether all the lights and fans are switched off before they leave the house or sometimes they forget to do so. But when they recall that they have left some appliance switched on, they can't do anything. Remote controllable appliances are the solution for such people. Since the phone of house occupants is connected to the smart appliances, they can control these devices even when they are out of the house.

Unique address identification is done for each of these intelligent appliances which receive a sequence of instructions to execute a particular command. These devices can be controlled remotely by occupants of the house which are

deemed authorized. Python libraries are used to accomplish the objective. It works as follows:

- The automated home is guided by home assistant who runs on an android smart phone.
- The android phone receives speech commands.
- It is checked whether the user giving commands is authorized or not.
- On successful user authorization, the commands are converted from speech to text using Google's speech to text API for android.
- The commands are then checked with the set of smart appliances which can be controlled by the user.
- If it gets a match, keywords within the command are checked for the user intention. Accordingly. The command is executed by the system.
- The command execution is done through Raspberry pi which controls the device status. The Raspberry pi has built-in GPIO (General Purpose Input Output) pins to which a device is connected and the signal is sent to let the current flow or not.

#### b) Intelligent Appliances

In addition to above features, the home automation also comes equipped with some sensors which maintain standards in the house. This relieves users from controlling temperature and lighting in the house. The house has various sensors like temperature sensors and light dependent resistors to add intelligence to regular appliances. These sensors are especially useful in those places where people experience lot of variations in weather. Every sensor has its own role in the house.

- Temperature Sensors: The temperature of the house is affected by the outside temperature. Temperature changes during day and night time are highly dependent some factors like type of hours of the day i.e. sunny, cloudy, hazy etc. The temperature sensors in the house can sense the outside temperature and help maintaining standard temperature within the house. This gives a sense of comfort to the occupants of the house because they do not feel too cold even if it is cold outside.
- Light Dependent Resistors: These sensors can be equipped to check the amount of light coming inside the house. If lights in the house are on even when it is full sun outside, the sensors automatically switch-off the lights. In similar manner, as it starts getting dark outside, the sensors switch on the lights automatically only in those rooms with some occupants of the house.

**c) Components used**

To develop a complete automated home, various components are used each for a specific purpose. Table 1 gives brief information about these components.

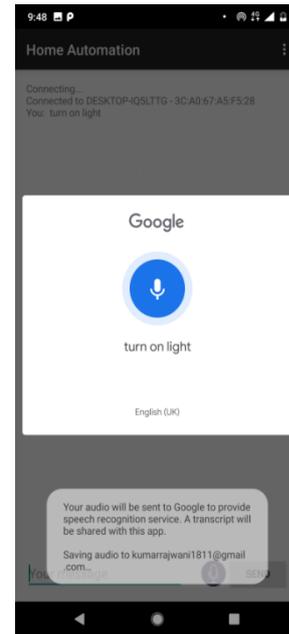
**TABLE I**  
Components of Home Automation System

Component	Purpose
Raspberry Pi 3	It is used to host the python script to control appliances connected to it. It receives commands from the android phone as given by user.
Android	The android phone is used to send commands to python script through a custom app.
Channel 5V Relay	This switch lets electrical current to flow through.
Temperature Sensor	Temperature sensor gives the current temperature measurement through electric signals. Here, it is used to control the devices such as fans, room heater depending on the temperature of the room.
Light Dependent Resistor	Light Dependent Resistor checks for the light intensity. Here, it is used to turn on the house lights when it gets dark in the room.
GSM Module	The GSM module is used to receive commands from the user using SMS and send SMS as a response to his commands.

**IV. RESULTS AND DISCUSSIONS**

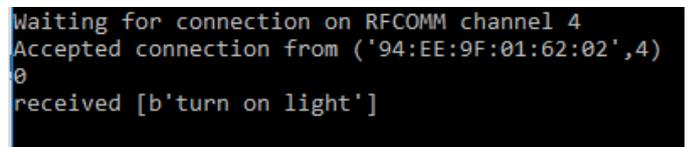
As discussed above, our approach to home automation is based on a design which consists of a Raspberry pi board with home appliances connected to it via relays. A wireless communication takes place between android based smart phone and Raspberry pi. Only authorized users are allowed to access the home appliances through voice commands.

Figure 1 shows an example of how the commands are sent to the Raspberry Pi for turning on the light. Similar commands are used to control other appliances at home as mentioned above.



**Figure 1: Sending Command from Android Phone**

On sending these commands, the automated home will act accordingly controlling the appliances. Figure 2 shows the commands as received on the other side.



**Figure 2: Receiving Command from Android Phone**

Tuning home appliances on and off through android smart phone was not that easy earlier even when the occupants of house are at some distance from the house.

**V. CONCLUSION**

This work started with the objective of understanding the basic idea behind home automation systems. Interest in this area resulted in the development of our own automated home. This home has smart and controllable appliances to fulfill basic expectations of users from an automated home. Addition of temperature and light sensors makes it smarter as the sensors adapt to the weather by adjusting the three parameters giving comfort to the occupants of automated home. The system is secure because it can be operated only by authorized users. Users can interact with the android phone to control appliances in the house by sending and receiving signals through raspberry pi. The overall implementation cost to us is very low due to easy availability of the components of the system. In future, this system can have face recognition to recognize the occupants of the home to unlock the door if nobody is at home.

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