Wireless Home Automation System

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Abstract: **This project focuses on the ease of controlling home appliances wirelessly with the use of smartphones or any other smart computing device. The system consists of micro controllers, wireless modules, relays & other circuit components all connected and programmed together to accomplish this task. This enables the user to control the desired appliance virtually without reaching out for the physical switch. This kind of a system is a boon for people with physical disabilities, senior citizens etc. This also acts as a parental control for people who have to go out for work leaving their kids at home**

Keywords: **Wireless Home Automation System**

I.   INTRODUCTION

The term "home automation" is anything that enables you to use your home appliances more conveniently and efficiently. It can be as simple as a remote or automatic control of a few lights, or it can be a complete system that controls all major parts of your home, custom set to your own personal preference. The alternative term used for home automation is demotics.

A typical wireless home automation system makes use of a Bluetooth/ WiFi for monitoring and controlling the home appliances/electronic devices connected to it. By means of IoT (Internet of Things), the application is further stretched to monitoring the whole network of appliances via Internet. A modern home automation system consists of a network of switches and sensors, all connected to a central 'hub'. This hub controls the whole system which is further connected and controlled by smart devices (smartphones, tablets etc).

One of the newest inventions in the field of home automation systems are *smart speakers.* A smart speaker is a type of wireless speaker and voice command device with an integrated virtual assistant (artificial intelligence) that offers interactive and hands free activation with the help of one "hot word" (or several "hot words"). Some popular smart speakers that are available globally are Amazon Echo, Google Home and Apple HomePod, although Amazon Echo and Google Home are the only one currently available in the Indian market. These speakers make use of their individual voice assistants (Amazon Echo uses Alexa, Google Home uses Google Now and Apple HomePod uses Siri) to accomplish a variety of tasks like usage of voice commands to control volume and play your desired music tracks, make phone calls or switch on/off or change the colour of lights of a particular room.

II.   OBJECTIVE

Home automation mainly works on the platform of IoT (Internet of Things) which is a network of home appliances and other electronic items embedded with softwares, sensors, actuators, and connectivity which enables these objects to connect and exchange data.

Each thing is uniquely identifiable through its embedded computing system but is able to inter-operate within the existing Internet infrastructure.

The IoT allows virtual access and control of a variety of electronic devices, whether home or office, creating a bigger environment for integration of physical world with computer based systems.

Early home automation began with labor-saving machines. Self-contained electric or gas powered home appliances became viable in the 1900s with the introduction of electric power distribution and led to the introduction of washing machines (1904), water heaters (1889), refrigerator, sewing machines, dishwashers, and clothes dryers. In 1975, the first general purpose home automation network technology, X10, was developed. It is a communication protocol for electronic devices. It primarily uses electric power transmission wiring for signalling and control, where signals involve brief radio frequency bursts of digital data, and remains the most widely available. By 1978, X10 products included a 16 channel command console, a lamp module and an appliance module. Soon after came the wall switch module and the first X10 timer.

By 2012, in the United States, according to a research, 1.5 million home automation systems were installed. There are three generations of home automation:

1. First generation: wireless technology with proxy server, e.g. Zigbee automation
2. Second generation: artificial intelligence controls electrical devices, e.g. Amazon Echo
3. Third generation: robot buddy who interacts with humans, e.g. Robot Rovio, Roomba.

Here are some more applications of home automation systems:

• Heating, ventilation and air conditioning (HVAC): It is possible to have remote control of all home energy monitors over the Internet incorporating a simple and friendly user interface.
• Lightning control system
• Occupancy-aware control system: It is possible to sense the occupancy of home using smart meters and environmental sensors like CO_2 sensors, which can be integrated

into the building automation system to trigger automatic responses for energy and building comfort applications.
• Appliance control and integration with the smart grid and a smart meter, taking advantage, for instance, of high solar panel output in the middle of the day to run washing machines.
• Home automation for the elderly and disabled.
• Pet care, for example tracking the pets movements and controlling access rights.**Hardware**

A. 8051 Micro-controller
The Intel 8051 micro-controller is one of the most popular general purpose micro-controllers in use today. The success of the Intel 8051 spawned a number of clones, which are collectively referred to as the MCS-51 family of micro-controllers, which includes chips from vendors such as Atmel, Philips, Infineon, and Texas Instruments.
The Intel 8051 is an 8-bit micro-controller which means that most available operations are limited to 8 bits. There are 3 basic "sizes" of the 8051: Short, Standard, and Extended. The Short and Standard chips are often available in DIP (dual in-line package) form, but the Extended 8051 models often have a different form factor, and are not "drop-in compatible". All these things are called 8051 because they can all be programmed using 8051 assembly language, and they all share certain Features (although the different models all have their own special features).
Some of the features that have made the 8051 popular are:
▪4 KB on chip program memory.
▪128 bytes on chip data memory(RAM)
•32 bytes devoted to register banks
•16 bytes of bit-addressable memory
•80 bytes of general-purpose memory
▪4 reg banks.
▪128 user defined software flags.
▪8-bit data bus
▪16-bit address bus
▪16 bit timers (usually 2, but may have more, or less).
▪3 internal and 2 external interrupts.
▪Bit as well as byte addressable RAM area of 16 bytes.
▪Four 8-bit ports, (short models have two 8-bit ports).
▪16-bit program counter and data pointer.
▪1 Microsecond instruction cycle with12 MHz Crystal.

8051 chips are used in a wide variety of control systems, telecom applications, robotics as well as in the automotive industry. By some estimations, 8051 family chips make up over 50% of the embedded chip market.
In this project, the 8051 micro-controller acts as the brain of the whole system. It is connected to to a Bluetooth/GSM module from which it receives the commands to perform the actions.

B. Bluetooth/GSM Module
It was developed by Bell Laboratories. This is the technology which is widely used in the world. It is a digital cellular technology for transmitting voice, data services which operates at 850MHz, 900MHz, 1800MHz, 1900MHz frequency band.
Software

We can also use GSM Module in sending messages via mobile in the form of SMS, MMS, etc for communicating with others.

C. Transistors & Resistors
A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. It is composed of semiconductor material usually with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals controls the current through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal. Today, some transistors are packaged individually, but many more are found embedded in integrated circuits.
Most transistors are made from very pure silicon or germanium, but certain other semiconductor materials can also be used. A transistor may have only one kind of charge carrier, in a field effect transistor, or may have two kinds of charge carriers in bipolar junction transistor devices. Compared with the vacuum tube, transistors are generally smaller, and require less power to operate. Certain vacuum tubes have advantages over transistors at very high operating frequencies or high operating voltages. Many types of transistors are made to standardized specifications by multiple manufacturers. In this project an NPN transistor has been used. The main function of the transistor in this project is that it assists in driving the relay. A resistor, as the names says, is used to resist or control the flow of current in a circuit. In this project, carbon resistors of 100kΩ have been used to prevent the flow of excess current through the transistors and relays.

D. Relay
A relay is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current. The heart of a relay is an electromagnet, a coil of wire that becomes a temporary magnet when electricity flows through it.
It a kind of electric lever when switch it on with a tiny current and it switches on another appliance using a much bigger current. The name suggests, many sensors are incredibly *sensitive* pieces of electronic equipment and produces only small electric currents. But often to drive bigger pieces of apparatus that use bigger currents. Relays bridge the gap, making it possible for small currents to activate larger ones. That means relays can work either as switches (turning things on and off) or as amplifiers (converting small currents into larger ones).

E. Step Down Voltage Converter
The purpose of a step down voltage converter is that it converts high voltage to low voltage, which is desirable for the working of the components in the circuit. In this project a 12V to 5V converter has been used.

F. Zero PCB
A zero PCB (Printed Circuit Board) is a circuit board with copper patches where the components of the circuit can be placed. These components are connected to each other by soldering their legs to the wire.

i. Keil uVision IDE

Keil uVision software development tool is used for programming 8051 Micro-controller and supports every level of software developer from the professional applications. Keil C Compilers, Macro Assemblers, Debuggers, Real-time Kernels, Single-board Computers, and Emulators support all 8051 derivatives. The Keil μVision Debugger accurately simulates on-chip peripherals of 8051 Micro-controller devices. Simulation helps to understand hardware configurations and avoids time wasted on setup problems. Additionally, with simulation, we can write and test applications before target hardware is available.

ii.   ISP Programmer

ISP Program software plays a very important role in the programming of the 8051 Micro-controller. This software is used to write/burn the program from the computer to the 8051 Micro-controller. It can control each and every time of operations like erasing of the program in a micro-controller, generating a new code into the micro-controller and can also reset all the previous commands/operations of the micro-controller.

III.   ASSEMBLY OF THE CIRCUIT

All the components in the project have been assembled and connections have been made as shown in the figure 1 and figure 2.
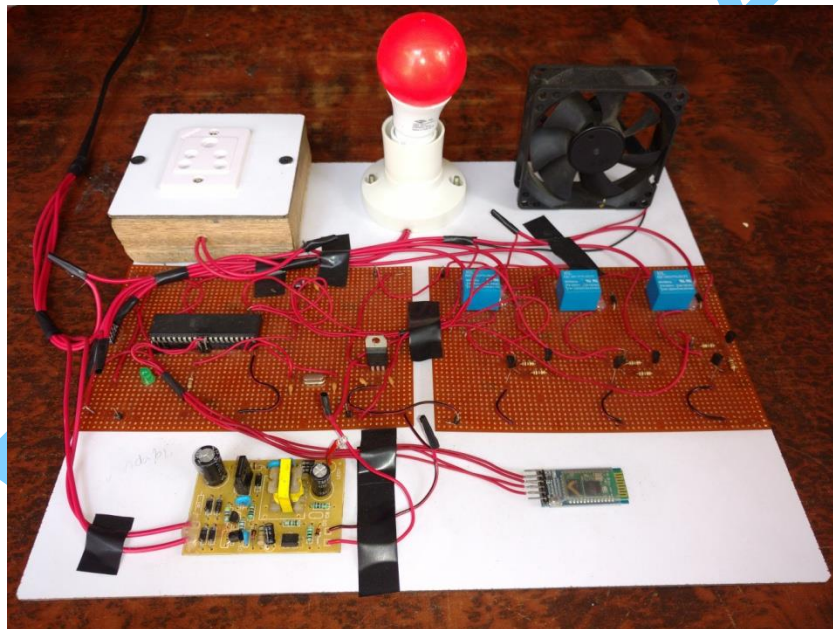
(Fig. 1: Physical circuit of the home automation system with Bluetooth module)

Fig. ...2: *Cir-*

cuit

diagram of home automation system with Bluetooth module
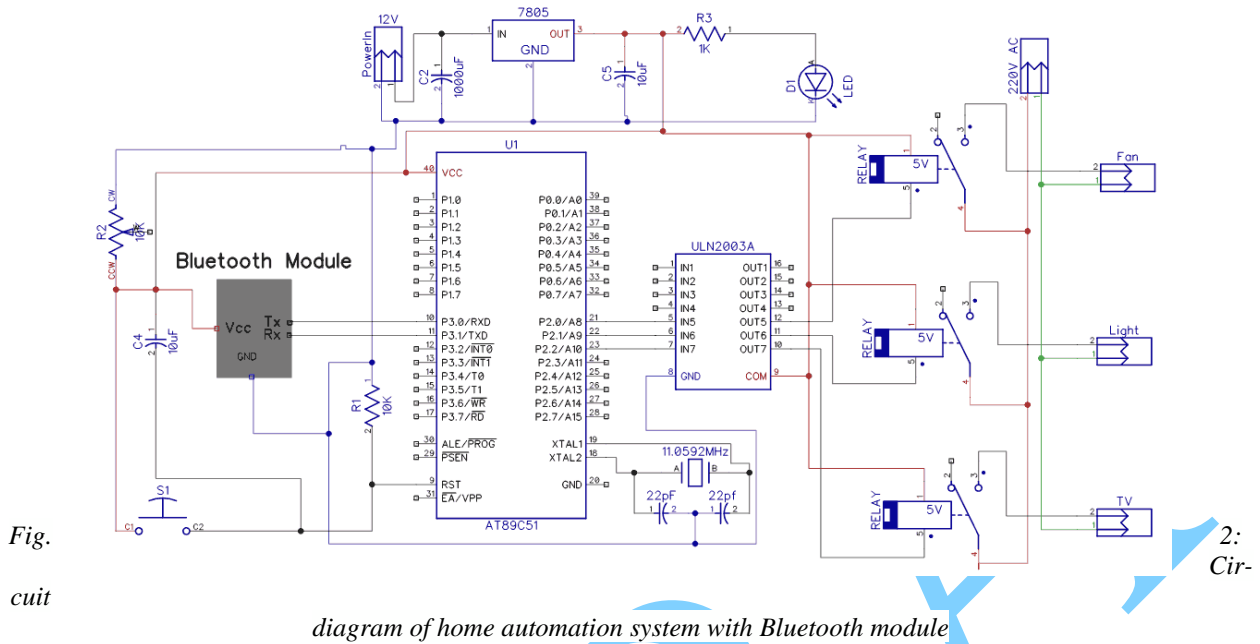
Errors Faced While Performing

While performing the project, several errors were encountered. Some of them were:
• Wrong circuit connections were made while joining and soldering the wires below the Zero PCB.
• Excess voltage was passed through the circuit, causing some of the components to get burnt. To rectify this, a 12V to 5V step-down Voltage Converter was used, which delivered the desired voltage for the operation of the circuit.

IV.   CONCLUSION

Indeed, this project turns out to be a great boon for our day to day lifestyle, where all of us have to be on the move. It helps us remote control your home appliances without reaching out for the physical switch. This also helps you keep a track of home appliances when you're out for work with kids at home.

V.   ACKNOWLEDGEMENT

I would like to thank Ansal University for providing me with an opportunity to pursue my major project, as it is an important part of the B.Tech course and it is the one that exposes you to the develop your skills and makes you adapt yourself to the latest trends and technologies. At the same time, it gives an experience of working on a project. I express my sincere gratitude to Dr. Arti Vaish, Mr. Sandeep Gulia and authorities of Ansal University for their inspiration, constructive suggestion, mastermind analysis and affectionate guidance in my work, without which this project work completion would have been impossible for me.

Further Scope of Home Automation

Home automation is constantly expanding its applications, day by day. Earlier it was only limited to switching on and off basic home devices like fans, lights, sockets etc. Now the applications have further been extended to controlling an entire electronic appliance and all its functions. For example, a smart home air conditioner can be controlled using a smartphone or a tablet (Apple Home Kit is a software that works with all Apple devices running on iOS. It acts as a virtual remote control for home appliances compatible with smart home automation). Not just an air conditioner but even a smart TV can be controlled this way. The home appliances can further be paired up with smart home speakers for creating a common controlling hub. Also integration of Artificial Intelligence with home automation results in fully automated devices, which adjust and alter settings/actions according to the changes in the environment

VI.   REFERENCES

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