

Wireless Home Automation System based on 8051 Microcontroller using Android Application

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Abstract : Home automation system(HAS) is a home equipped with special facilities to enable occupants to control home electronic devices, including televisions, fan, light switches, cameras, and air-conditioners. It is used to provide convenience for user to remotely control and monitor the appliances and it provides a better use of electricity. The efficient use of electricity makes the home automation to play an important role in daily life. All smart phones come with the ability to communicate over the cellular networks, and built-in short-range communication capabilities, such as Bluetooth, that could allow them to communicate with and control appliances in their surrounding environment. This study has been taken to determine the type of platforms, hardware components and process mode of domestic automation system. Bluetooth domestic automation is a study based on controlling of domestic appliances using Bluetooth module, microcontroller, and android phone.

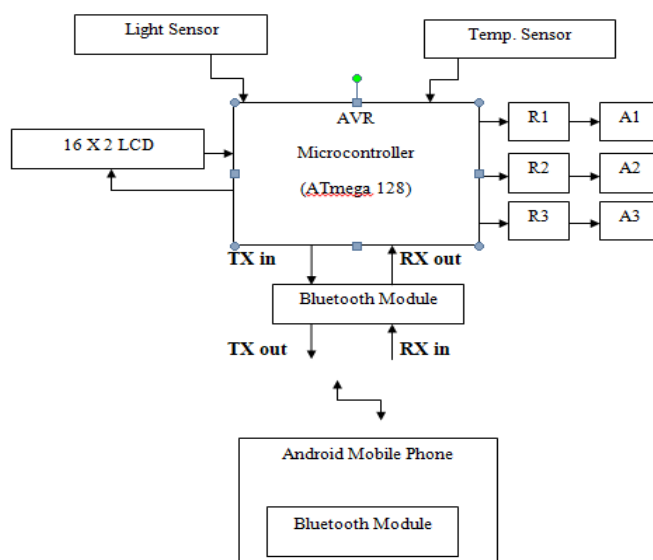
IndexTerms - HAS,Bluetooth module,microcontroller,android phone.

I. INTRODUCTION

With the increasing the number of appliance services and their complexity, there is an urgent need to get a user friendly, automatic, energy efficient and remote control system which makes day to day task easy. It is seen generally seen that at home, every electronic equipment including fan, light, air-conditioners etc. are all manually operated, that is a person needs to go near to the appliance to switch it ON or OFF making it a daily task which needs to be performed by owners of homes. To overcome this, new innovations and new technologies have surfaced with the implementation of which one can lead a more comfortable and luxurious life. One of these innovations includes the Smart home with electrical automation system. This system not only presents the overall design of Home Automation System (HAS) but also this system is designed to assist and provide support in order to fulfill the needs of elderly and disabled in home. Figure 1.1 shows the overall control function of the system. This proposed system is directly installed beside the conventional electrical switches on the wall. User can communicate with this system via Bluetooth. Bluetooth is a wireless connection enabled the system communicates with graphical user interface (GUI) on PC/laptop or smart phone without cable. Main control board contains PIC Microcontroller (PIC18F2550 is chosen due to its capability to perform the both serial and USB features to establish the Bluetooth and USB connection to the GUIs), sensor (HSM20G Sensor Module is chosen because it is the low cost 2-in-1 combination of humidity and temperature modules), Bluetooth module (low cost Cytron Bluebee Bluetooth module is chosen). Microcontroller and Bluetooth Based HAS present smart home system using Bluetooth communication based on ATMEGA microcontroller.

II. SYSTEM MODEL AND ASSUMPTIONS

This paper presents design and implementation of an embedded system which can easily interface with the existing home appliances and communicate with a smart phone via Bluetooth using serial interfacing. Figure 5 shows Block diagram of controller device, which consists of two parts, one is android application (used for communicating with the controlling circuit through Bluetooth channel) and the other one is an electronic controlling circuitry, which consists of a microcontroller, a Bluetooth module, relay driver IC along with relays which will switch electrical loads on the circuit and to switch the power supply. In this proposed system, android device sends a command which is received by the receiver of the Bluetooth module and forwards it through its USART serial interface to the microcontroller. The microcontroller receives the command and takes the necessary action.



. Figure 1 Block diagram of controller device

Proposed System

In this model Microcontroller and Bluetooth based Home automation system has been used since it helps in building a dependable and flexible system that can be easily operated and adapted for a new electrical appliance. The existing system is generally a complex task in our day to day life. For e.g. when a television is to be operated it is to be controlled using a remote. When an AC is to be operated it should controlled initially with a remote. So all the existing systems in the modern world are to be controlled using a device or a chip, so all the existing systems are less efficient compared to the proposed system. The main idea of the model is to focus on controlling the home appliances from the Bluetooth of the smart phone, which is used as a remote control to control the home appliance thus making it simple in controlling the home appliance easier. Specific deliberate choices in selection of appropriate implementation platforms and availability of hardware components were made. Priority was given to low cost availability, reliability, flexibility and simplicity in all these selections.

This system is aimed at designing a device which can control the home appliances through smart phones. An android application is developed in the smart phone which enables us to control device through Bluetooth. A circuit has been designed where the microcontroller is connected to the relay and the Bluetooth device. Once the user switches on/off the appliance through the application developed in the smart phone, the command is received by the Bluetooth which is connected to the microcontroller. The microcontroller receives the command and enables the relay which is connected to the appliance to turn it on/off. The relay acts as a switch and only pin of the relay is connected to the supply and another is connected to the appliance. Thus depending upon the command sent the appliance is switched on.

The designed domestic automation system uses AT89C51 microcontroller, an android mobile phone that has Bluetooth hardware, UARTS standard for communication between the microcontroller and the Bluetooth module of the domestic automation system. The design will also use TRIAC and a driver for interfacing. Microcontroller controls the switch 'ON' or 'OFF'. The designed system describes how to use the android Bluetooth to accomplish the four major tasks necessary to communicate using Bluetooth: setting up Bluetooth, finding devices that are either paired or available in the local area, connecting devices, and transferring data between devices. In order to use Bluetooth features in application, it must declare the Bluetooth permission. Permission to perform any Bluetooth communication is needed, such as requesting a connection, accepting a connection, and transferring data, before the actual design of the project work.

III. CIRCUIT DESCRIPTION AND METHODOLOGY

The proposed system for AC load controller, manual or human effort is not required to turn on and off the home appliances such as the fan, lamps, air-conditioner etc. Everything is saved in a centralized server from which control of all electronic home appliances is made possible remotely.

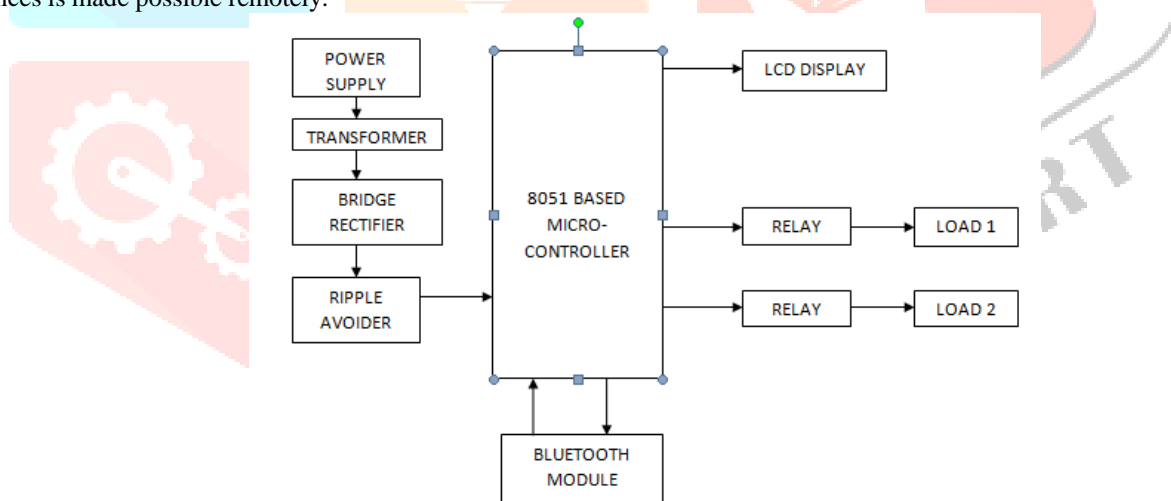


Fig.2. Block Diagram of the whole system

The circuit for detecting the signal from bluetooth device and display on LCD is based on 8051 family microcontroller AT89C51. Most of the components used in the circuit require regulated +5V. Currently we supply power of 220V which is step down to 12V by a step down transformer. To provide +5V regulated power supply we are using 7805(KA7805/LM7805). The 7805 have 3 pins. Pin number 1 is regulated or unregulated input where we give the step down voltage of 12V. Pin number 2 is Ground (GND) and Pin number 3 is regulated output. Irrespective of input at Pin number 1, the output will always be +5V (±0.01V). To reduce any noise or ripple from the power section, one 1000µF is connected between Pin 1 and Pin 2. The microcontroller used in the circuit is 40 PIN DIP 8051 microcontroller AT89C51. PIN no.40 is Vcc, where we can provide minimum 4V, maximum 5.5V and typically 5V. Hence, we have connected PIN no. 40 of AT89C51 with PIN no. 3 of 7805. PIN no. 20 is Ground (GND).

Any microcontroller, microprocessor require clock source to fetch instructions and execute it. We can use crystal oscillator, function generator, timer or even another microcontroller to provide clock pulse. Few microcontrollers has internal oscillator like AVR, ATMEGA 8, ATMEGA 16, ATMEGA 32, PIC etc. but AT89C51 does not have any internal oscillator. Hence, we must have to use external clock source. PIN 18 & 19 of 8051 are marked as XTAL 2 and XTAL 1 respectively. According to data sheet AT89C51 can operate at 3-24 MHz, but we have used 11.0592 MHz crystal only as we have to use serial communication to communicate with the bluetooth module at the next phase. When we use 11.0592 MHz crystal with 8051, it generates error free 9600 baud rate otherwise the serial communication will not be estimated.

In serial communication, BAUD RATE plays a major role for the data transmission and reception. To generate baud rate we use timer in 8051 microcontroller. Primarily, we have T0 and T1 as timers in 8051. T0 and T1 can be used as 8-bit timers or as 16-bit timers. T0 and T1 has 4 different modes of working. The mode of timer is configured with the help of TMOD Register.

M0 and M1 bit of TMOD is used to configure timer MODE.

M0	M1	MODE	OPERATION
0	0	0	13-bit Timer
0	1	1	16-bit Timer
1	0	2	8-bit auto reload
1	1	3	16-bit split

Table:1 Mode configuration of Timer

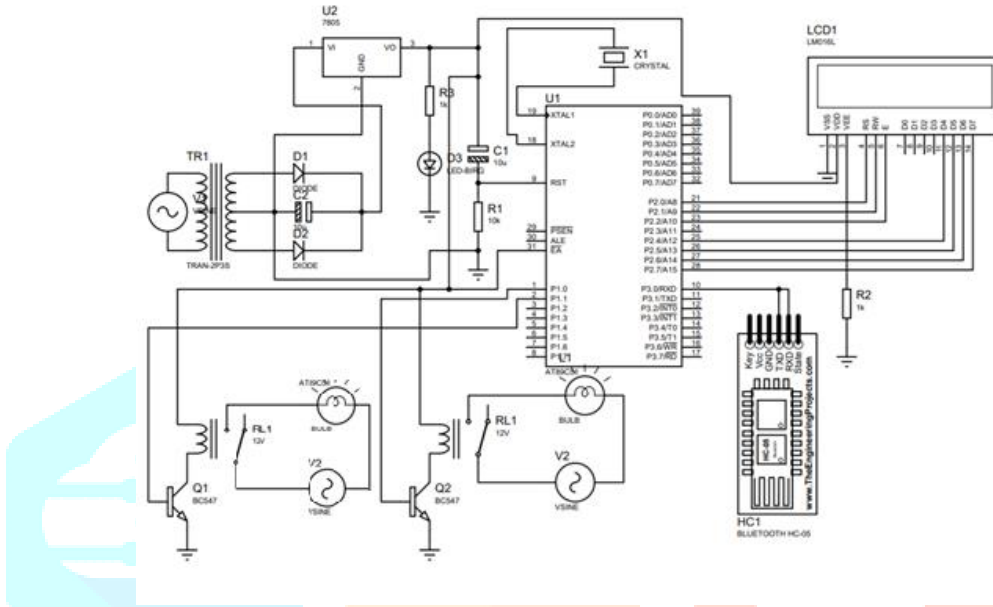


Fig. 3. Circuit Diagram

Use of Timer

1. Delay Generation
2. Counter
3. Baud rate generation

CT- It represents whether we are using the timer as Timer or as a Counter. When CT=0, then it will be used as a timer in which it uses clock pulse from crystal. If CT=1, it will be used as a counter where it will take pulse from external hardware.

GATE represents how the timer will start. If GATE=0, it will start the timer with software instruction. If GATE=1, it will start the timer through hardware.

To operate the system we connect the bluetooth module with 9600 baud rate, 8 bit size, 1 stop bit and no parity bit.

PIN 9 is reset PIN. As per data sheet if we provide high (+5V) at PIN 9 for machine cycle (2x12=24 clock pulse) the device will restart, and for normal operation, PIN 9 must be pulled down. Hence, we have connected a 10K resistance across PIN 9 & Ground (GND).

PIN 31 is EA. If we have to use external memory (program memory) we have to connect PIN 31 with ground, but to use the internal 4K flash memory of AT89C51 we must have to connect PIN 31 to Vcc. As we are using internal program memory, we have connected PIN 31 to +5v.

To display relevant information and data, we are using a 16x2 alphanumeric LCD. The LCD module is having 16 pins. PIN 1 is ground (GND), PIN 2 is Vcc, and PIN 3 is contrast control. To adjust the contrast we have connected a 1K variable resistance. The middle terminal of the variable resistance is connected to PIN 3, 1 terminal is connected to +5V and the other terminal is connected to ground.

PIN 4, 5 & 6 of the LCD module are the most important PIN to work with LCD. They are marked as RS (Register Selector), RW (Read Write) & EN (Enable) PIN. The RS, RW & EN pin of the LCD is connected to PIN 21, 22 & 23, i.e., P2.0, P2.1 & P2.2 of 8051.

PIN 4 to PIN 14 of LCD are marked as D0-D7 which is called data/command bus & use to transfer data/command from microcontroller to LCD. We have used port2 (P2) of the microcontroller, i.e., PIN 25 to 28 of AT89C51 is connected with PIN 11 to PIN 14 of the LCD. No connection is made from PIN 7 to PIN 10 of the LCD.

PIN 15 & 16 of LCD have no relation with the programming; they are just to provide power supply to backlight of the LCD. PIN 15 & 16 are marked as A and K or BL+ and BL- or LED+ and LED-. In circuit diagram, PIN 15 & 16 are not shown. Similarly, PIN 40 & 20 of 8051 is not displayed in circuit diagram.

AT89C51 is having four input-output ports- P0, P1, P2 and P3. The internal pull up of P1, P2 and P3 are activated and since there is connection to any pins of P0, external pull up for P0 is not needed.

The transmitter and receiver pins of the bluetooth module is connected to the receiver pin of the microcontroller i.e. PIN 10. The transmitter pin of the bluetooth module is short-circuited with the receiver pin of the bluetooth module.

Now, the main purpose of our project is to control the two loads which we have taken into account. Load 1 and Load 2 are both Bulbs. Against both the loads, particular commands with their individual functions/tasks are written. When the respective command is received by the micro controller, the tasks or functions against it performed and hence the command is executed. We are considering Command 1 for Load 1 and Command 2 for Load 2.

Here, two high current transistors are used for controlling the loads. To control Load 1 the base of the high current transistor is connected to P1.0 i.e. PIN 1 of the microcontroller. When Command 1 is received then the particular PIN 1 or P1.0 will become high and for this there will be a current flow across the connected coil. Due to the flow of current, the metallic moving conductor of relay which is at NC (Normally Close) position will come to the NO (Normally Open) position, hence making the external circuit closed for which Load 1 is turned ON. Similarly, when Command 2 is received then PIN 2 or P1.1 will become high and current will flow through the coil. Now the external circuit containing Load 2 is open and for that no current flows through it and Load 2 is turned OFF. So when the current flows through the coil, the metallic moving conductor of the relay comes to its NO position from NC position making the external circuit closed and hence, Load 2 is turned ON.

Advantages of this system:

1. It is a robust and easy to use system
2. There is no need for extra training of that person who is using it
3. This project can provide the facility of monitoring all the appliances within the communication range through bluetooth
4. By using this system the user can check the status of appliances at whatever time of the day
5. All the control will be in our hand by using this system

Disadvantages of this system:

1. Bluetooth used in this system which have a range of 10-20m so the control cannot be achieved from outside this range
2. Application is connected after disconnect of the bluetooth
3. When the new user want to connect then first download application software then the code and configuration must be done

IV. RESULTS AND DISCUSSION

The main aim of this system is to control an Electrical appliance by means of Bluetooth technology by giving a proper command through mobile. Here we are using 11 commands in order to control an Electrical Appliances.

Case (i) When the power supply is given to our circuit then the circuit is ready to work, but this is an initial case. In this case the LOAD 1 and LOAD 2 are in OFF state position.

Case (ii) When an input signal is given by means of Bluetooth the LOAD 1 is in ON position and LOAD 2 in OFF position.

Case (iii) Similarly the LOAD 1 and LOAD 2 both in ON position.

Case (iv) In this case the LOAD 1 in OFF position and LOAD 2 are in ON position.

Here the commands are also presented in detailed for their corresponding operation

Table 5.1 Operating Commands

Commands	Results
1	Load 1 ON
A	Load 1 OFF
2	Load 2 ON
B	Load

V.CONCLUSION

This AC power control system has numerous applications in the domestic as well as industrial areas. In conclusion, this low cost system is to design to improve the standard living in home. The remote control function by smart phone provides help and assistance especially to disabled and elderly. Furthermore modern day wireless technologies like IOT and Bluetooth etc means remote control from a faraway distance is easily possible. This increases its scope and helps in better resolving of safety issues. The developed system eliminates the stress of human manual switching and to introduce flexibility of control without direct contact to switches even such that could be easily done via an android phone application at any comfortable point at domestic premises within the wireless coverage distance. The system makes switching boundless within the Bluetooth 7m coverage. Thus this paper has achieved its target using the architecture of a Bluetooth based switching automation of domestic electrical powered appliances through application software on android phone platform. With this, user can switch appliances 'ON' and 'OFF' on his/her bed or any comfortable spot through hand android phone. Nevertheless, the user usage distant is limited to the Bluetooth coverage length of about 7 meters. Future research may be geared towards developing a household switching device that can beyond 7m coverage however without charges. Two layers circuit board can be designed and used in place of single layer circuit board for easier soldering work and neatness to commercialize the product 2 OFF

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