1600 hops/s. The maximum number of devices that can share a piconet (having one master with all the others behaving as slaves) is 8. More than one piconet can exist in an area, thus forming a "scatternet". Multiple, independent and non-synchronized piconets are collectively given the name "scatternet". Each piconet is identified by a different frequency hopping sequence. The users using the same piconet are synchronized to this hopping sequence. When a new device is sensed by the piconet, that device must respond to the interrogation to get access level security. Hardware encryption is also offered. Generally the range of Bluetooth is 10 meters however distances of up to 100 meters can be achieved with an optional amplifier to boost up the power level. The power consumed is low, 0.3 mA in standby which can increase and reach just 30 mA during the transfer of data. The level of power consumed can be adjusted to keep the interferences to the minimum. The first generation of Bluetooth offered a gross data rate of up to 1 Mbps. This 1 Mbps bandwidth is divided into three 64 Kbps channels for voice and the rest of the bandwidth is for supporting packet data. One to one connections allow a maximum data rate of 721 Kbps [6].

Fig.2 illustrates the overall control function of the system. The system is directly installed along with the conventional electrical switches on the wall. The Bluetooth wireless connection enables the system to communicate with the GUI i.e. Graphical User Interface on PC/laptop or smart phone and does not require the use of cables at all. Remote controlling of the target home appliances is performed by the Main Control Board. This system provides three different types of physical control methods to the Main Control Board, thus improving the standard of living in homes. These methods are as follows:

- One physical control method is by pressing on the modified Low Voltage Activating Switches. The conventional high voltage switches are replaced by the modified 5 Volt push buttons as the activating switches. The risk of dangerous electrical shock to wet hands is done away with the use of these low voltage switches.
- In the second and third control methods, the appliances are controlled by using wireless remote control. The second control method is by clicking on Window GUI on PC/laptop by means of mouse or touch pad.

This method is advantageous as compared to the use of conventional switches and the wired system because the computer user can control the home appliances without having to go to the switches on the wall himself. Third control method is done by Android GUI installed in Smart Phone. The user touches the screen of the phone to control home appliances. This portable method is able to assist the disabled people who have difficulty in motion and the elderly.

The sensors that connect to the main control board measure room temperature and it's humidity level. The sensor indication is able to remind the user to switch on/off the heater, fan or air conditioner in the house. The home appliance switch status and temperature or humidity reading are synchronized to the two GUIs on the personal computer or laptop or smart phone. The main control board real-time monitors the switch's status and sensor reading. Any change in the reading will be transferred to the two GUIs. After the smart phone, Bluetooth connection is connected to PC or laptop. The Window GUI will act as a server to forward or transmit any data from/to the smart phone and main control board. Some connection parts of the system are designed with two connections (Primary and Secondary) to the system. In case any issue occurs on personal computer or laptop, smart phone can directly connect to the main board. While in case of Bluetooth connection, the issue occurs between personal computer and laptop and control board, personal computer or laptop can connect to the board by wired USB i.e. Universal Serial Bus connection. The secondary connection acts as the backup solution in the system.

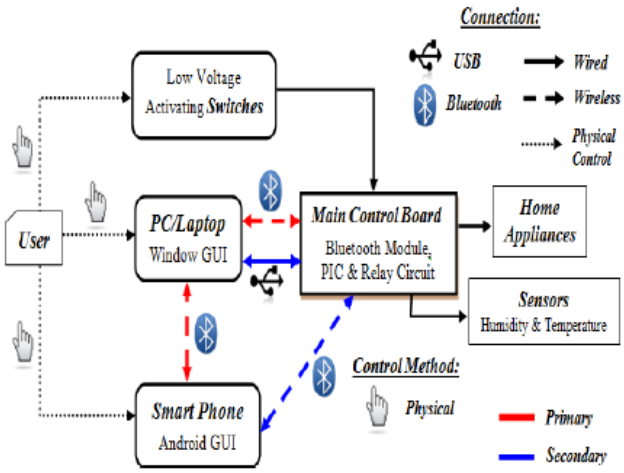


**Figure 2:** Control function of Bluetooth based Home Automation System

## 3. Hardware Implementation

This section mainly discusses about the hardware construction of the main control board.

Fig.3 demonstrates the hardware block diagram in the main control board. Atmel Microcontroller, AT89C51 is preferred here due to its potential to perform the serial features to set up the Bluetooth and USB connection to the GUIs. HSM-20G Sensor Module is chosen as the sensor because it is a low cost 2-in-1 combination of humidity and temperature modules. For the Bluetooth module, low cost Cytron Bluebee Bluetooth module is used to establish the Bluetooth connection between main control board and the GUIs. The electrical current is directly connected to the main control board thus separating the regulator and relay circuit. The voltage regulator is made up of a common regulator circuit that consists of a regulator, a transformer and a rectifier. 5V and 3.3V DC output is regulated in order to realize the voltage requirements of the specific components in the main control board. Moreover, low voltage activating switches are used instead of the existing switches.

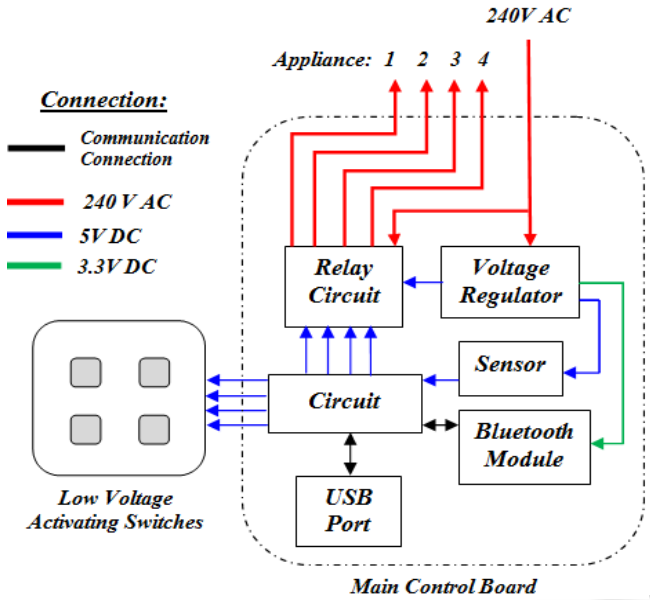


**Figure 3:** Block Diagram of the Main Control Board Hardware

The existing switch connection is connected and controlled by the relay circuit inside the main control board. Also multiple control boards can be installed in homes. Bluetooth master device in PC or laptop can connect a maximum of 7 devices in a Piconet. Although the Main Control Board becomes compact but can still perform the strong functions and has all the features of the conventional systems. Moreover, this system comes out to be simple and has much cheaper components.

The circuit for Home Automation System is shown in Fig.3. The home components we tried to control are:

- Two Bulbs
- One Fan

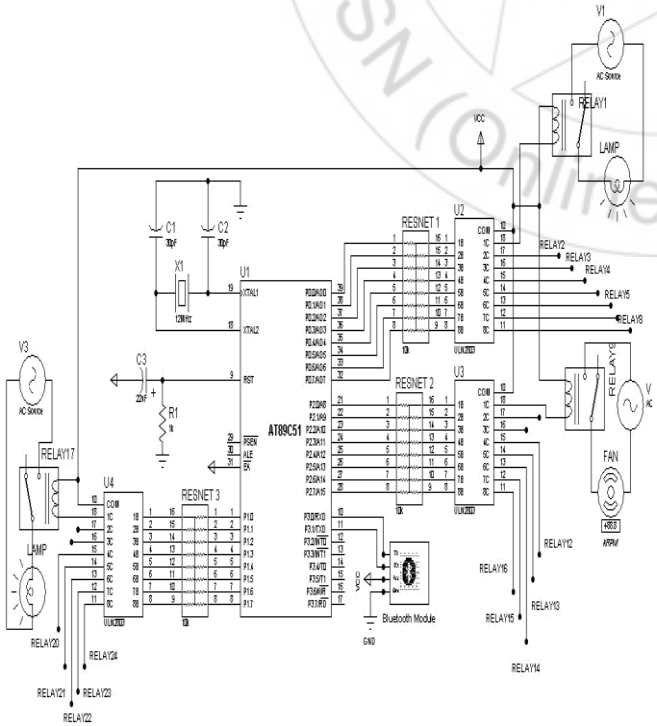


**Figure 3:** Home Automation Circuit

Home Automation Circuit comprises of the microcontroller AT89C51, Serial Bluetooth Module, octal peripheral driver array ULN2803, regulator IC 7812, IC7805 and a few discrete components. Here in this circuit, microcontroller AT89C51 works as the main programmable switching unit which receives data from Bluetooth serial module and transfers appropriate program data to ULN2803 for operating relay ON or OFF. The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash Programmable and Erasable Read Only Memory (PEROM). The Atmel AT89C51 is a powerful micro computer which provides a highly-flexible and cost-effective solution to many embedded control applications. The AT89C51 provides the following standard features: 4K bytes of Flash, 128 bytes of RAM, 32 I/O lines, two 16-bit timer/counters, five vector two-level interrupt architecture, a full duplex serial port, an on-chip oscillator and clock circuitry. [7]

## 4. Conclusion and Future Scope

The ease of installation is taken into account by this system. The system is designed to directly install along with the electrical switches on the wall. Complex wiring, reinstallation and overhead wiring on the wall can be done away with the use of this system. The existing switch connection is connected and controlled by the relay circuit inside the main control board.

The purpose of the system is to use mobile phone's inbuilt Bluetooth facility for automation.

Furthermore, multiple control boards can be installed in homes. Bluetooth master device in PC/laptop is mostly able to connect up to 7 devices in a "Pico net". With these simple and low cost components, the main control board can be constructed in pretty small size but can still perform the strong functions and features of the system. The HAS i.e. Home Automation System furnishes a good paradigm for any Automation System based on Bluetooth.

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## Author Profile

**Adiba Tabassum** received her B.Tech. degree in Electrical Engineering from Zakir Husain College of Engineering & Technology, Aligarh Muslim University in 2011. During 2012-2015, she taught in the University Polytechnic, Jamia Millia Islamia, New Delhi. Currently she is pursuing M.Tech. (Power System) from M.D.University, Faridabad, Haryana, India.