



Home Automation System using Bluetooth

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Abstract: - This paper presents a user-friendly, low-cost, Bluetooth-enabled smartphone, Arduino board, and water level sensor-based home automation system. In the proposed system, Bluetooth technology is used to command up to 18 items, such as household appliances, through a smartphone application. The proposed system is different from the majority of traditional home automation systems that are currently designed for specific purposes. The said system has more features than customary home automation systems, like a water level sensor that uses ultrasound. The system's software and hardware architecture are also presented in this paper. The said home automation system prototype was put into practice and tested on hardware, producing the precise outcomes anticipated.

Keywords: Home automation, Smart-phone, Arduino, Bluetooth, LCD Images;

I. Introduction

The use of information technologies and control systems in a home automation system reduces the need for human labour. The rapid advancement of technology has influenced people to do the majority of their work remotely using smart-phones, such as controlling home appliances. The lowest possible error rate, versatility, and diligence are all attributes of automated equipment. Researchers and manufacturers of home appliances are interested in the idea of a home automation system. Automation systems save time and energy while also reducing the need for human labor. [1]. Early home automation systems were employed in labor-saving machinery, but today their primary objective is to provide elderly and disabled people with the means to carry out daily tasks and remotely operate household appliances. A Bluetooth-based wireless home automation system is inexpensive and simple to incorporate in an existing house. According to a study, GSM and wireless technologies are slower than Bluetooth. Up to 3 Mbps of serial data transmission rates are possible with Bluetooth technology, over a distance of 10 to 50 meters, depending on the Bluetooth device being used. The suggested approach makes use of Bluetooth technology to develop and deploy a dependable, affordable, and approachable home automation system. The Arduino board, a Bluetooth module, sensors, and a smartphone app are the main components of the suggested approach [2]. A relay connects the Arduino board to the Bluetooth HC-05 module, The Arduino board is connected to household appliances via a relay. The Bluetooth module is linked to the Arduino board using the smart phone application, which is used for serial communication between the Bluetooth module and the smart phone. To show the user about the status of the operations or actions, an LCD display is also connected. The suggested model has the ability to send alerts via messages or ringing alarms, in addition to remotely controlling the appliances. Nowadays, the majority of traditional home automation systems are made by keeping the elderly, disabled, or a particular purpose in mind. The suggested method offers a general-purpose home automation system that is easy to install in an existing home and is suitable for the elderly as well as disabled person. A water level sensor that is simple, practical, and easy to use will be provided to customers so they can offer easy controls to the users [4].

II. Associated Work Done

A number of studies based on home automation systems have been looked at. The materials[2] provide complete functionality for communication between an Arduino board and a smartphone device. Remote control of home appliances using Bluetooth technology have been thoroughly studied. An Android mobile phone application is used to control an Arduino board that is connected to home appliances. Earlier, it was impracticable to run more than four home appliances as it was only designed to manage three to four appliances, but the presented model could easily control up to 18 different home appliances, as the technologies have improved in times and also latest technologies have been used [3].

III. Block Diagram and simulation model of the system

Fig.1 shows the block diagram of a home automation system that uses an Arduino UNO for processing, a Bluetooth module for input signal and a relay module for switching home appliances. The supply voltage is lowered to 5 volts using the buck converter. The signal 5-volts and supply voltage are each represented by different coloured lines viz. black, green, and red as shown in the figure 1. The Arduino UNO development board digital pins, TX, and RX pins are used to link the Bluetooth module to it. It is then connected to the relay board that is used for switching purposes. With the Bluetooth module the relay board switches the appliances on or off.

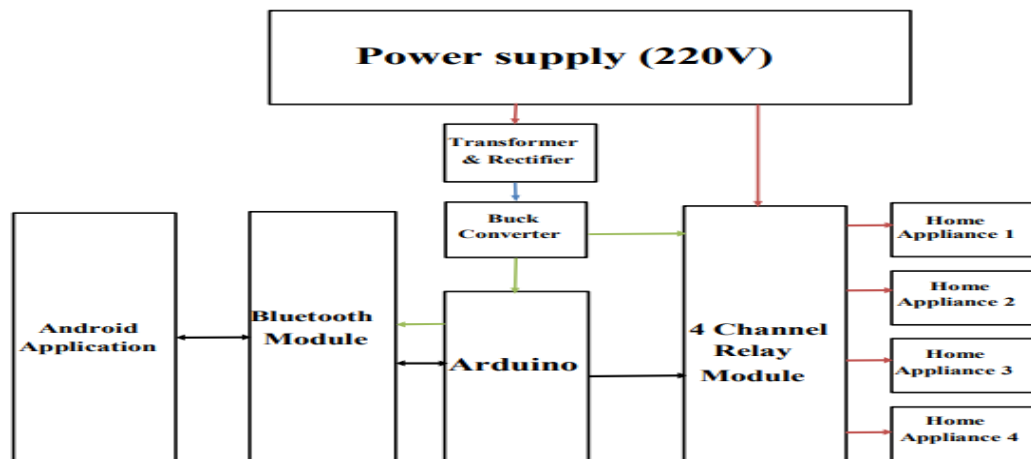


Fig. 1: Block diagram of Bluetooth based home automation system

VI. Hardware Architecture

The proposed Bluetooth-based home automation system includes a mobile smart-phone running Android OS, an Arduino BT board (ATmega328p microchip), a Bluetooth module (HC-05) and an LCD display (16X2). Smart-phones are used to exchange information with the Arduino via smart-phone applications and Bluetooth technology while paired or connected to each other. For the hardware implementation, the Bluetooth module HC-05 and Arduino UNO are used.

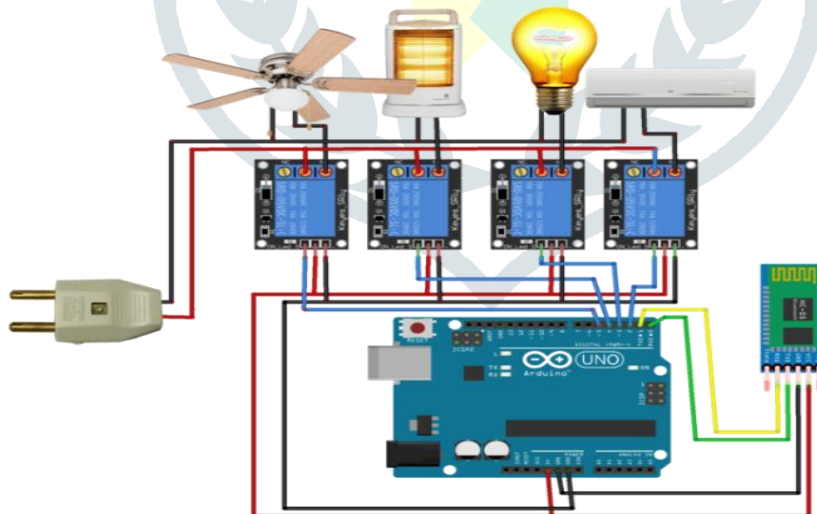


Fig. 2: CAD design of Bluetooth based home automation system

● Arduino UNO:

With the help of Arduino, one can build computers that are more capable than the desktop model of sensing and managing the physical world. It is a physical computing platform that is open-source and based on a straightforward microcontroller board and a development environment for creating software for the board. One can build as many as interactive gadgets that can control a variety of lights, motors, and other physical outputs in response to a variety of switches and sensors one could. Arduino can function alone as well as in collaboration with computer software, depending on the project. The ATmega328 is a microcontroller used on the Arduino UNO board. Six of its analogue inputs are PWM outputs, and it has a 14 digital I/O pins, a USB port, a power jack, and a

16 MHz ceramic resonator, an ICSP header, and a reset button. The microcontroller can be started by plugging it into a computer via USB, power it with an AC-to-DC converter, or use a battery.

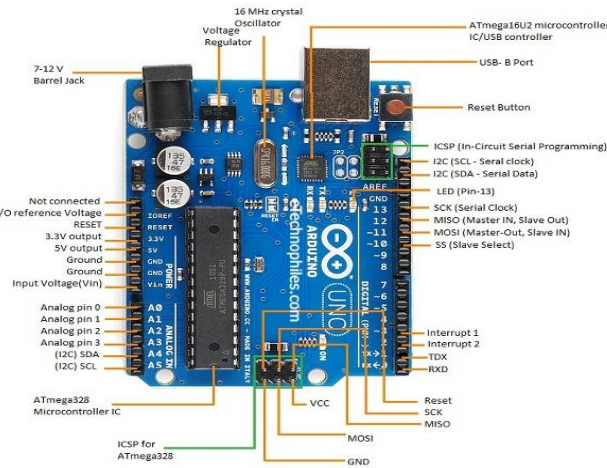


Fig. 3: Arduino Uno with pin out

- **Bluetooth module HC-05.**

The Arduino Uno and the smartphone may communicate wirelessly thanks to the HC-05 Bluetooth module. The HC-05 is a slave device that operates between 3.6V and 6V. State, RXD, TXD, GND, VCC, and EN are among its six pins. For serial connection, attach the RX pin to the TX and the TX pins of the HC-05 Bluetooth module to the RX pin of the Arduino Uno, respectively. Arduino and a Bluetooth module connections are shown in the Figure 4.

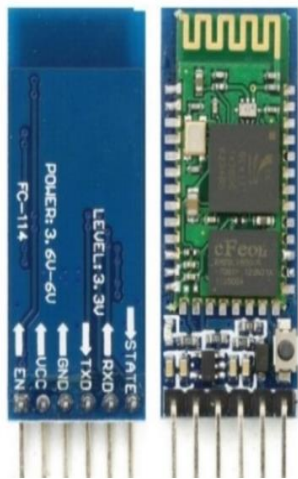


Fig. 4: Bluetooth Module.



Fig. 5: LCD display

- **LCD Display**

A liquid crystal screen I2C LCD display module (16X2) is used to produce a visible image. The I2C also called as 162A LCD display is a very basic module that is commonly used in different circuits. The 162A refers to a display of 16 alphanumeric characters per line in two lines. Each character is displayed in a 5 by 7-pixel matrix on this LCD. For 3V power supplies, a negative voltage version is available. An LCD display, display's output by turning segments or pixels on and off. A pixel is regarded as ON when sufficient electric potential is applied between the segment and common electrodes, resulting in a dark pixel on the display. When there is insufficient electric potential applied between the electrodes, a pixel appears clear on the display and is deemed to be in the off state. The ability to produce both positive and negative images exists in LCDs. The requirements of the application are used to determine the type of image to choose.

- **Channel Relay Board.**

The Arduino Uno and the smartphone communicate wirelessly via HC-05 Bluetooth module. The HC-05 is a slave device that operates around at 6 volts. State, RX, TX, GND, VCC, and EN are among its six pins. For serial communication the TX of Bluetooth module is connected to RX and RX pin to the TX of the Arduino Uno respectively.



Fig.6: Relay Module pinout

V. Software Architecture

A Bluetooth terminal application and the Arduino Integrated Development Environment (IDE) are utilized. The Arduino IDE tool, also known as an Integrated Development Environment, is used to develop the complete suggested system. The Arduino board and smartphone are connected through serial communication at a baud rate of 9600 bits per second. The "Serial.available()" Arduino IDE command is used to receive serial data from a smartphone, and the "Serial.println" command is used to transfer serial data from an Arduino board to a smartphone. The code needed to accept serial data from a smartphone and the received byte value is stored in a state variable, which is later used to compare it to certain conditions and carry out the specified operation. To control additional appliances, state variables are evaluated with various situations in a similar fashion.

● Bluetooth android application.

For wireless communication between smart-phones and the Arduino board, a smart-phone application named Bluetooth (BT) Simple terminal is used. It can send ASCII data serially from a smart-phone to an Arduino board via Bluetooth. Following table shows ASCII data and their corresponding operations. The proposed method allows users to control up to 18 appliances and sensors using a Bluetooth terminal application. In the following table input data with its equated operations is shown: -

Input Data	Operation
a	Turn ON Light
b	Turn OFF Light
c	Turn ON Fan
d	Turn ON Fan
S	Check status of all appliances
W	Check status of water level indicator

Table: 1

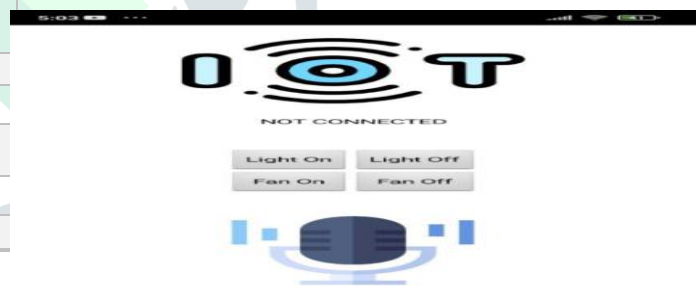


Fig. 7: UI of android AAP.

VI. Results

A water level sensor, an HC-05 Bluetooth module, a smartphone are used in the making of the intended home automation system. Relays are used to connect the Bluetooth module's lights, fans and motors to the Arduino Uno's digital output ports and the Arduino Uno's RX and TX pins, respectively and for switching circuits with voltages ranging from 5V to 240V. Only authorized users should connect their smart-phones to the HC-05 Bluetooth module. The user interface of the Bluetooth terminal application is depicted in Fig. 7. The proposed home automation system was tested at a distance of 20 meters and performed absolutely perfectly.

VII. Conclusion

A flexible wireless, low-cost, and user-friendly home automation system design has been developed in this paper. It outperforms existing Bluetooth-based home automation systems and provides a universal approach to home automation, not only for the elderly and/or disabled, but also by using sensors to reduce labour and to conserve energy. Furthermore, the proposed system can send reports and can invoke alarms within the app via reading the sensors data. It provides additional security for unauthorized users. The system can be for any device that needs to switch ON/OFF without access to the internet wirelessly. Furthermore, the smart-phone app used in the proposed system can control up to 18 household appliances. At a distance of 20 meters, the system was analysed and tested with 100

percent accuracy. It can only control devices within a short distance. Home automation systems can also communicate with biomedical signals like EMG. The ability to control these devices with muscle movements will benefit amputees.

VIII. References

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