Acknowledgement

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Abstract

Home automation is not new, throughout history it is continuously strived to automate tasks in the home in order to make our lives easier. The main theme of this project is to design a system that would take voice input to switch appliances. The overall system is controlled from an android application that takes voice input. Bluetooth module serves as a wireless medium for communication between microcontroller and android device. Using Bluetooth wireless technology and microcontroller's intelligence home appliances can be operated. Moreover, voice command as input for switching devices in this project imparts conveniences of usage for differently abled and elderly peoples. Application areas of the project can be the home, office for the elderly and differently abled peoples.

Keywords: -

Home automation, Bluetooth, wireless, voice command

Table of Contents

List of Figures

Abbreviations

AVR	: Advanced Virtual Risc architecture
EDR	: Enhanced Data Rate
IEEE	: Institute of Electrical and Electronics Engineer
ISM	: Industrial Scientific and Medical
LCD	: Liquid Crystal Display
LED	: Light Emitting Diode
MCU	: Multipoint Control Unit
MIPS	: Micro Instructions Per Second
PCB	: Printed Circuit Board
RF	: Radio Frequency
SPDT	: Single Pole Double Throw
SPP	: Serial Port Protocol
WHAS	: Wireless Home Automation System

1. Introduction

This project is not just among the technologically savvy crowd and remodeling enthusiasts, but also among increasing numbers of mainstream homeowners. The modern electrical automation has made the life more sophisticated, easier and economical.

This system is to facilitate elderly and disabled people with an easy-to-use home automation system that can be fully operated based on speech commands. The system is portable and constructed in a way that is easy to install, configure, run, and maintain. The project demonstrates a system that can be integrated as a single portable unit and allows one to wirelessly control lights, fans, air conditioners, television sets, security cameras, electronic doors, computer systems, audio/visual equipment's etc. and turn on or off any appliance that is plugged into a wall outlet, get the status of different appliances and take decision accordingly.

1.1.Background

Automation is becoming a need of the present high-tech scenario. Home automation is one of the fields applicable in daily life. Technology has advanced so much in the last decade or two that it has made life more efficient and comfortable. The comfort of being able to take control of devices automatically has become imperative as it saves a lot of time and effort. Therefore, there arises a need to do so in systematic manners which have been tried to implement in this system. The system is an extended approach to automate a control system. With the adoption of system, can gain control over certain things that require constant attention and automate homes.

1.2.Problem Statement

Home automation systems presently existing target those seeking luxury and sophisticated platforms. Only few have approached to those automated system that can help peoples with special needs like the elderly and the disabled. Older people are incapable to control home appliances by moving all over their house especially if double story house.

Another problem that leads to develop such a project of smart home system is because of humans' bad attitude itself to turn OFF/ON home appliances are common problem

among us. Percentage of wastage of high electricity is increasing year by year. A better smart home system is able to overcome such a serious problem. This kind of problem can be solved by developing a system which can control home appliances by a command of voice because it is feasible. Controlling the switching of various appliances like bulb, electric fan, motors, etc. only after perfect match of the security protocol can be another issue. So, to overcome these sorts of problems it is decided to design a microcontroller based embedded system using voice reorganization via Bluetooth module.

1.3.Objectives

The objectives of the projects are divided into the main and specific objective and shown below as:

1.3.1.Main objective

The main objective of this is to design and implement wireless switching system using voice command.

1.3.2.Specific objectives

The specific objectives of this project are:

i. To implement voice recognition feature via android application.
ii. To design, simulate and implement the wireless transmitter and receiver section.
iii. To test the prototype module that control two bulbs, fan and a door.
iv. To display the status of switching.

1.4.Scopes and Applications

These are the fields where this project can be used as listed below:

- It can be extensively useful for differently abled and elderly peoples.
- It could be implemented in working areas like house, office, schools, restaurants etc.
- It can be adopted and enhanced for making smart homes.
- The applications for this project are in military, navigation, automobiles, aircrafts, fleet management, remote monitoring, remote control, security systems, teleservices etc.

2. Literature Review

2.1.Historical background

Smart home automation began in early 2000s.Since then it is a viable technology for consumers. Various technologies are used for wireless switching like Bluetooth, WI-Fi, Xbee, and GSM etc. according to the need. [1]

In 2008 designed a general-purpose controlling module designed with the capability of controlling and sensing up to five devices simultaneously. The communication between the controlling module and the remote server is done using Bluetooth technology. The server can communicate with many such modules simultaneously. The controller is based on ATMega64 microcontroller and Bluetooth module which provides a serial interface for data communication. The designed controller was deployed in a home automation application for a selected set of electrical appliances. [2].In 2003 proposed a home appliance control system over Bluetooth with a cellular phone, which enables remote-control, fault-diagnosis and software-update for home appliances through Java applications on a cellular phone. The system consists of home appliances, a cellular phone and Bluetooth communication adapters for the appliances. The communication adapter hardware consists of a 20MHz 16bit CPU, SRAM and a Bluetooth module. The communication adapter board is connected to the home appliance and to the cellular phone through serial ports. The appliances can communicate with the cellular phone control terminal via Bluetooth. [3]

2.2.Review of related literatures

Various existing system use cases of wireless home automation and various architectures or technologies related to home automation which includes Bluetooth protocols, Xbee modules and voice recognition chip. Shih-Pang Tseng et al. proposed Smart House Monitor & Manager (SHMM), based on the Zigbee, all sensors and actuators are connected by a Zigbee wireless network. They designed a simple smart socket, which can remote control via Zigbee. Also, pc host is used as a data collector and the motion sensing, all sensing data are transferred to the VM in the cloud. The user can use the PC or Android phone to monitor or control through the Internet to power-saving of the house. In 2014, Nikhil Singh, Shambhu Shankar Bharti, Rupal Singh,

Dushyant Kumar Singh, developed Remotely Controlled Home Automation System. They made server and android based Home automation system. [4]

2.3.Review of existing systems

Many journals, research papers, projects, book related to wireless home automation and voice recognition has been reviewed, analyzed to draw some new prospective and concept for development of the project. There is a need to design a user-friendly system which will be utilizing the latest technologies for home automation. The home automation can be implemented using latest wireless technologies like low power, low cost Bluetooth modules using voice commands. The voice commands are used to control all the electric appliances in household or office environment. [5] Fault identification system was designed to help the user to ensure that their home appliances had gone exactly ON or OFF or undergone FAULT by getting the status from load end, unlike the other design that gets the status at user end which may give a false indication, when power supply is not available for the particular load or when load get open circuited (due to wire discontinuity or open fuse condition) . [6]Moreover, existing system rarely address the disabled peoples.

3. Methodology

3.1.Flow diagram of methodology adopted

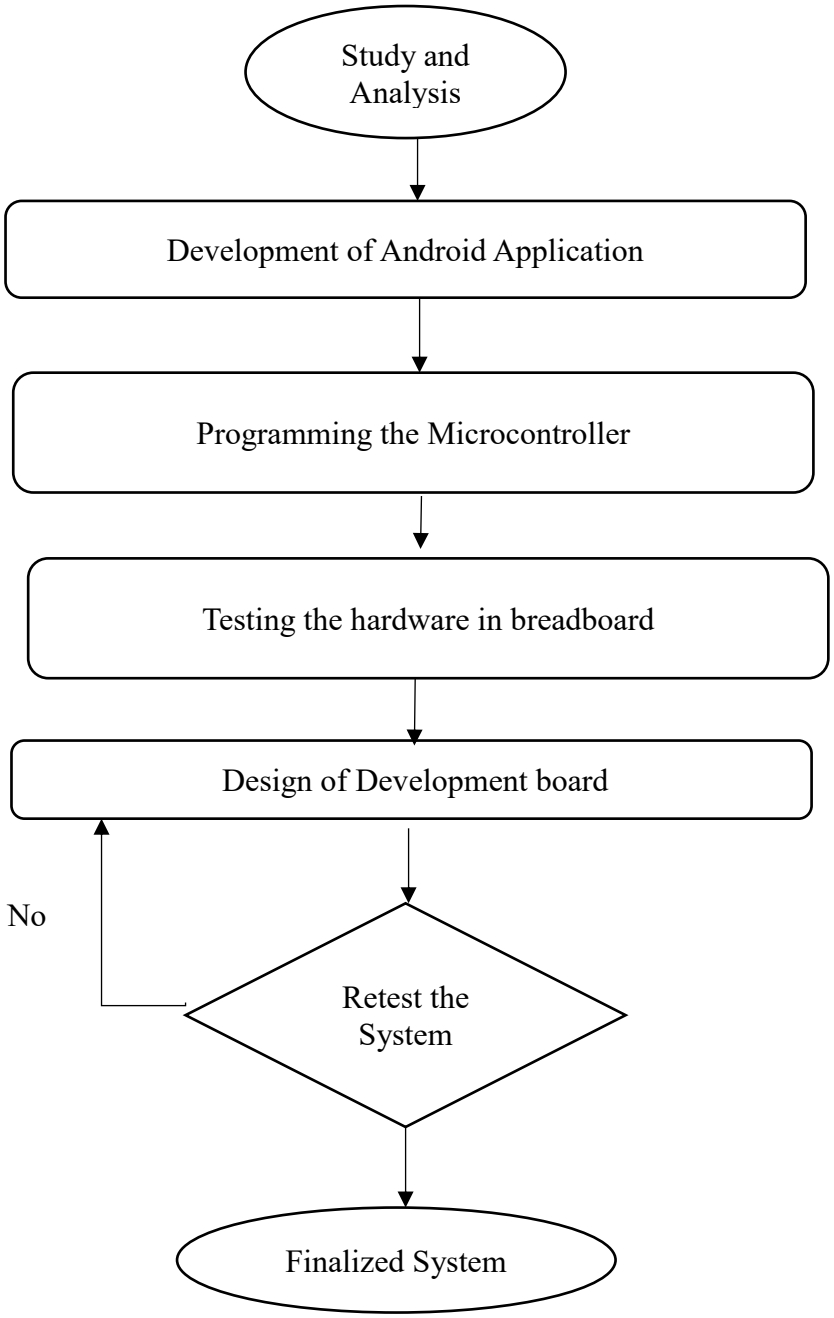

Fig 3.1: Flow diagram of methodology adopted

At first, analyzing of the project in detail and then taking factors such as economical, technical feasibility, finalization of the project is done. And the requirement for the project is analyzed properly, moving further to the design portion. For this, proteus is used for simulation. Simulation will lead in the development of the project. If the

simulation goes correct, breadboard will be accordingly used. After the completion of development in the breadboard, testing and verification are the next steps. If the development testing goes right, we shall use PCB to finalize our development board. Then, the development board will again be tested. And it will be forwarded to respective teacher for verification purpose. After verification, documentation will be done that will include details of the projects. The process of this project is clearly shown in block diagram and flowchart which provides the overall view of working principle.

3.2.Block diagram of the system

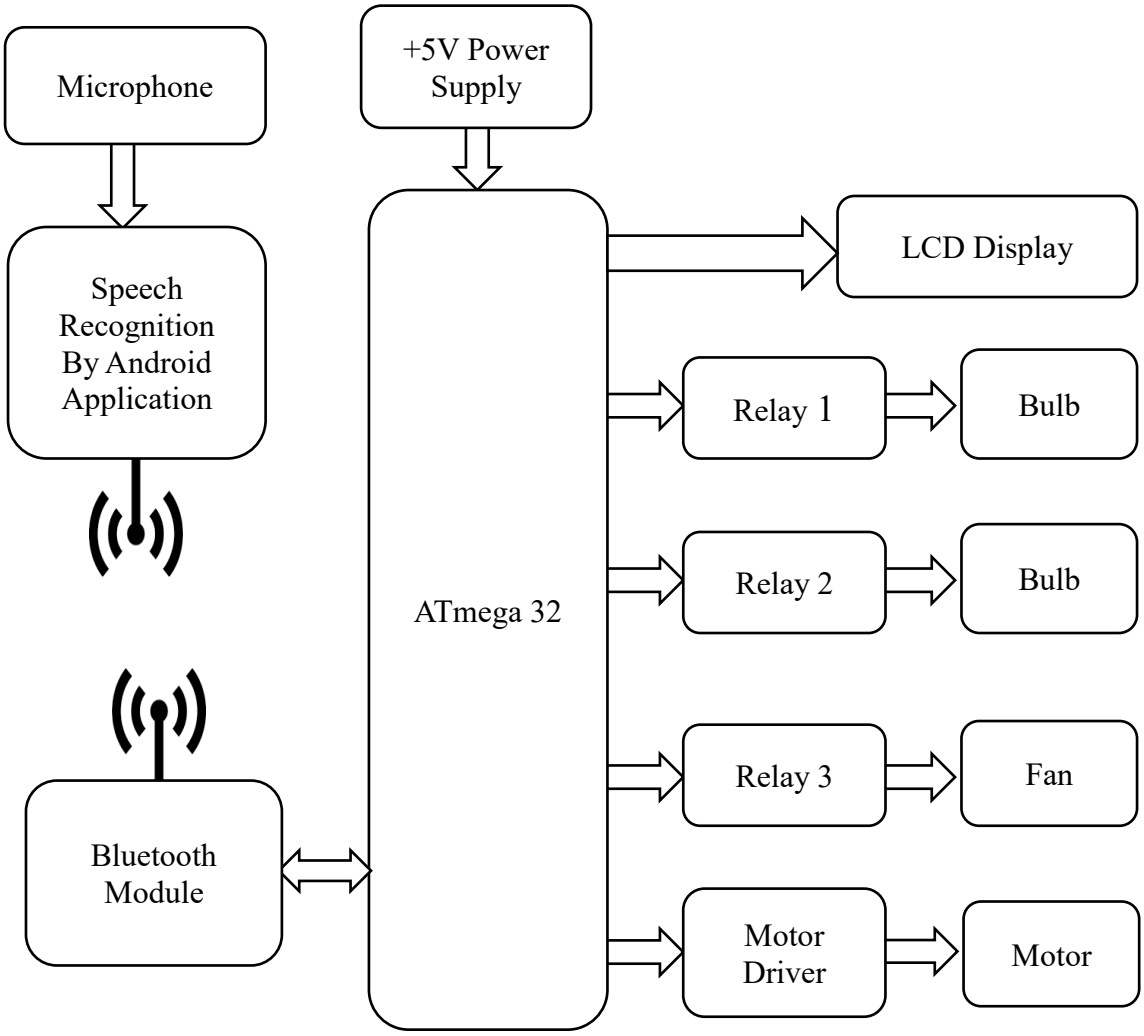

Fig 3.2: Block diagram of the system

The approach for designing this system is to implement a microcontroller-based control module that receives particular instruction. The microcontroller then will carry out the issued commands and alert the user with the help of buzzer and LCD display. The

automation centers on giving voice commands and uses low-power Bluetooth wireless communication modules to switch the electrical appliances like bulb, fan, motors etc.

Firstly, proper research and study over the project is done. After that hardware and software requirement analysis has been completed for accomplishing the project. Design of the circuit including development board and power supply part is done after that. Circuitry itching in PCB has been also completed.

After proper design of the required circuitry, AVR programming has been used to employ the microcontroller to control the operation of various home appliances. Using Google's API for speech recognition, android application to take voice commands as input has been made. Moreover this application is transmitter whereas Bluetooth module acts as slave.

After design and simulation, proper testing and debugging of hardware and program leads to a working prototype of this project. Tasks like Development board itching in PCB, component placement, android mobile and Bluetooth module interfacing with microcontroller should be done. Making Bluetooth module to work as slave only by selecting the particular baud rate and interfacing LCD module and relays with Atmega32 is also accomplished.

At last, final system model along with completed code and working model of project has been completed.

3.3.Flow chart of the system

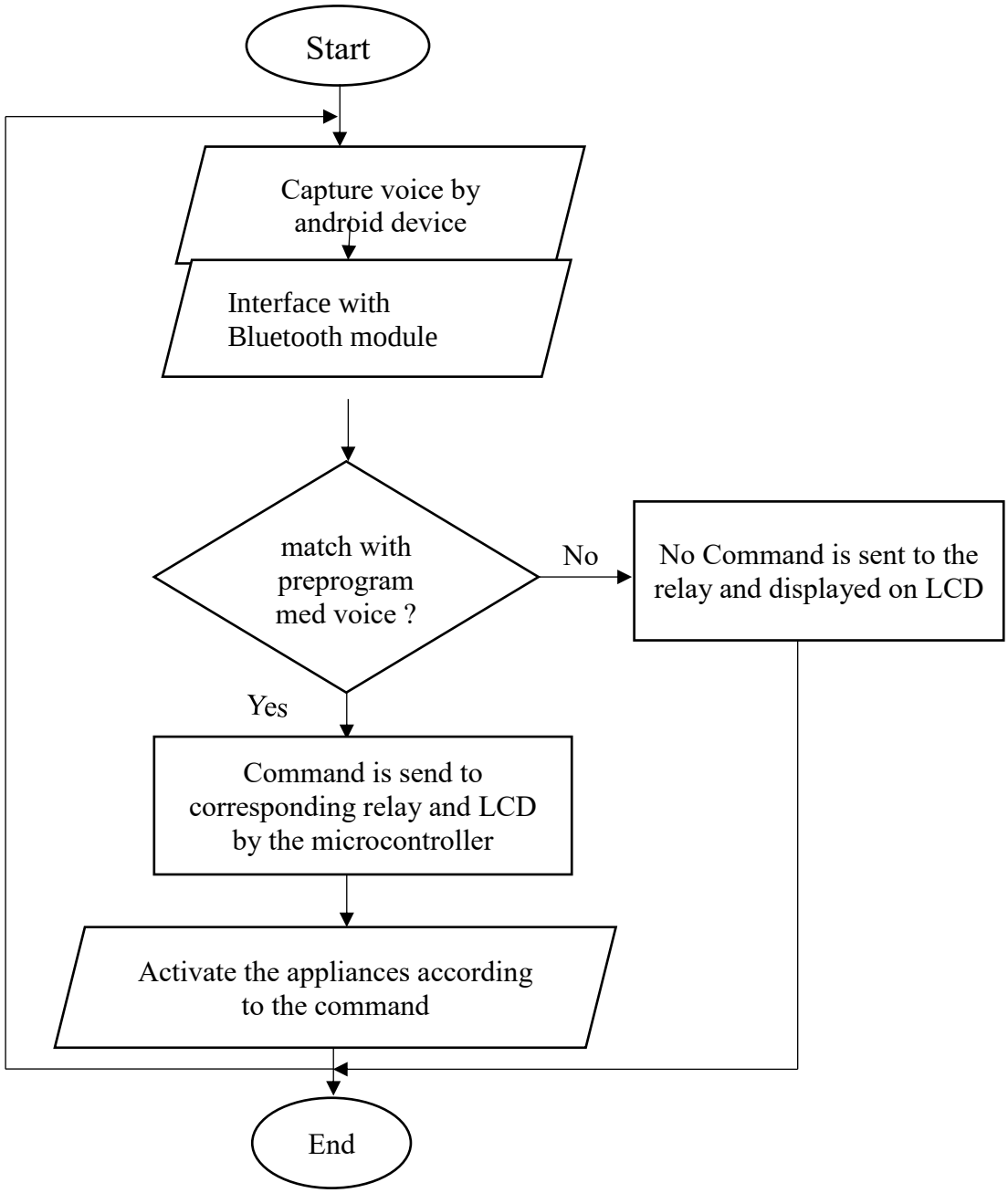

Fig 3.3: Flow chart of the system

Firstly, human voice is recognized by the android application which communicates with the microcontroller wirelessly using Bluetooth module. Using serial communication microcontroller can receive and send data. After that the input voice command is checked whether it matches with preprogrammed instruction or not. If no match is found then, no any appliances change their state and accordingly the LCD alerts the

users. Secondly, if match is found then, microcontroller uses its intelligence to switch the electrical appliances.

Using this system, user will be able to send voice commands to request to home automation setup. The request will be received by voice recognition unit and via Bluetooth communication, microcontroller will process these commands. And only if the input commands matched with the preprogrammed commands, the relay circuit on the device node will change the status of the device accordingly. The changed status will be sent back via the LCD display. According to the input instructions, microcontroller will decide which particular device needs to be switched.

4. Hardware and Software Requirement

4.1. Hardware Requirement

Following are the hardware components required for this project:

- Microcontroller(ATMega32)
- Microcontroller burner
- Components for AVR development board
- LCD display
- DC motor
- DC motor driver
- SPDT Relay Switches
- HC-05 module
- Transformer

4.2.Software Requirement

Following are the main software requirements:

- Atmel Studio
- Proteus
- Bluetooth Terminal

4.3.Hardware Description

Fig 3.4.1: HC-05 Bluetooth Module

HC-05 module is an easy to use Bluetooth SPP module, designed for transparent wireless serial connection setup.

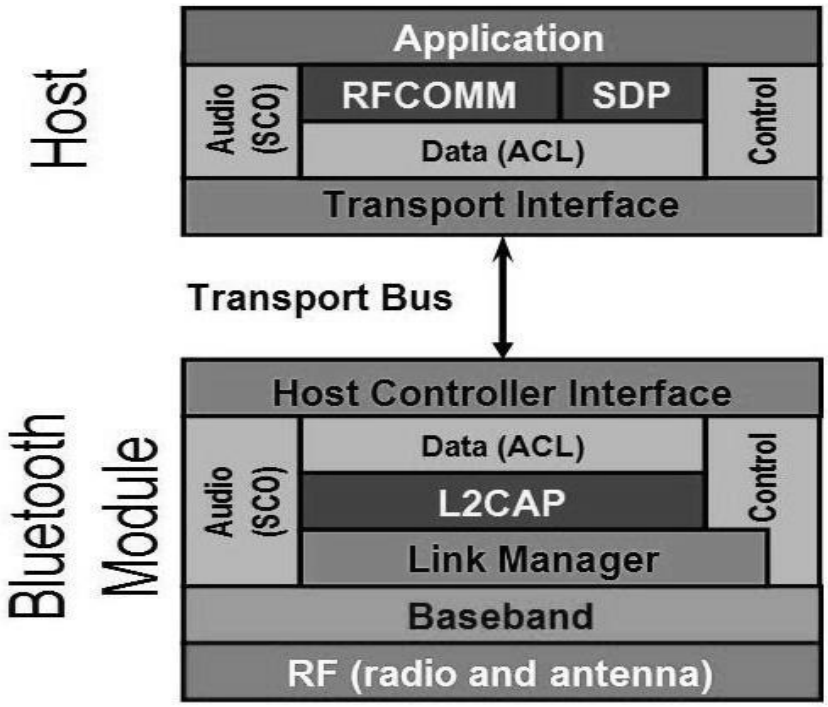

Fig 3.4.1: Bluetooth Data transfer Protocol

Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with Adaptive Frequency Hopping Feature.

Fig 3.4.2: SPDT Relay switch

This is a high quality single pole, double throw (SPDT) sealed relay from Omron. It is to switch high voltage, and/or high current devices. The coil voltage on this relay is rated at 12VDC, and the load current is rated up to 10A.

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. It is a 16-pin IC which can control a set of two DC motors simultaneously in any direction.

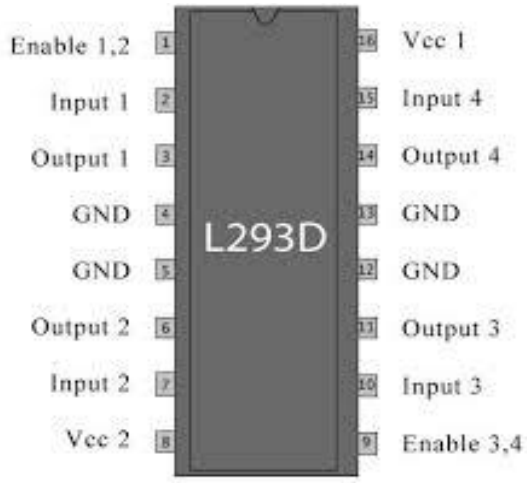

Fig 3.4.3: Pin Diagram of L293D

The Atmel AVR ATmega32 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing the powerful instruction in a single clock cycle, the ATmega32 achieves throughputs approaching 1 MIPS per MHz allowing this system designed to optimize power consumption versus processing speed.

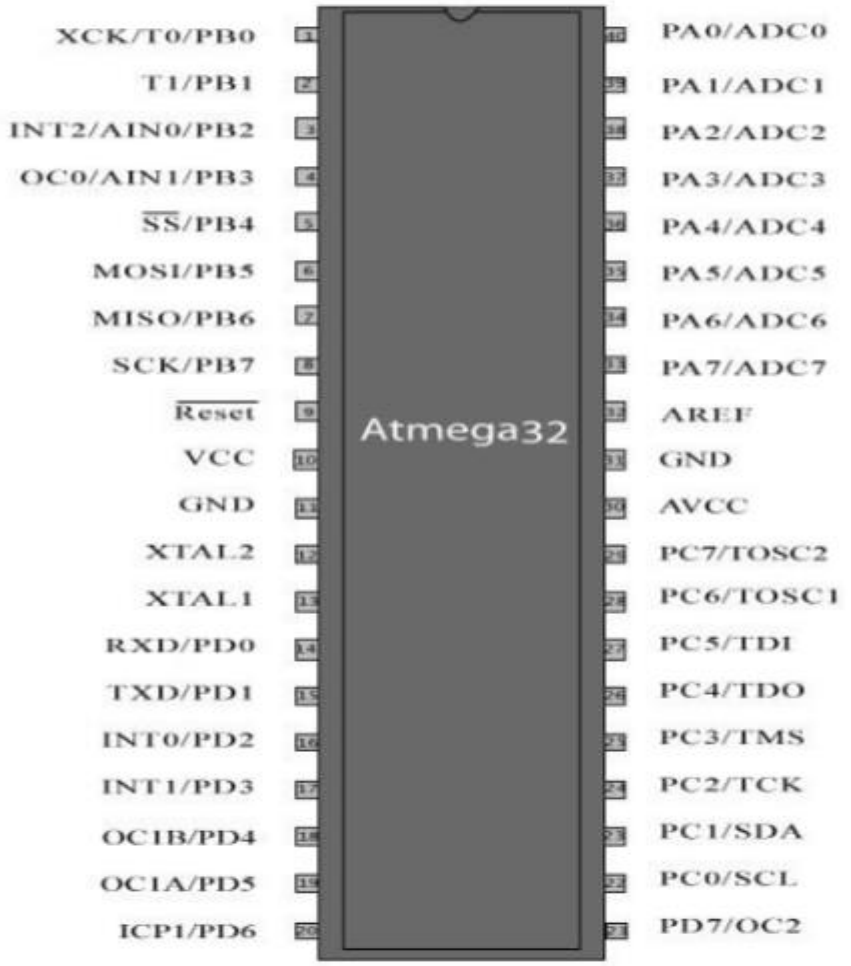

Fig 3.4.4: Pin Diagram of ATmega32

The ATmega32 provides the following features: 32Kbytes of In-System Programmable Flash Program memory with Read-While-Write capabilities, 1024 bytes EEPROM, 2Kbyte SRAM, 32 general purpose I/O lines , 32 general purposed working registers, a JTAG interface for Boundary scan, ON-chip Debugging support and programming, three flexible Timer/Counter with compare modes, Internal and External Interrupt, a serial programmable USART, a byte oriented Two-Wire Serial Interface, an 8-channel, 10-bit ADC with optional differential input stage with programmable gain (TQFP package only), a programmable Watchdog Timer with internal Oscillator, an SPI serial port, and six software selectable power saving modes. The Idle mode stops the CPU while allowing USART, Two-Wire Interface, A/D Converter, and SRAM.

5. Results and Discussion

5.1. Implementation of voice recognition

Using API of voice recognition, android application is customized. It is made to pair up with Bluetooth module with password protection. Voice recognition is speaker and environment dependent as found from experiments. The android application used for voice input is shown below:

Fig 5.2.2: Android application

5.2.Data transmission and reception

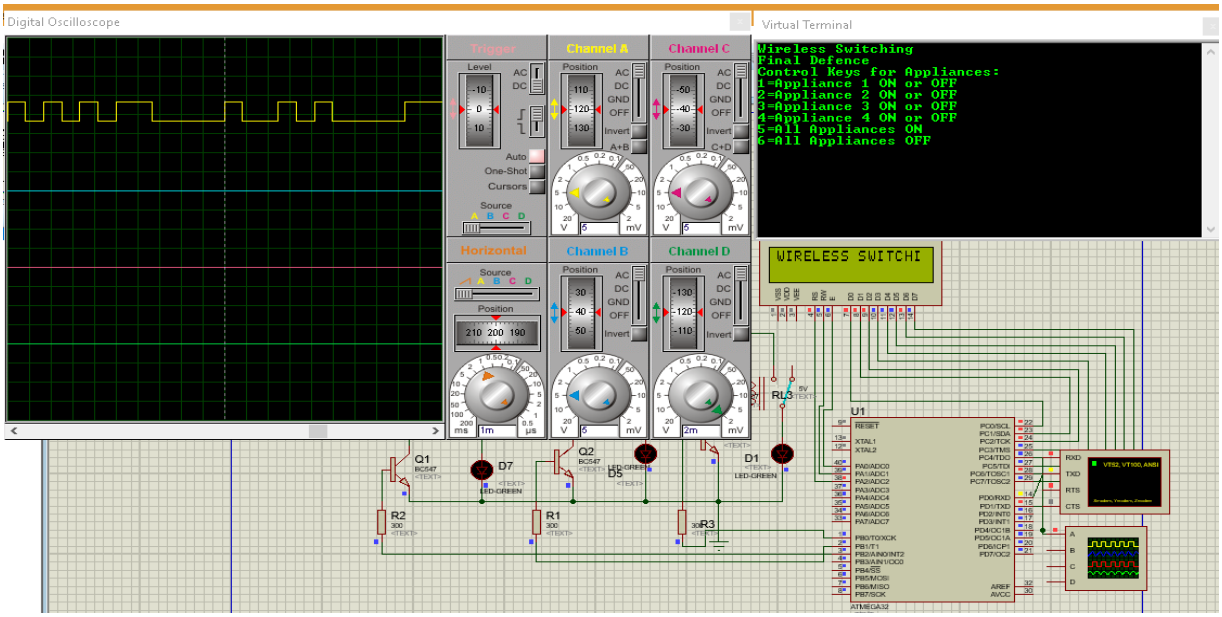

Fig 5.2.2: Waveform of Data transmission in oscilloscope

This is the waveform of data transmission achieved from oscilloscope using virtual terminal as Bluetooth module. Square wave was generated.

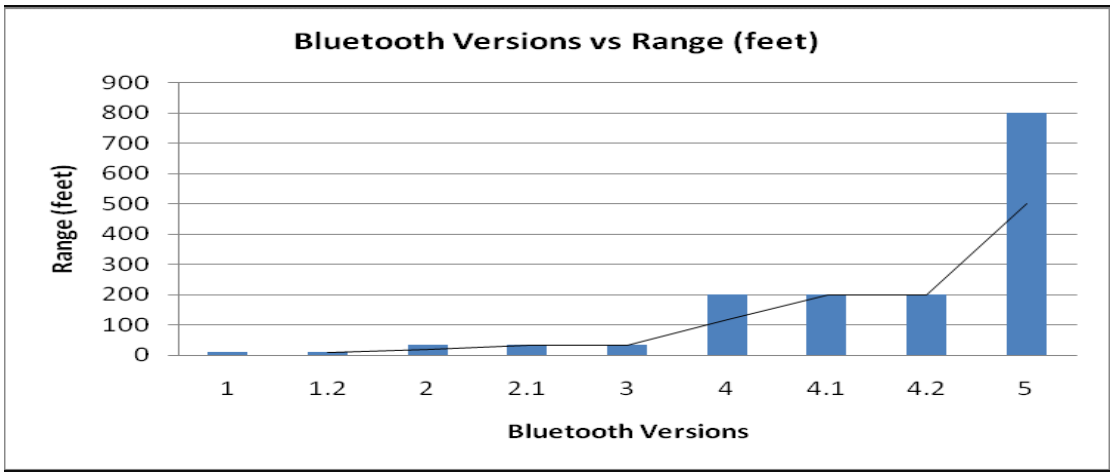

Fig 5.2: Bluetooth Version vs. Range

Bluetooth module operates in two modes i.e. master and slave. Here slave mode is used where the Bluetooth module cannot initiate a connection; it can however accept incoming connections. After the connection is established the Bluetooth module can transmit and receive data regardless of the mode it is running in. The version of Bluetooth module also affected the range of the wireless communication. As the graph shows latest version supports the range of 800 feet.

5.3. Simulation and displaying

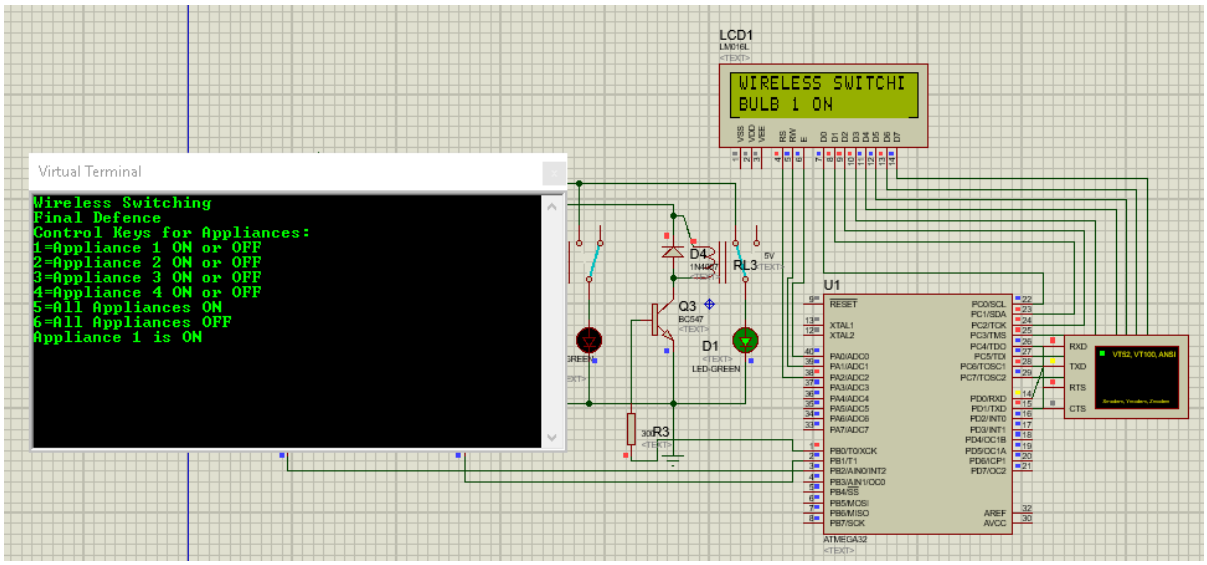

Fig 5.1.3: Simulation of the system

The simulation of the system in proteus along with device's status on LCD is as shown above. Simulation showed the output of our system in virtual manner i.e. input is given via virtual terminal and respective output can be achieved in LCD. Here, characters were passed instead of voice in the simulation process.

Moreover, simultaneously status of the system can be depicted with LCD module as shown below:

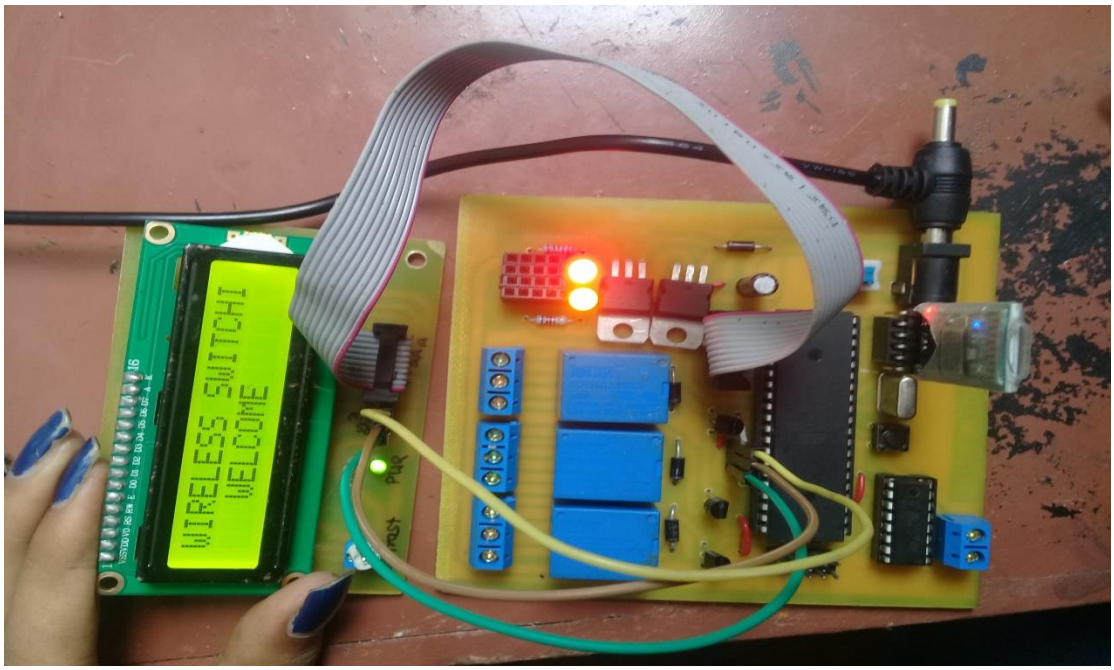

Fig 5.1.3: Displaying status of the system

5.4.Design of System prototype and Implementation

Fig 5.1.1: Prototype Design of the system

The objective of this project to design and implement wireless switching system using voice instruction especially targeted to differently abled and elderly is achieved. This is the working prototype of the project that can switch two bulbs, fan and door too.

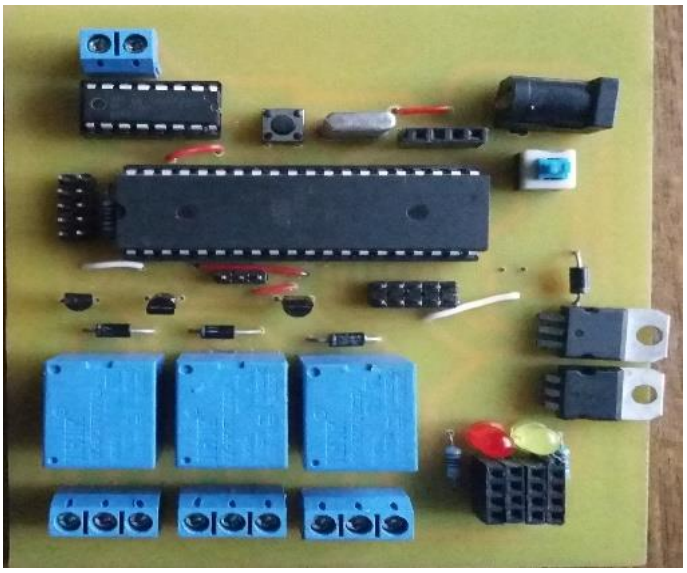

Fig 5.1.1: Final control system

Above figure depicts the control system that is implemented in the system. The project is solely controlled by this system

5.5.Discussion

During the development of a system for real time, different methodologies were studied and best feasible method was chosen. The system used android application for voice input and Bluetooth for wireless communication. By customization of available android application and using Google's API of voice recognition, the application is designed. Data transmission and reception via Bluetooth protocol followed the string format. Also, waveform of data transmission and reception could not be visualized due to lack of oscilloscope that supports frequency range of 2.4 GHz. Moreover, both simulation and practical testing of the system responded in the similar manner.

While merging and final logical coding, there arised different conflicts like baudrate mismatch.The tested and debugged code in the final system design was implemented and working prototype was developoed.

6. Conclusion

The aim of this project was to describe an interdisciplinary, undergraduate engineering design project: microcontroller based wireless switching system using voice commands. A particular design of such system has been described, various design issues regarding the same has been discussed.

As per the objectives of the project, the design and implementation of wireless switching system using voice command is completed successfully. Beside this, implementation of voice recognition feature via android application is also achieved. Moreover, the design, simulation and implementation of wireless transmitter and receiver section is also accomplished. Thus, giving rise to the working prototype of the system along with status showing feature.

Along with these technical aspects we also learned a lot about how to work efficiently as a team. Teamwork was key in completing a project of such scale within the given constraints of time and budget. This taught about task allocation and efficient time management. Knowledge of efficient troubleshooting techniques by conducting periodic group discussions is learned. Hence, many problems and challenges were encountered throughout the project phase and most of them solved through the group discussions.

7. Limitation and Future Enhancement

7.1.Limitations

- Low range of Bluetooth module
- Environmental noise affects the response of the system

7.2.Future Enhancements

- It can be upgraded by GSM module
- It can be enhanced by using various sensors like light sensor, gas sensors, water level sensor so that users should not manually check the system.
- Making a design easier to handle, such that many high load devices can be controlled at once.

8. References

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Appendices

Appendix A1 (Design)

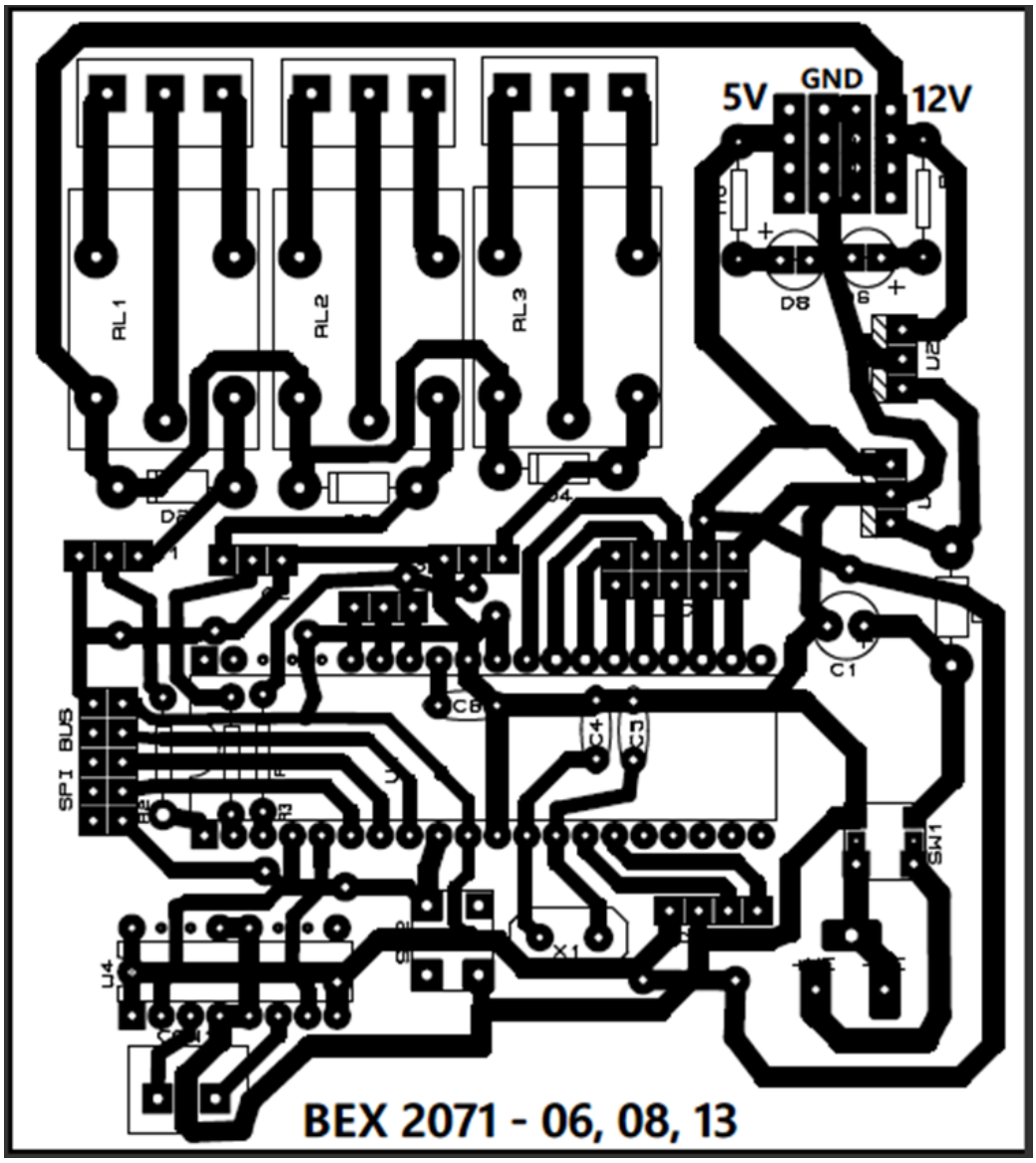

Fig A1.1: PCB layout of the system

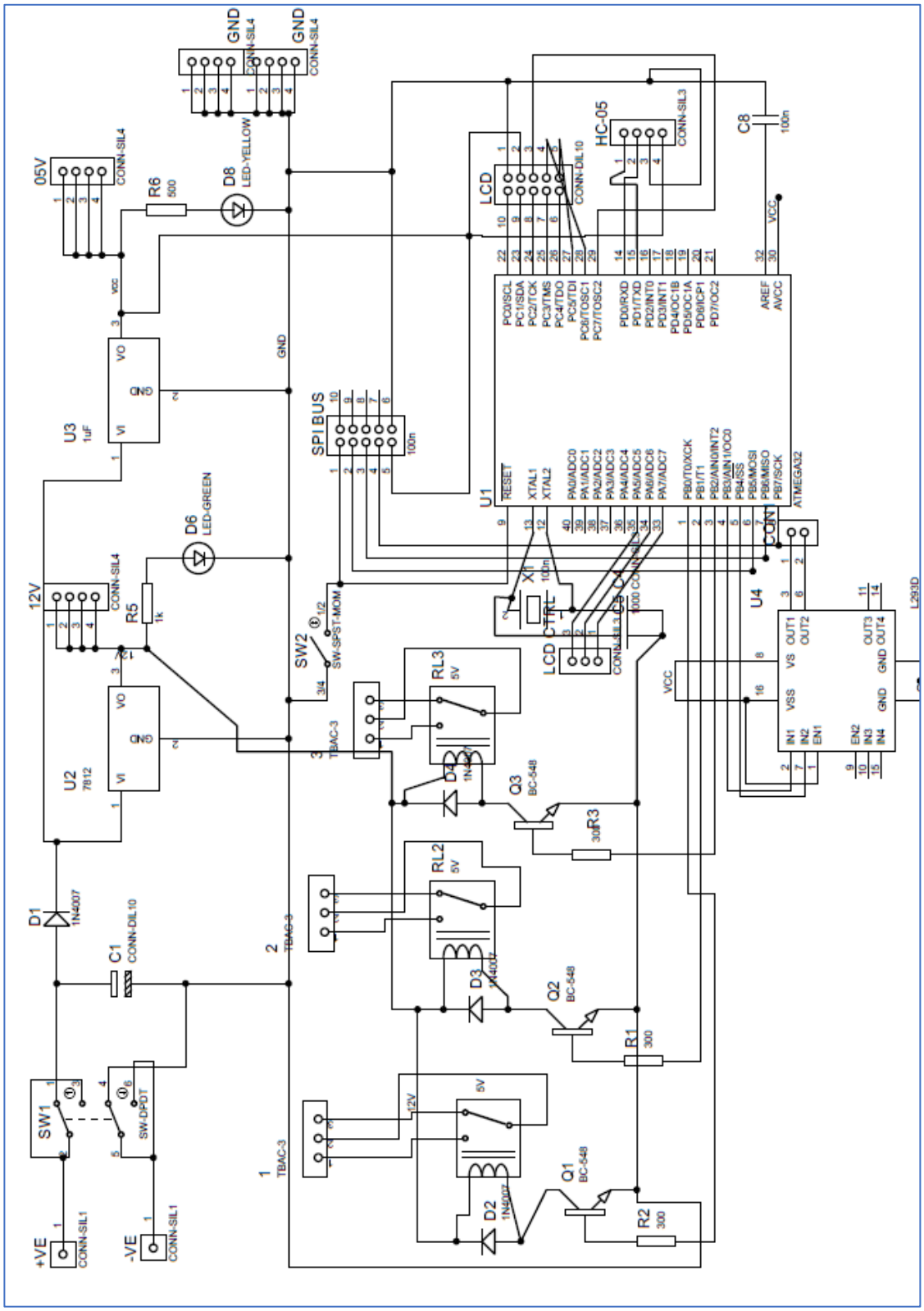

Fig A1.2: Schematic layout of the system

Appendix A2 (Snapshots)

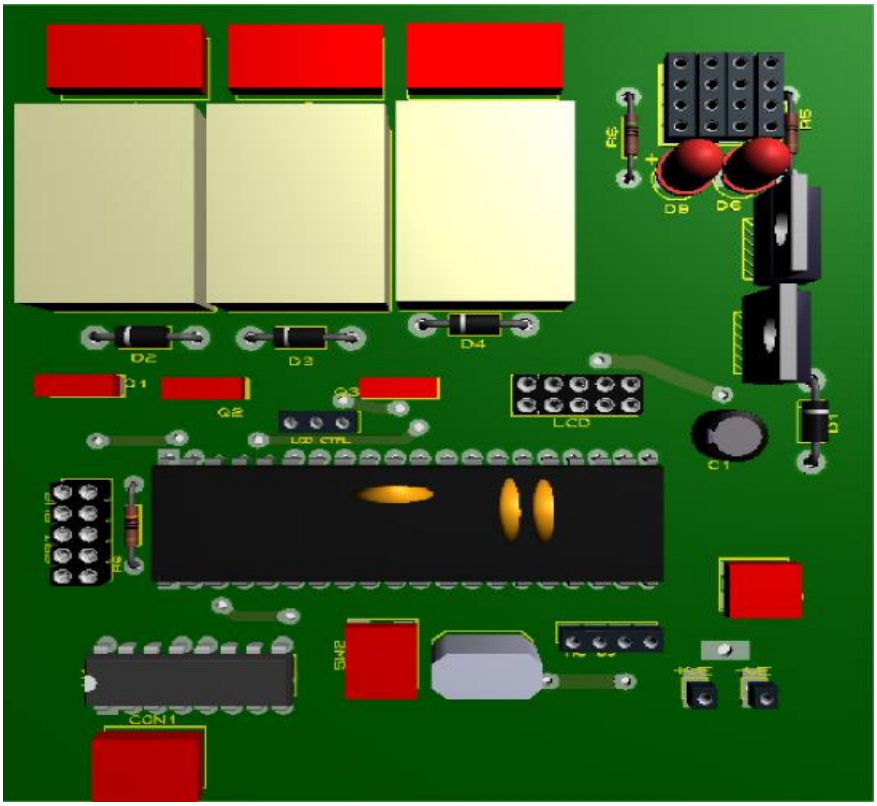

Fig A2.1: 3D View of the System

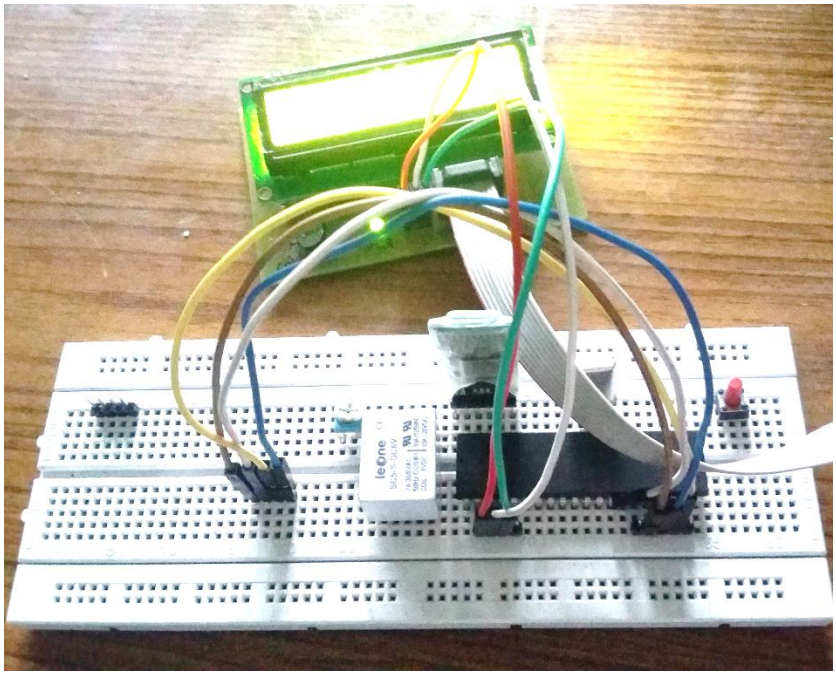

Fig A2.2: Testing of circuit in breadboard

Fig A2.4: Drilling

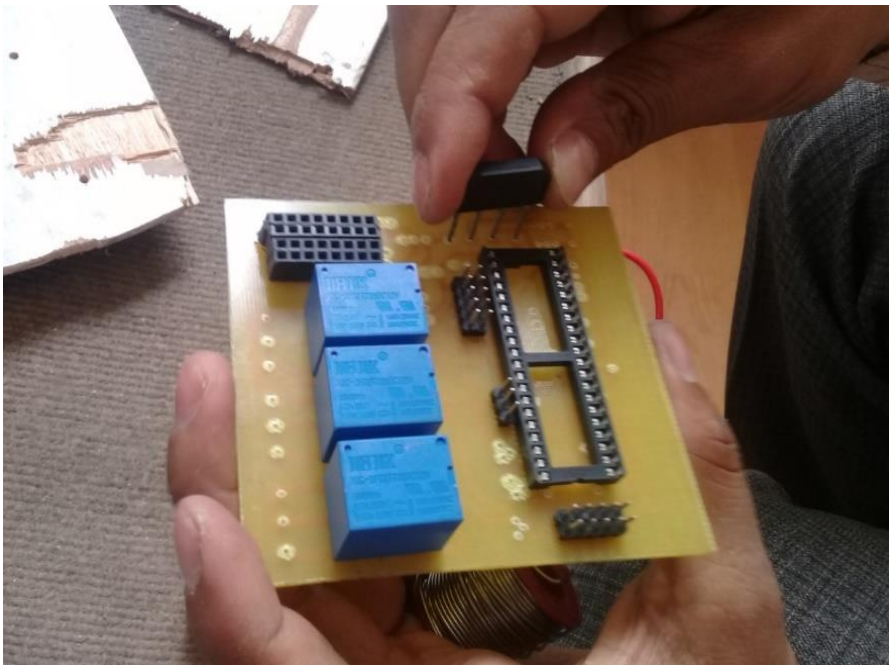

Fig A2.5: PCB Components Placement

Fig A2.6: Soldering

Fig A2.6: Project members with hardware