IMPLEMENTATION OF A BLUETOOTH TECHNOLOGY AND AN ANDROID APPLICATION BASED HOME-AUTOMATED SYSTEM

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Abstract

In this study, a Bluetooth technology and an android application home-automated system using an Arduino microcontroller implemented. The system is aimed at designing an automated appliance control that is user- friendly and convenient to use. The construction comprised an Arduino UNO microcontroller board, Bluetooth module (HC-06), and an android application (MIT App Inventor 2). The Arduino, programmed with C ++ programming language using Integrated Development Environment (IDE), controls any component connected. Once the home-automated system is powered ON, the user controls the electrical appliances attached to it without stress. The device was designed to drive four gadgets at once but two appliances were used in this study. This home-automated system can switch ON and OFF any home appliances, such as refridgerator, air condition, T.V set, sound system, electric cooker and so on, using the android app and Bluetooth module. With this automation system, domestic appliances can be controlled from any area of the home in line with the range of the Bluetooth module.

Keywords: Home-Automation, MIT 2 App Inventor,Mobile Application, Smartphone.

Introduction

The word "Automation" is simply the act of things/processes happening on its own without the physical or human effort. It is ran with the help of set of programs/instructions given to a machine developed by human in order to reduce the physical effort, thus allowing things to be done in one's comfort zone with ease. Therefore, if the whole world is placed on automation, how easy, fun and lovely will that be. It means all unnecessary hard labor man does will dismiss.Tasks like opening of doors, switching of electrical appliances, lights and many more are done at home/office by saying the word, enquiries are made on the internet at home by not typing/using your smart phone just by asking the questions orally and within microseconds you have answers given by the voice assistant. This is not magic, it's simply the beauty of technology. A process in which things are controlled at home/office by microcomputers remotely either by Wi-Fi, Zigbee, Z-wave, RFID (Radio frequency identification), Bluetooth control protocols.

Radio frequency identification (RFID) was used to design and monitor the indoor activity of elderly people in a smart home by (Nisar, Ibrahim, Wu, Adamov & Deen. 2016). The RFID monitored and collected the movement activity of the elder person using RFID tags, information collected was used to take critical decisions about the health of the elderly person. But RFID can't work where its radio waves do not cover.

Similarly (Nisar & Ibrahim, 2019)presented A Smart Home Model Using Android Application where the vital signs of the elderly are monitored. A communication module and sensors such as accelerometer, gyroscope, force and temperature were attached to the knee and walking analyzer to monitor and extract of a person's unique walking pattern, which is used to classify the walking pattern an individual whether walking anomaly and walking with a level of stability. The signals are taken by the sensors and information gathered from walking analyzer and knee monitor was used to design a smart sleep room where vital signs like body temperature, breathing patterns and cardiac are monitored these signs are sent through a smartphone and a local wireless network to monitor elderly persons' health.

The processes involved in this design are too cumbersome and if sensors are not properly attached signal might fail and waking pattern will not be got. Also, (Nisar, K. et al. 2016) proposed "a smart home model using android application" the home model uses ZigBee module to communicate between the android phone and the smart home model. This is not an effective medium of communication, as an external ZigBee transceiver must be connected to the android phone. This leads to waste in power, use of many components as compare to Bluetooth that is part of an android phone already. In the same vein, (Nisar, K. et al. 2016)proposed a smart home automation for the elderly

using Wireless sensor network and android application, the system was divided into modules namely sensor, control and actuator.

The sensor module served as the transmitting medium, the con- trol module controlled the smart house, remote monitoring of other sub-modules and the actuator modules showed the response of all appliance connected in the actual system as illustration, the drawback of this system is that failure to the control modules is failure of the whole system. (Amirah, Mohamad, & Chan, 2014)presented a low-cost Bluetooth based home automation system using an Android phone was presented by. An Arduino Mega 2560-R3 board and relays were used to connect the home appliances as input/output ports of the board, a Bluetooth were used to establish wireless communication between them.

Furthermore, (Wanjale, Mathews, Mendes & Navale, 2014)designed and implemented an Android application with a Bluetooth module and Arduino UNO board for home-based automation. Users can interact with the android phone and send a control signal to the Arduino UNO that will control other embedded devices/sensors. Similarly, (Tyagi, Agarwal & Gola, 2016) controlled Home appliances through voice commands with Arduino and Android OS. In the same vein, (Sriskanthan & Karande, 2002)networked all home appliances and controlled them through Bluetooth. The network contained a remote, mobile host controller and home appliances. The home appliance communicated with the host controller through the Bluetooth devices, which operated the Home appliances through a RS232 network using Bluetooth module. (Yuksekkaya, Kayalar, Tosun, Ozcan & Alkar, 2006) developed a GSM, Internet, and speech recognition based home appliances automation. The Signals from the Radio Frequency (RF) antenna were processed by the microprocessor, which in turn was used to control the appliances. Also, (Pandya et al. 2016)also presented a Bluetooth-based home automation, but the only difference is that it had an authentication mechanism that made it secure and accessible to authorized users. (Teymourzadeh et al. 2013)designed and implemented a smart home automation system based on a mobile phone and GSM modem.

In this design, an incoming message was sent from the user phone to the GSM modem as a text message via the cellular network. It then decodes the SMS to activate the connected appliances; this is not a cost-effective method of automation, as there is no means of getting feedback from the system. (Jubadi & Zulkifli. 2007) proposed how to use a Television (TV) remote control to control room lighting and other appliances in their work entitled “Programmable Infrared Accessory Light Switch”.

An Infrared (IR) remote and one IR receiver was programmed to store the frequency of the existing remote and use them directly to control appliances. (Gurek, Caner, Mustafa, Senem & Ilker, 2013)explored internet-based home appliance connectivity but, a major demerit is this: when there is no internet connectivity, the system fails especially in a country like Nigeria. (Diarah., Egbunne & Aaron, 2014) in their work titled, “Design and Implementation of a Microcontroller Based Home Automation System Using Aiwa Remote”, explore the use of television remote to control home appliances, this is not efficient as users have to be physically present to activate the system by pointing the remote towards the appliance.

2. Methodology

This study was implemented using the hardware and the software approach. The hardware components were used in constructing the automation system itself while the software part of the system comprised of the programming aspect and the application development section.

The android application specifically built for this system was connected to it via the Bluetooth technology of which a Bluetooth module (Bluetooth HC-06) was coupled in the system. The brain of the automation system is the Arduino microcontroller board (Arduino UNO). The whole framework was constrained by two gadgets, in particular the microcontroller and a remote organization known as Bluetooth. The framework design created five significant areas specifically:

- *Microcontroller unit*
- *Notification unit*
- *Communication bridge*
- *Relay module*
- *Power supply unit.*

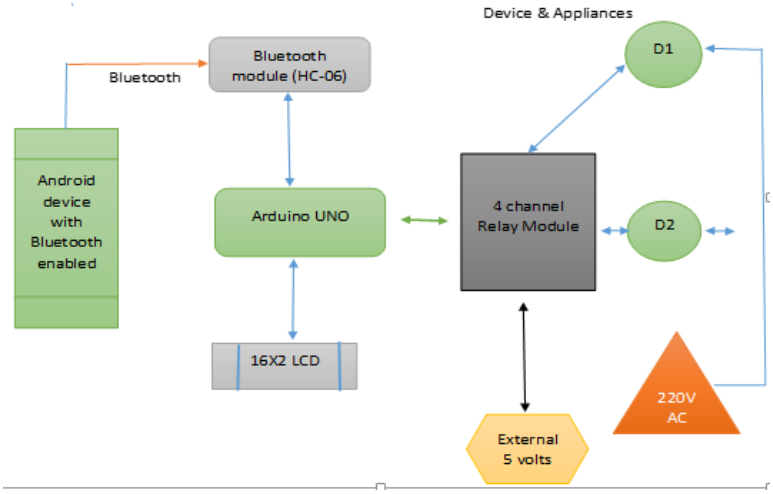


Fig. 1: THE BLOCK DIAGRAM OF THE SYSTEM

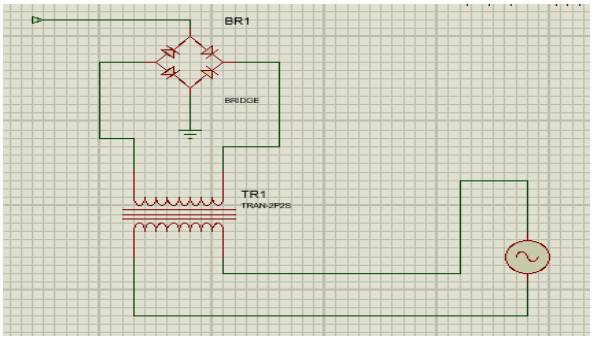


Fig. 2: THE SYSTEM POWER SUPPLY CIRCUIT DIAGRAM

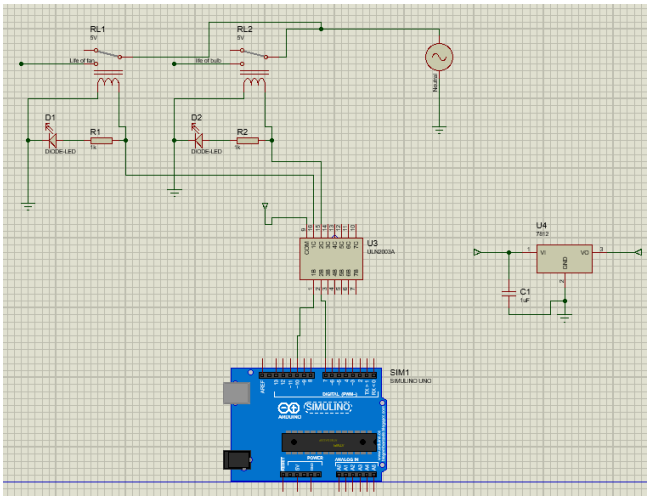


Fig. 3: THE SYSTEM CIRCUIT DIAGRAM



Fig. 4: THE MIT 2 APPLICATION AND THE SMARTHPHONE

3. Results

The system works with an AC power source, however, if there's no light, the system cannot work.
The home automation system could be operated successfully through the following few steps:

- Connect the system to an AC source and press the switch button on the housing of the system to switch it on.
- Switch on the Bluetooth of your smartphone that has the home automation application already installed on it.
- Go to "the Bluetooth settings" on the smartphone and pair the phone with the Bluetooth HC-06 listed in the "available device" section. Enter the default code **(0000 or 1234)** to successfully pair the device with each other, fig.4.
- On successful pairing, open the installed application and sign up with a unique username and password, then click login.

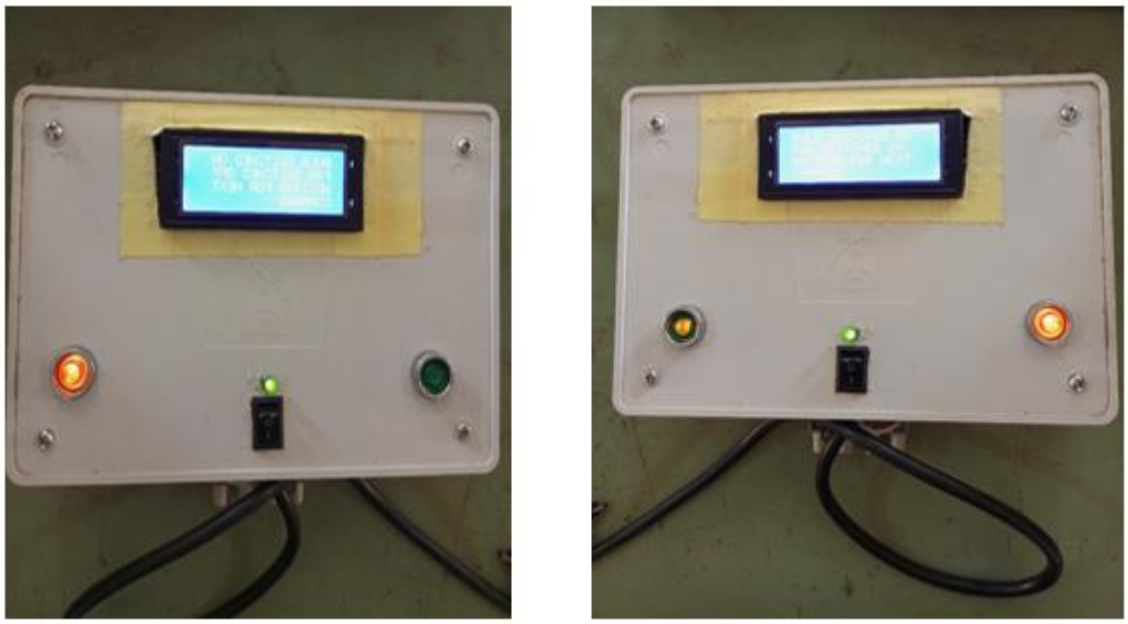


Fig. 5: AUTOMATION SYSTEM IN ACTIVE STATE.

On the welcome screen, click on any of the appliance you wish to access. On the next screen, click on the Bluetooth **"HC-06"** to connect the app to the system. On successful connection, (fig.5) the system can then be controlled by the smartphone. Fig. 6 was used to display how the device turned ON electric bulb and fan.

The input voltage, $Vi = 220V, RL = 2.2k, R2 = 1k$,

To prevent any damage from the device (HO-06), the output voltage, V_o should be close to 3.3V;

Thus, $$Vo = \left[\frac{2.2k}{2.2k+1k}\right] * 5V \quad (1)$$

$Vo = 3.46V$, which is close enough to 3.3V.

From the A.C source, a 12v, 600mA step down transformer was connected to the input voltage source to step down the voltage from 220VAC to 12VAC. Then, a full wave bridge rectification circuit was connected to the 12VAC to convert 12VAC to 12VDC.

A Voltage regulator of 7805 was connected to the 12VDc to step it down to 5Vdc for the Arduino board.
The control is done by the Arduino sending a signal of 5Vdc to control a 5Vdc relay. Thus, the relay connect the life of the 220VAC to the life terminal for the device to be active. And also a signal is also sent to disconnect the life of the device from the 220VAC terminal. So, the same control is done for the two terminal outputs. The current rating depends solely on the current rating for the devices.

For instance, for a 60watt bulb, $P = 60W$ and $Vi = 220v$.

From $P = IV$, (2)

current, i = ?

Therefore, $i = P/V$ (3)

$$i = 60/220$$

$$i = 0.27\ ampere.$$



Fig. 6: AUTOMATION GADGET TURNED ON ELECTRIC BULB AND FAN.

4. Conclusion

The smart phone can be used in controlling home appliances, with the push of a button tasks are done with ease and convenience. Linking the phone and the automation system is the Bluetooth technology (the inbuilt Bluetooth of the smartphone and the Bluetooth module HC-06 in the system). A privatized application was developed and installed on the mobile device to control the system.

5. Recommendation

Features like Biometrics can be added to the application so as to strengthen the security of the system, thus preventing unauthorized personnel from accessing the system. However, the limitation of this study is that both the system and its application can only be assessed by android phone users only. Future work can be done to ensure that iOS users can also use the system.

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