

A Generic Model of Smart Home Appliance Control System: Design and Implementation

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Abstract—Technologies taken most part of human lives for optimizing day to day chores and monitoring surrounding to facilitate all services for maintaining daily routine. From time to time with upcoming generations has become a magnet for innovative ideas that leverage technology to solve society's problem efficiently and effectively. In the era of information technology, from top to bottom humans are surrounded by numerous digital prototypes having potential to make their lives cumbersome to operate each appliance having its own control or remote control. Humans always feel to operate all home appliances remotely with single control system when he is away from his own native place. This paper presents a generic system for the proposed appliances control system describing the underlying design and implementation process. This paper also presents concrete guidelines for future researchers, academia and industry as well as for government to follow in developing a practical sustainable smart home appliances control system that has the potential to bring significant personal, professional and economic benefits to nation growth. We still face many challenges and hurdles in acceptance of these services. This paper also forecast the key future challenges associated with development and acceptance of the domain.

Keywords—Smart Home Automation, Internet of Things (IOT), Control System, Bluetooth, Smart Things

I. INTRODUCTION

Humans need an interface to interact with every things and controller to control the working of device so as to effectively manage the process which positively affect environment and helps to produce the desired output which results in completion of user and machine goal. An interface allows creating both configurations for the controller and creative user interaction design module and control panels that allows to interact with devices and to control them. Controller manages runtime integration between devices and schedule various critical situation so as to not contradict with the functioning of devices.

Things are everything which surrounds human and all those device/appliances which are directly or indirectly playing important role in making life easier by helping in daily activities so as to refine the life style. Some of the appliances such as washing machines, music system, washers, freeze, air conditioner, bike, bicycle, television, fan, light, surveillance camera, utility meters, thermostats, water motor, shower, dryers, printer, car, smart phones, computers, wearable electronics and door

lock-unlock etc. Fig. 1 shows different smart things/devices which are easily available in every home environment.

Things/appliances may act as smart things-devices due to their persisting working culture in response to the human action. Devices collective intelligence in collaboration with other devices in surroundings makes them smart enough to interact with controller to receive and transmit data signals to achieve common goal while executing particular action on the behalf of individual operating condition for performing remote sensing actuating and monitoring.

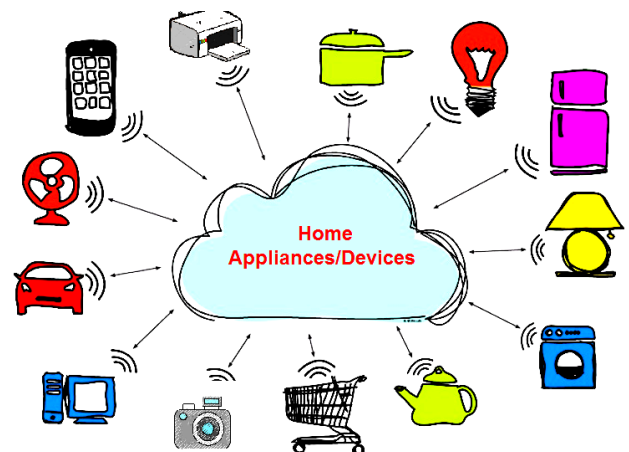


Fig. 1. Different smart things/appliances in home

While interacting with controller various things/devices have following capabilities which make them smart enough to response to appropriate command given either manually or remotely.

- Unique identities to represent themselves
- Remote sensing capabilities
- Actuating capabilities
- monitoring capabilities
- Data collecting capabilities
- Interacting with other devices
- Data sending capabilities
- Exchange of information
- Process data/signal either locally
- Executing capabilities
- Time driven action

Smart devices have embedded hardware modules for sensing, actuation and for communication purpose to remotely monitor, control and exchange data between devices. Machine to machine is networking of machines or devices which are work collectively for achieving

associated appropriate task or results in completion of desired event. Since few decades internet is continuously evolving and changing rapidly with the advancement in technologies. Today internet is not only confined to human-human communication.

Internet of Things (IOT) as the future evaluation of the internet technology realises machine to machine, human to machine and machine to human type of communication flow. Internet of Things (IOT) as like smart devices/things have embedded hardware modules also embeds some intelligence in internet connected objects to communicate for exchanging information, taking various kinds of probability decisions, invoking action based on the inferred decision and providing amazing services. Thus, Internet of Things (IOT) act as technology which provides connectivity for everyone and for everything.

Under domain of Internet of Things (IOT) keeping in mind humans are assisted at every level, not only connecting internet enabled devices but to configure, control and networked over those things which are traditionally not associated with the internet. Internet of Things (IOT) devices having certain physical attributes with unique identities have the capability to self configure according to physical & virtual environment, dynamically self adaptability to communicate data associated with users and their associated environments.

With vastly evolving technology, there is neither an appropriate definition of a 'smart home' nor we can distinct it from other very similar systems. Somewhere comes under the application of ubiquitous computing in which with ambient intelligence home environment is monitored. In generic way, 'smart home' is a residence which is equipped with all technologies those are above defined such as controller of every device, appropriate interface for interacting with devices, smart devices/appliances with embedded hardware module for ambient intelligence, Internet of Things (IOT) with internet enabled connectivity to interact & exchanging information among other peer devices i.e machine to machine with internet connection.

In recent years, rapid introduction of network enabled digital technology inside home environment offers new and exciting opportunities to build the connectivity of devices for purpose of home automation. Smart home is a place where all devices/things have potential to interact more seamlessly with immediate environment. Some examples to witness the rich environment inside smart home such as surveillance camera can adapt their modes to normal to infrared night modes based on whether it is day or night, camera could switch from lower resolution to higher resolution, weather monitoring node can describe its monitoring capabilities to another connected node to communicate and exchange data, smart lighting that adapts the lighting to suit the ambient conditions, smart washer/dryers that can be controlled remotely and notify when the washing/drying cycle is complete, smart thermostats allow controlling the temperature remotely and can learn the user preferences, smart refrigerators can keep track of the items stored and send updates to the user when an item is low on stock, alert raised by smoke detectors can be in the form of signals to a fire alarm system, gas

detectors can detect the presence of harmful gases such as carbon monoxides.

We present a generic system for the proposed appliances control system describing the underlying design and implementation process. Home automation system allows controlling of various different appliances in a home remotely using mobile android application graphical user interface and secondly through user voice enabled assistant on the basis of predefined commands to operate devices. The system provides the option of manually and remotely switching on/off the appliances. Paper presents empirical analysis for controlling the one room appliances like inside light bulb, outside light bulb, fan, television on-off system through android application and voice enabled assistant over bluetooth connectivity.

This paper also presents concrete guidelines for developing a practical sustainable smart home appliances control system. We still face many challenges and hurdles in acceptance of these services. This paper also forecast the key future challenges associated with development and acceptance of the domain.

II. SYSTEM ANALYSIS

We make a system through which we can control appliances of our home and operate them easily. We face many problems in society as physically challenged people, old people have problem to operate their device such as ON/OFF the lights, fans etc. Sometimes some appliances remain ON by mistake so it increases the charge of bill. So, this system is very useful for these types of problems.

A. Problem Definition

In today's world nobody have the time to run here and there in home so home automation saves time as we control our appliances by sitting at one place and operate them according to our own choice. As in the absence of family our appliances remains ON so it increases our bill. So, automation saves our money by ON/OFF our appliances by sensing us. As we save energy then indirectly it contributes to our economy. Home Automation give relax to the owner of home as he does not have tension of his home about appliance are ON/OFF or security. It is reliable for user to manage the devices easily.

B. Proposed System Features

This system operates our appliances as we can communicate with our system in many ways as we generally send commands by an android application or by our voice enabled assistant using our smart phone. Some of the proposed system features are:

- Easy graphical interface for operating appliances.
- Useful for physically challenged people and old persons.
- Easy to implement.
- It is low cost device
- It saves times.
- Reliable

B. Proposed System Setup

1) *Arduino Uno*: Arduino is the low cost open source ATmega328P microcontroller board .It has 14 I/O pins to communicate with sensors. We operate output devices of our own choice. It is just like CPU of computer as it is the

brain of many projects. It is a low cost device. Specification:

- It use ATmega328 micro controller.
- It operates on 5v.
- It has 32kb of flash memory.
- It has 14 I/O pins.
- Its clock speed is about 16 MHz

2) *Bluetooth module HC-05*: This device is used for wireless communication. It used master slave configuration flow wireless communication. It is programmable input output control. It works up to 50 meter range. Fig. 2 shows Bluetooth module HC-05.

3) *Relay*: The Arduino relay is used to control large load device such as AC and DC motors, light bulbs etc. It is operated by micro controllers such as Arduino, AVR, PIC, ARM etc. It is operated on 7A/240VAC. Fig. 3 shows relays. Number of relays used in proposed system: 4
 Rated load: 7A/240VAC
 Control action time: 10ms/5ms

controlled by relay. Here Arduino works as intermediate to operate appliances via relay according to the given command.

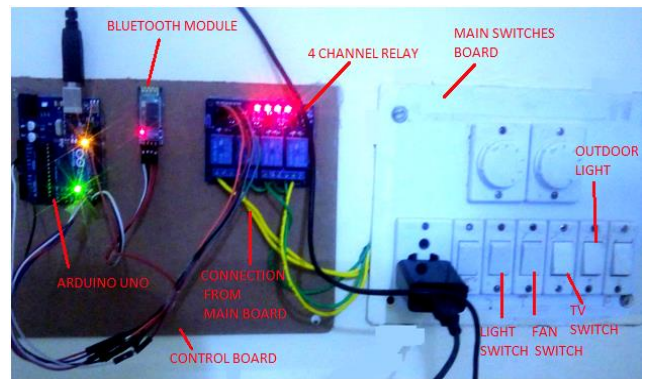


Fig. 4. Implementation of proposed appliances control system

We can communicate with our system through android application. The app sends data to Arduino via interface of Bluetooth module and Arduino further proceed that command and it enable/disable the relay which is connected to the main switches board to ON/OFF the appliance. Similarly this can be done by voice app. The voice app sends voice command and operates the device in enable/disable the appliance according to the given voice command.

HC-05 BASIC SET UP

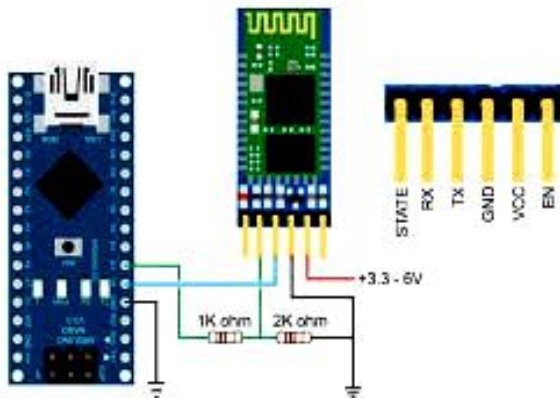


Fig. 2. Bluetooth Module HC-05

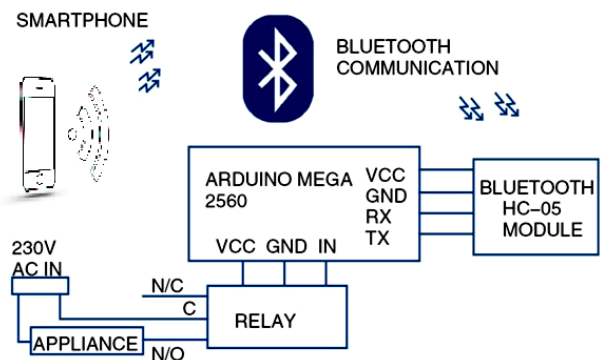


Fig. 5. Block diagram of proposed appliances control system

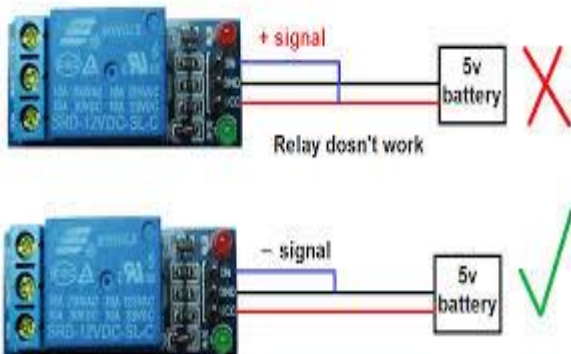


Fig. 3. Connection establishment of Relay

III. SYSTEM DESIGN AND IMPLEMENTATION

Moreover implementation of wireless Bluetooth connection in control board allows the system to install in more simple way. The control board is directly installed beside the electrical switches where switches are

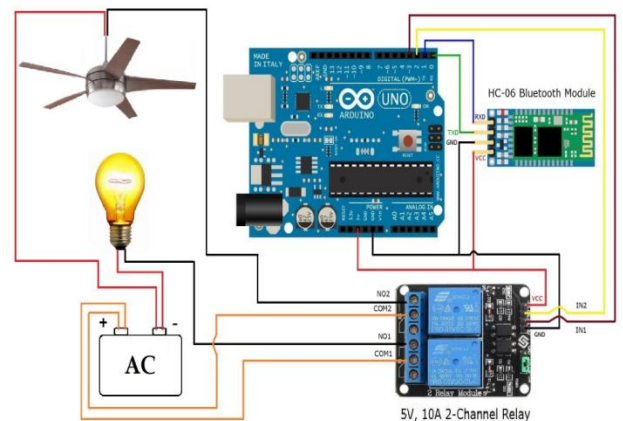


Fig. 6. Circuit Diagram of proposed appliances control system

IV. SOFTWARE DESIGN

The app sends data according to the selected button to the Arduino as 'FULL HOME ON' button enables all the appliances of the home. Fig. 7 shows the user interface which is used to control appliances in smart home. Similarly, each command has its own functionality.

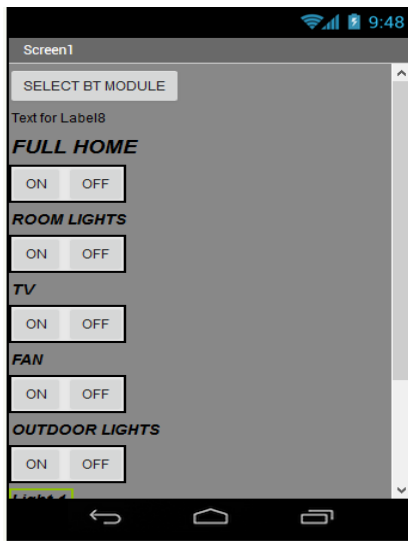


Fig. 7. Android application user interface used for controlling appliances

Another application used to control the appliances is based on the user voice enabled assistant who works on predefined commands. Fig. 8. Shows the user interface voice enabled assistant for controlling appliances. This android application takes your voice command and sends that command to the Arduino by a Bluetooth module and Arduino works according to the save commands. If your voice command matches with the saves command then it do functionality in the form of ON/OFF the appliances.



Fig. 8. Voice enabled assistant for controlling appliances

V. ADVANTAGES AND APPLICATIONS

The main advantage of "Home automation through android mobile" is that it helps physically challenged, disabled person and old aged persons. Replace television, air conditioner, etc. remotes for sleep modes. Smart homes are much better than are normal homes.

- Faster operation and efficient.
- No need to carry separate remote or any other controlling unit.
- We can control device from a long distance, thus it gives ease of access.

VI. FUTURE PROSPECTS

As in future up to 75 billion devices will connect to IOT. So it has a vast future. Every devices of our daily use is connected to internet as it communicates with humans. For future work, is that to bring this device on server so that the use can control the devices from anywhere in the world. They have no boundary of range.

VII. CONCLUSION

Home automation is good resource of future as it makes home environment fully automated. People can control their home automation devices and control them through their mobile phones. This product is cheap as it has high potential of marketing in future because people from higher class to lower class can afford it. This low cost device improves the standard of living in home. This device work as assistant for people to operate lights, appliances etc. to people.

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