DESIGN AND CONSTRUCTION OF A BLUETOOTH-ENABLED AUTOMATIC HOME APPLIANCES REGULATOR

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Abstract

In recent years, there has been a rise in the necessity to manage and keep an eye on an automatic system appliance. This project work demonstrated how Bluetooth may be used to operate electric equipment like fans. The system included a Bluetooth module, a relay module IC, as well as additional hardware. To activate and regulate the speed of the chosen appliance (an electric fan), code was transferred from the Arduino to the Bluetooth module in this project via the Android smartphone. The Arduino then communicated with the relay module. The relay driver gave the electric fan instructions, and it subsequently supplies a switch mechanism and an LCD (liquid crystal display) that shows the fan speed. The outcome demonstrated that the work achieved the intended goal. The system is designed to meet the needs of the physically challenged and elderly. Users get increased comfort, risk reduction, and performance thanks to automated processes.

Keywords: Android, Arduino, Bluetooth, MIT 2 App Inventor, Relay Module.

Introduction

Automation is a technique for using electronics that minimizes the need for human intervention. Due to its many advantages, the foundation of an automated system for daily tasks is improving. (Patil & Gaikwad, 2017). Due to improved performance and less labour required when connecting via smartphone, controlling electrical items through a phone has gained popularity recently. This is helpful for elderly and physically challenged people who cannot access or manage the devices (Aderinkola *et al.*, 2019). Through the use of a smartphone and Bluetooth, a wireless technology for information sharing built into Android smartphones, a fan as a home appliance can be operated. This method of transmission ensures safety when sending and receiving information as well as protection from interruptions. On computers, phones, and other electronic devices, Bluetooth is a short-range communication technology. The electronic fan is the most crucial device because of its many advantages, including cheap cost and power consumption. Even more so, it would be challenging to imagine a world without fans. A cooling fan is currently one of the most essential items that people need when it's hot outside, although its speed can be manually adjusted using a fan regulator or dimmer (Gosalia *et al.*, 2017).

(Ahsan et al., 2014) reviewed union models. A mobile system for assistive technology and provides the idea of universal remote control application for smart phones, with new features of automatic of nearly devices and controlling different devices through Wi-Fi or Bluetooth.

For the purpose of managing electrical appliances, several researchers have developed smart automation. The Z-track wireless trackball TV remote control was created by Zenith. Like a computer mouse, the remote operates. The control options that are concealed in various areas of the screen are activated when you click the ball. A method for controlling appliances based on Android was implemented by Khadke (2014). The system combines embedded technology and Android mobile technology. It uses the Bluetooth module LM400, whose functionality is based on the CSR blue core 4-EXT Bluetooth system. The technology that was created and put into place allows for smartphone-based management of light intensity and fan speed.

A smart house automated control system was developed by Mowad et al. (2014) using an Android application and a microcontroller. The system is backed by a remote control system that acts as a sub-controlling system. It is also connected to a wireless Bluetooth approach so that both an Arduino and a controller may be used to monitor and control the electronics house equipment from anywhere in the globe.

M Zeebaree and Yasin (2014) used a remote XY Smartphone application to successfully implement fan speed control via a smartphone, sending and receiving data to an Arduino. The Arduino Uno receives data from the remote XY via the Bluetooth module HC-05, which is then sent to the relay module, which in turn chooses or controls the fan's speed using digital data. But sometimes it takes a while for the relays module to understand an Arduino command.

Kim et al., (2010) proposed a PC based interface for end users to use universal remote control (URC) conveniently. The proposed URC can easily connect ubiquitous home automation and security environment with the total solution. Akshay et al., (2016) studied the use of mobile telephony in remote controlling of home appliances. Smart home is a home equipped with special facilities to enable occupants to control or program an array of automated home electronic devices.

A straightforward Bluetooth mobile application that delivers signals from the mobile phone to the microcontroller made it feasible to control fans using smart Android devices via a wireless Bluetooth microcontroller (Aderinkola et al., 2019). The technology introduces a smartphone application built on the Android operating system that continuously communicates with the fan through mobile devices to adjust the fan speed. The wireless connectivity offered by Android devices aids people, especially elderly people with physical disabilities.

Materials and Methods

The lists of materials used and the method adopted for construction of the device was discussed below.
Table 1: List of materials used.

MATERIALS	QUANTITY
Bluetooth module	1
Electrical fan	1
Arduino Uno	1
Transformer	1
Diodes	6
Capacitor 1000uf	2
Capacitor 100uf	2
Variable Resistor 10k	1
Resistor 10k	6
Hot gum socket	4
Paper tape	1
Vero board	1
Voltage regulator (7805)	1
Inductor 100Uh	5
White box	1
LCD 20*4	1
4 Channel 5v Relay module	1
4 Channel connector	2
Switch	2
Power cable	1
LED (green and red)	2

Methodology

The bridge rectifier employs four diodes coupled in a bridge configuration to rectify both cycles of a sine wave. On one side of the diode bridge network, the load is connected, and on the other, the secondary winding of the transformer is. Diodes D1 and D2 conduct during the source's positive half-cycle, whereas D3 and D4 are reverse biased. As before, this results in a positive load voltage across the load resistor. The load voltage has the same polarity as the input, and the load current flows in the same direction. The circuit converts the AC input voltage to the pulsing DC output voltage in this manner.

The algorithm for computing the average DC value is the same as that used for the full-wave rectifier, which generates a full-wave output.

$$Vdc = \frac{2xVp}{\pi} \quad (1)$$

$$Vdc = 0.636Vp$$

According to the equation, the whole wave signal's DC value is roughly 63.6 percent of its peak value. Due to the barrier potential, the diode does not switch on until the source voltage reaches roughly 0.7 volts, thus we cannot achieve a perfect full wave voltage across the load resistor. The source voltage is lost in the diode by two diode drops (0.7 x 2 = 1.4v) when the bridge rectifier operates two diodes at a time. Thus, the maximum output voltage is provided by;

$$Vp\ (out) = Vp\ (in) - 1.4V \quad (2)$$

Output frequency

The input frequency is doubled in the full wave signal's frequency.

i.e $$F(out) = 2\ F(in) \quad (3)$$

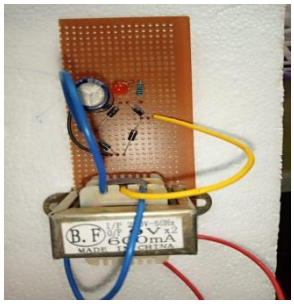

Plate1: Connection of Power supply

A voltage regulator is a three-terminal device with pins 1 and 3 that are known as the input, ground, and output, respectively. The first leg of the inductor is linked to the same positive leg of the capacitor as is the input pin, and the negative leg of the capacitor is connected to the ground pin. Another capacitor's positive leg is linked to the output pin, while the capacitor's negative leg is connected to the ground pin.

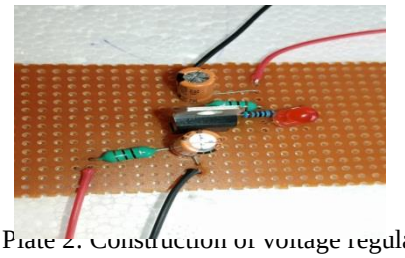

Plate 2: Construction of voltage regulator.

Connection of the Arduino Uno to the relay module.

- Pin (s) to digital 4 of the Arduino Uno.
- Pin (-) to GND pin of Arduino Uno.
- Pin (+) to 3.3v pin of the Arduino Uno.
- ON pin to 5v pin of the Arduino Uno.

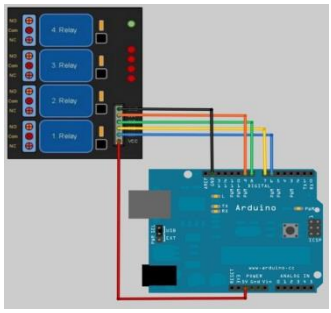

Figure 1: Connection of Arduino to relay module. (https://www.hobbyist.co.nz)

Connection of the Bluetooth module.

- The GND pin to the GND of Arduino Uno.
- The VCC pin to 5v of the Arduino Uno.
- The RXD pin to end of the 2k resistor and the first pin of the 2k resistor to pin 1 of the Arduino Uno.
- The TXD pin to pin 0 of the Arduino Uno.

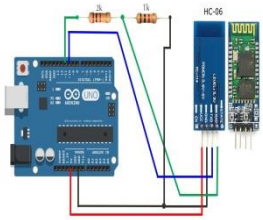

Figure 2: Connection of Arduino to Bluetooth module. (https://www.aranacorp.com)

Hardware implementation.

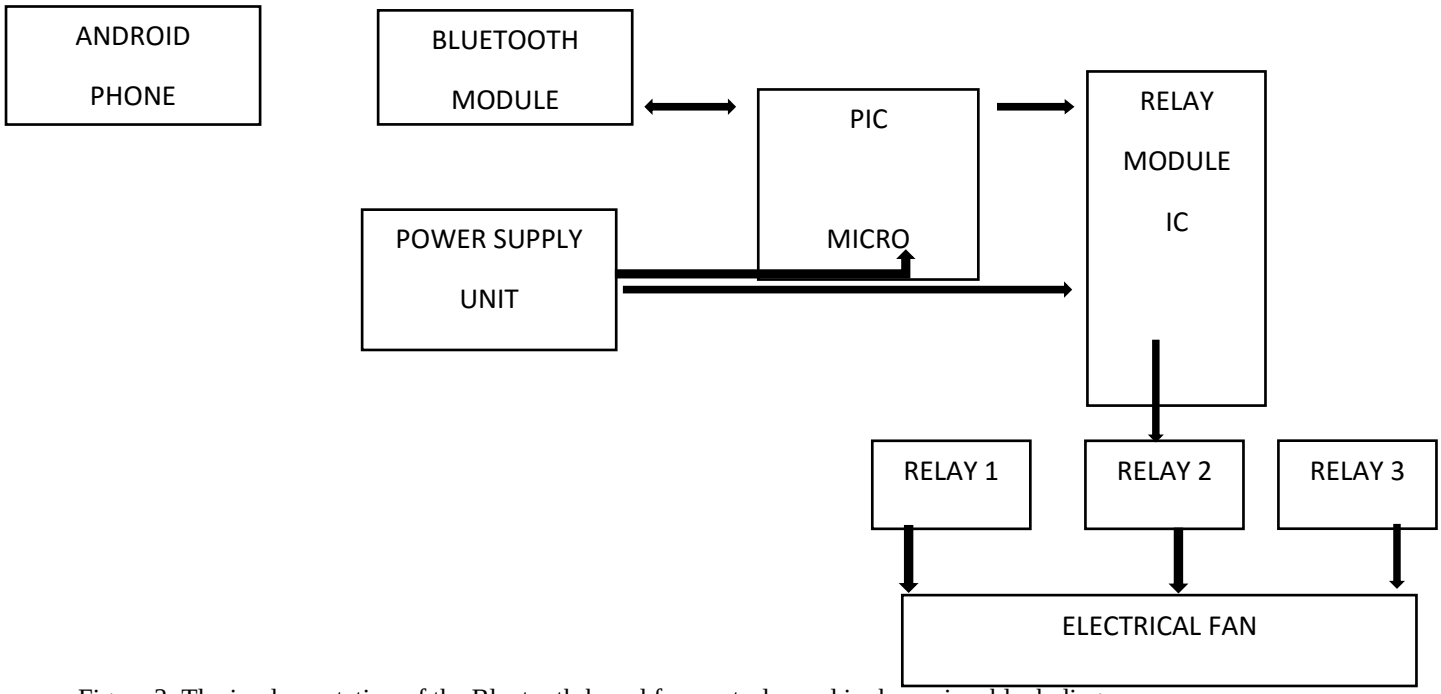

Figure 3: The implementation of the Bluetooth-based fan control speed is shown in a block diagram.

Implementation of the system

The implementation of the system includes the step-to-step procedures which are put into consideration to achieve a desired result and they include the following;

1. Pre-implementation testing of the component parts.
2. Programming of the micro-controller unit.
3. Hardware implementation.
4. Casing.
5. Coupling of the circuit.

The microcontroller unit's programming.

The Arduino Uno must be used to write a program on the microcontroller unit in order for it to carry out the intended operation. Another source code was generated using the C++ programming languages that the Arduino offers in order to direct the Arduino to send a signal to the relay module IC (which deals with the selection of speed). Before the Arduino can really utilize the source code, it must first be uploaded onto the chip.

Results and Discussion

Results

Table 2: Connectivity testing between Android smartphone and the Electrical fan.

Distance(m) outsides the homes	Fan Responses
1.00	Signal received
5.00	Signal received
7.50	Signal received
10.00	Signal received
12.00	Signal not received

Plate 3: The constructed automatic fan regulator using Bluetooth.

Table 3: Measured voltage for the input and output of the system.

VOLTAGE	Volts
Input voltage	5.0
Output voltage	
Speed 1	175
Speed 2	205
Speed 3	231

LCD voltage	4.97
LED voltage	3.3

Discussion

The Android smartphone receives data or information via the Bluetooth application and then uses the Bluetooth module to send a command to the relay module IC to adjust the fan's speed as well as turn the system ON or OFF. The relay driver IC, which interfaces with the Bluetooth module, relays the command to the fan. The LCD screen shows the speed changes procedure (speeds 1, 2, and 3). The use of an Arduino Uno in a system consists of programming, which are instructions that the system needs to follow in order to process information and data. The range at which the fan may receive a command from the phone when the user approaches the house was determined by testing the connectivity between the smartphone and the Bluetooth module.

According to Table 4.1, the communication distance between the smartphone and the device is in the range of one to ten meters. Bluetooth is thus the main use of this system.

The device's input voltage was checked and found to be 5 volts (table 4.2). This voltage is needed to turn the system on. However, based on their separate functions, the output voltage can be divided into two groups.

The fan's voltages as follow:

Speed 1: The fan is turned on by 175 volts of electricity given to the first speed.
Speed 2: The second speed receives a 205-volt supply, which activates the fan's second speed.
Speed 3: The third speed is given a voltage of 231 volts, which turns on the fan's third speed.

Liquid crystal displays, or LCDs.

A flat panel display or other electronically controlled optical device that employs a polarizer and liquid crystals to modify light is called a liquid crystal display. Liquid crystal does not directly generate light; instead, it creates images in either colour or monochrome using a backlight or reflector. It is used to display the device's output readings or the summary of the entire program (it may display the speed ranges (1...2...3...) and other necessary stuff). When an electric current flows through a semiconductor device called a light-emitting diode (LED), the LED can produce light. The light-emitting diode's primary function is to signal whether the system is powered on or off; while the system is powered on, the LED turns high, and when it is not, it turns off.

Conclusion

This approach is intended to raise living standards in residences and workplaces. The wireless connectivity offered by Android phones aids people, particularly the elderly and physically handicapped. The project goes into detail on the layout and construction of the Bluetooth-controlled fan speed control system. An Android smartphone can be used to control the Bluetooth wireless network. Finally, the system was created to make use simple and comfortable for everyone, especially the elderly and physically impaired. When a Bluetooth connection is used, devices can be controlled more quickly and easily than with previous technologies. This research work was suggested in order to produce a system that is simple to use, inexpensive, manageable, dependable, and long-lasting regardless of usage by elderly or physically challenged people, as well as to minimize human effort. It was urged that everyone utilize this Bluetooth control device in their homes, offices, and anywhere else where simplicity and convenience are required. It cannot be utilized if there is a power outage. Therefore, it is advised that this gadget be utilized in situations where there is a constant source of electricity.

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