

IoT BASED SMART HOME

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Abstract

Internet of Things (IoT) is an integrated part of Future Internet including evolving Internet and could be conceptually defined as a dynamic worldwide network setup with self-configuring capabilities where physical and logical (virtual) “things” have identities, physical and virtual attributes, use artificial intelligence, have interactive interfaces, and are seamlessly integrated into the global information network. Home Automation System(HAS) or Smart Home where physical devices, appliances, surveillance system based on IoT uses computer, portable devices and dedicated mobile application to control and monitor basic home functions and features using wireless communication. The main control system implements wireless Bluetooth technology, WIFI and internet facilitates remote access from mobile phone, PC/laptop. It is meant to save electric power and human energy and provides more safety control on the existing electrical system. Also, smart home concept based on IoT improves the standard living and provide support in order to fulfil the needs of individuals, designed to assist elderly and disabled. These Smart Homes can lead to more efficient usage of electricity and would be deployed in Smart cities in future.

Key Words: IoT, Wireless communication, Android Application.

1. INTRODUCTION

With the great development in the field of internet and technologies, Physical and virtual things can communicate, integrate with technologies and provide solutions to real time problems. Internet has become a vital part of our lives. A new technology “Internet of Things” establish communication among devices, integrate technologies through internet (network) and control and monitor things(devices). Internet of things is a network comprises of electronic devices, sensors (Physical devices) which are connected together (logically), exchange information, control and monitor devices, analyse data and integrate and collaborate with other technologies on digital platform. They seem not only talking but also sharing data with each other[7].

In a Smart Home or Home Automation System where home appliances, electronic devices and sensors can be logically connected together to

facilitate one other and can be operated and monitored from remote location through web application, smart phone etc. Moreover data collected from sensors, devices can be analyse and use for other tasks[4]. Low cost sensors and actuators embedded in various devices can sense, process, communicate and react to the gathered data[5].

In order to bring IOT into reality, IP-based communication that tends to serve both as a locator and identifier for devices is being used. But devices, smart sensors, sub-system use multiple protocols and ways to communicate, As a result increasing demands of convergence among various heterogeneous network devices requires NDN(Named data networking) to content centric networks (CCNs) [4]. Most of the IOT system uses Global System for Mobile Communication(GSM), Wireless Fidelity(WIFI), ZIGBEE and Bluetooth. Each of the technology has their own applications

and uniqueness. GSM modem and micro controller is not accepted by users as long term cost is high and has some limitations[9]. PC's GUI doesn't ensure remote accessibility and Symbian OS application has limited users and it has limited functionality[2]. A smart home system which integrate with existing physical electrical system, could be convenient to user and reduce overall cost of project[5]. Moreover any system that has limit the control only at the Graphical user interface, is not user friendly[9]. Bluetooth has suitable capability and provide connection to 100 metres at globally available frequency of 2400Hz. Bluetooth will significantly reduce cost of Home Automation System and can be integrate with Physical system using low voltage activating method. Smart Home system can be established using bluetooth module that communicate to smart phone, PC/laptop. Window operating system on PC, Android operating system on Smart phone facilitates the connection and enhance functionality of system. System is flexible enough to communicate with wireless as well as wired devices [2]. PIC microcontroller optimises the relay circuit and enhance reliability. Even with low budget, System is still secure, reliable and convenient, provideremote access to individuals or automated system(s) to make life easier in home[27].

SYSTEM OVERVIEW

In the Smart Home, the system is directly installed beside the conventional electrical system at home (Fig 1).The Bluetooth wireless connection (Bluetooth module) enabled the system communication with smart phone and PC/laptop. The system Main Control Board integrated with Micro-controller 8051 control the home appliances[1]. Micro-controller is controlled by GUI on handheld devices using WIFI or Bluetooth through Bluetooth/WIFI module[3].

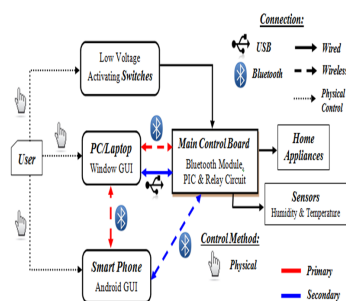


Fig 1. System Block Diagram

The user can control the devices using android application through GUI on smart phone. The disabled people, who have problem with locomotion difficulty can also control and monitor devices using portable method. The sensors measure room temperature, humidity level and intensity of light in the smart home. They are connected to the central control board. The indication from the sensor can be analysed and interpreted by user to switch ON/OFF the devices like heater, air conditioner, fan, light bulb etc. Feedback from sensors can be used to switch off unnecessary electronic appliances[3]. Moreover devices like fan and light bulb can be operate at different speed/intensity as per requirement. Multiple devices can be operated simultaneously using single button (command) on the GUI[1].

After the smart phone's Bluetooth connection is connected to personal computer, the window GUI will be act as a server among other portable devices[2]. System is integrated and some connection parts of the system are connected (Primary and Secondary) to control board. In case of failure on PC/Laptops, Handheld devices can directly communicate with control board. While in case of communication failure between PC and control board, handheld device can connect to Main board using Bluetooth/WIFI.

HARDWARE DESIGN

Hardware design can be optimised as per consumer's requirement. In the hardware block diagram of the control board (fig 2). Microcontroller 8051 has the capability to Integrate with Bluetooth module and Relay circuit. Bluetooth communication between Control board (Microcontroller) and smart phone is established using low cost Cyton Bluebee Bluetooth through Bluetooth module[2].

The electrical current is supplied to the Control board which include the relay circuit, regulator and microcontroller. The voltage regulator includes regulator circuit, which is common and reliable. Regulator circuit consist of transformer, regulator, diodes, capacitors and resisters[1]. 7-9 V and 4V DC output is regulated for components in the control board. Relay circuit facilitates the connection to

devices (home appliances). The system can be easily implemented beside the conventional electrical switches.

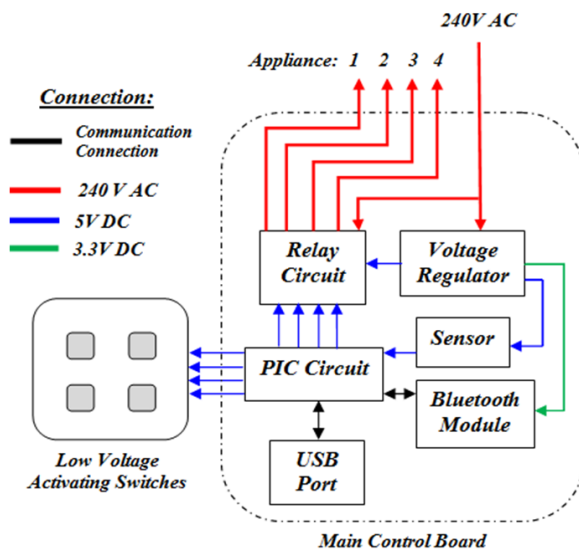


Fig 2. Hardware Block Diagram (Main Board)

Bluetooth device facilitates communication between smart phone and control board. Bluetooth master device can connect multiple device. This makes the system simpler and easier to implement[12]. Moreover the system is smart enough to interact and respond using LED signal[2].

SOFTWARE DESIGN

Software design section is an integral part of system and perform the main function. It includes PIC micro controller, Bluetooth module and GUIs (Android Application)[1]. The functionality of system can be easily understood with the help of a flowchart(see figure 3).In the chart PIC controller detects input signal (Switch detection function) in the system. A switch press (signal) will initiate the Function loop (Main) of the micro controller[2]. Then, the Peripheral interface controller micro controller will activate the relay circuit for device(s)[2].

User can easily operate devices from GUIs (smart phone). Multiple device can be operated using single button on GUI. Moreover intensity of light bulb, speed of fan can be control using appropriate button on GUI.

Bluetooth Module (Chip) can be programmed using C language to facilitate PIC microcontroller and

establish reliable communication among smart phone and main control board. Functionality and reliability can be enhanced through module. Multiple device can be connected to main control board using Bluetooth[2]. WIFI/Bluetooth can easily detect and connect to main control board[6].

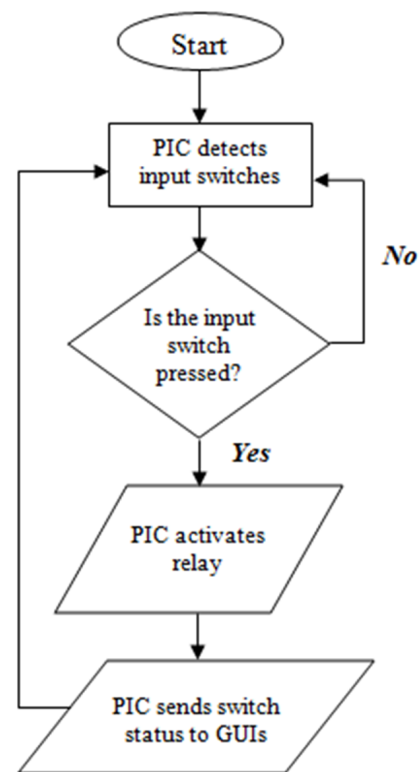


Fig 3. Flowchart describing sequence of execution

Application for Handheld devices (smart phone) is designed in Android Version 4.2 with API level 21. Android Application is compatible with higher version. Application interface is interactive and user can enter text (symbol) to operate device(s).

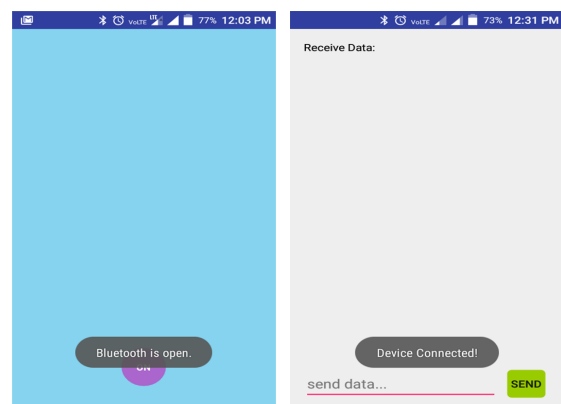


Fig 4. Android Application GUI

Fig 4 illustrate the interface of Android Application to select Bluetooth device and send data to operate device (Home Appliances).

Benefits of Smart Home

Internet of Things (IOT) based Smart home or Home Automation System is the building block for smart cities. The trend of Internet of Things is shaping the sustainable development goals. In the past there have been conducted many researches for proposing system for Smart Home. IOT based technologies have direct impact on global market[5]. The first and foremost benefit to smart homes is convenience, as more connected devices can handle more operations (lighting, temperature, etc.)[4]. Moreover, smart home IOT devices can help reduce costs and conserve energy[3]. Features like advanced security systems with cameras, motion sensors, access to emergency services and a link to the local authorities are integrated in the Smart home[9]. Smart home not only improves the standard living but also provide support in order to fulfil the needs of individuals. Smart home may feature accessibility technologies and is specially designed to assist elderly and disabled residents[3]. Moreover Smart homes provide energy-efficient solutions. Lights can shut off automatically when no one is in a room. The thermostat can be set, to maintain the indoor temperature before residents arrive in the home[15]. Resale value of smart home is five folds to conventional home and there is a huge demand for Smart home across the globe. Automating a home can be a worthwhile investment in increasing its market value and attracting possible buyers in the future [4].

CONCLUSION

The Internet of Things (IOT) is clearly one of the dominant features of modern world. It has brought great advancements. Internet of Things based Technologies not only connect and integrate but also transform our cities. Smart Home is an integral and vital component of smart city and rapidly transforming world. This low cost Smart Home System is one such approach that can meet Sustainable development goals with improving the standard living. Smart Home not only provide Convenience to user, but also ensure efficient use of

resources like electricity. In this paper, we proposed a basic model for smart home and explained the basic architecture and designed of the Smart home system. Moreover Smart home can be the solution of global problems like Global Warming, Pollution, excessive energy consumption. Moreover, Smart Home System is going to be an essential part of future smart cities.

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