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Bluetooth Based Home Automation System Using a Microcontroller

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Abstract
Because we live in the 21st century, where automation plays a significant role in nearly every aspect of modern life, When it comes to industrial automation, the idea is applied to huge equipment or robots that aid in boosting productivity, energy efficiency, and time efficiency. Home automation, on the other hand, involves automating the living space. Due to our widespread usage of smart phones and the internet, this is achievable. Home automation can be further divided into two categories: one that only controls appliances from a distance using a smart phone, and another with sensors and actuators that uses a "Smart" system to control lights, temperature, door locks, electronic devices, electrical appliances, etc. The main goal of this project is to create a home automation system that can be remotely managed by any Android OS phone utilising a Microcontroller board with Bluetooth. As technology develops, homes also get smarter. The traditional switches in modern homes are rapidly giving way to centralised control systems with remote-controlled switches. At the moment, traditional wall switches scattered throughout the house make it challenging for the users to operate them all the way by physically making them to operate. But in case of the elderly or disabled people it becomes more difficult to do so. With smartphones, a remote-controlled home automation system offers the most cutting-edge solution. At the transmitter end, a GUI application on the mobile phone transmits ON/OFF orders to the receiver where the Bluetooth module is interfaced to the Microcontroller board at the reception end to achieve this different appliances are related. Through this technique, the loads can be remotely turned on or off by tapping the designated area of the GUI.

Keywords: Bluetooth Wireless Technology, Smart phones, Microcontroller Uno, Android Device, home automation.

Introduction

The development of technology never stops. It is a significant contribution to society to be able to create a product with current technology that will improve the lives of others. The design and execution of a low-cost, adaptable, and secure mobile phone-based home automation system are presented in this work. The design is built on a standalone Microcontroller BT board, and the input/output ports of this board are connected to the home appliances through relays. The Microcontroller BT board and the cell phone communicate wirelessly. This system's low cost and scalability allow a range of devices to be controlled with only minor changes to its fundamental structure. The appliances at home are password-protected so that only authorised individuals can access them. Within Bluetooth's range, you can switch your home appliances on and off. Technology for smart homes has been created as one of the applications for smartphones. Building automation systems for homes or offices is becoming more and more popular because of their many advantages. In order to monitor and manage various equipment, including lights, fans, garage door motors, smoke detectors, and other necessities, industrialists and researchers are attempting to construct effective and affordable automatic systems. Today, a smart phone uses Bluetooth technology

for more than just file and data transfer. In recent years, home automation systems have employed Bluetooth technology in several applications. The ability to link digital devices at a range of 10 to 100 metres at a speed of up to 3 Mbps depends on the Bluetooth device class and operates across an unlicensed frequency band at 2.4 GHz. Our ability to operate home appliances is made possible by home automation systems. Thus, by saving time and minimising human effort, numerous manual tasks are replaced. The design of the home automation system keeps the existing electrical switches, synchronising their status across all of the control systems with low voltage activation, which increases safety against the risk of electric shock and offers security to elderly people. This study uses an Android smartphone-based home automation system that is Bluetooth-based, along with a Microcontroller UNO microcontroller board. Users of such a system will be able to utilise Bluetooth to manage their home's lighting, water pump, garage motor, and smoke detection. An Android smart phone, which is in practically everyone's hand these days, and a control circuit are the user's primary requirements. An Microcontroller Uno microcontroller makes up the control circuit. It handles user-controlled device switching and alert detection. Bluetooth wireless technology is used to connect the microcontroller and the smartphone since it is an inexpensive and secure wireless network. Additionally focusing on smoke detection, this programme is protected against unwanted users. Any Android-powered smart phone, tablet, etc. may do remote operation using a touch screen and a GUI (Graphical User Interface).

Literature Review

Mobile phones and a Bluetooth-based home automation system:

Relays are used to connect the home appliances to the Microcontroller BT board at input and output ports in a Bluetooth-based home automation system. The Bluetooth connection is made possible by the Microcontroller BT board's high level interactive C language software. Only authorised users are permitted access to the equipment thanks to the password protection that is offered. For wireless communication, a Bluetooth connection is made between the Microcontroller BT board and the phone. The Python script used in this system is portable and may be installed on any OS environment.

Home automation using RF module

Building a home automation system with an RF-controlled remote is a key objective of home automation systems. Now that technology is advancing, smarter houses are also becoming a reality. Modern homes purposefully migrate away from existing light switches and towards centralised control systems with RF-controlled switches. It is now difficult for the end user to approach standard wall switches that are scattered throughout the house in order to control and operate them. even more so for the elderly or physically challenged individuals to do so. RF technology is used in home automation to offer a simpler solution. This is done by combining an RF remote control with the microcontroller on the transmitter side, which delivers ON/OFF signals to the receiver where the connected devices are. Using wireless technology, the loads can be turned ON/OFF globally by manipulating the designated remote switch on the transmitter. For receiving feedback from the phone that shows the device's status, one circuit is created and put into use. Within Bluetooth's range, you can switch your home appliances on and off. Technology for smart homes has been created as one of the applications for smartphones. Building automation systems for homes or offices is becoming more and more popular because of their many advantages. In order to monitor and manage various equipment, including lights, fans, garage door motors, smoke detectors, and other necessities, industrialists and researchers are attempting to construct effective and affordable automatic systems. Today, a smart phone uses Bluetooth technology for more than just file and data transfer.

The programme that is installed on a smart phone uses a relay switch to control the Microcontroller UNO digital output pin numbers 13, 12, 11, 10, 9 and 8 to turn on and off lights and fans. For switch control action of 220V AC home

applications, pins 13, 12, 11, 10, 9 and 8 are connected to 5 V DC Relay units. The successfully tested and operational design of the home automation system.

Smart home automation systems have gained popularity in recent years, especially with the rapid growth of internet WebPages. Different smart home systems with upgraded technology have been put into place. The majority of technologies are built on using an android application to operate home automation systems, which provides users with a user interface for viewing and managing their house's electronic equipment over a local network or the internet. Within Bluetooth's range, you can switch your home appliances on and off. Technology for smart homes has been created as one of the applications for smartphones. Building automation systems for homes or offices is becoming more and more popular because of their many advantages. In order to monitor and manage various equipment, including lights, fans, garage door motors, smoke detectors, and other necessities, industrialists and researchers are attempting to construct effective and affordable automatic systems. Today, a smart phone uses Bluetooth technology for more than just file and data transfer.

Microcontroller Board

An open-source electronics platform called a microcontroller is built on simple hardware and software. A motor can be started, an LED can be turned on, and something may be published online by using a microcontroller board to read inputs like light on a sensor, a finger on a button, or a tweet. In order to operate the Processing, we send a series of instructions to the board's microcontroller using the Microcontroller Programming Language and the Microcontroller Software (IDE). The microcontroller has been the brain of countless of projects over the years, from simple household items to intricate scientific apparatus. Around this open-source platform has collected a global community of makers, including students, hobbyists, artists, programmers, and professionals. Their efforts have added up to an unbelievable amount of knowledge that is easily available and may be very helpful to both beginners and specialists. At the Ivrea Interaction Design Institute, the microcontroller was created as an accessible tool for quick prototyping, targeted at students without a background in electronics and programming. The Microcontroller board began altering as soon as it attracted a larger audience, diversifying its offer from basic 8-bit boards to goods for Internet of Things (IoT) applications, wearables, 3D printing, and embedded environments. All Microcontroller boards are fully open-source, enabling users to construct them on their own and eventually customise them to suit their own needs. Additionally open-source, the programme is being improved by users all around the world.

Microcontroller UNO

The finest board for learning electronics and coding is the Microcontroller UNO. The UNO is the Microcontroller family's most popular and well-documented board. An ATmega328P-based microcontroller board is called Microcontroller Uno. It has a 16 MHz quartz crystal, 6 analogue inputs, 14 digital input/output pins (of which 6 can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything required to support the microcontroller; to use it, just plug in a USB cable, an AC-to-DC adapter, or a battery to get going. The Italian word "uno" (which translates to "one") was used to signify the Microcontroller Software (IDE) 1.0 release. The Uno board and Microcontroller Software (IDE) version 1.0 were the benchmark releases of the A microcontroller, which have since progressed to newer generations. The Uno board is the first in a line of USB Microcontroller boards and serves as the microcontroller's reference design.

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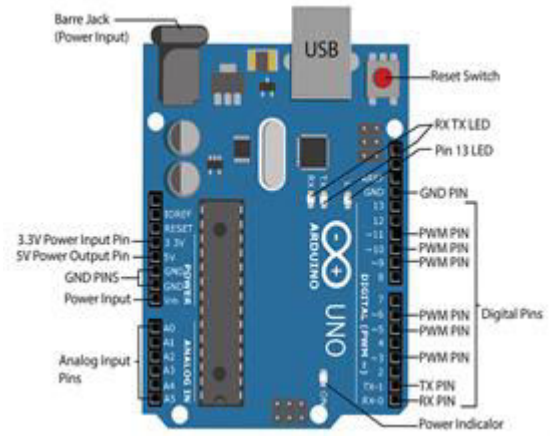

Figure1. Microcontroller UNO board

Microcontroller Software

Open-source software called Microcontroller IDE (Integrated Development Environment) makes it possible to modify, compile, and debug code more effectively and with assistance. It functions on Linux, Mac OS X, and Windows. The environment is created using Processing and other open-source technologies and is written in Java. Thus, this Microcontroller IDE effectively comes with built-in commands and functions that, despite operating on the Java platform, are tailored to interact with the Microcontroller board. Thus, the Microcontroller IDE is used to modify, compile, and debug code before burning it into the Microcontroller board. It's time to launch the Microcontroller IDE and set it up to use the same device and port now that we know what COM port the Microcontroller is on. The IDE should first be loaded. Go to Tools > Board > Microcontroller Uno once it has loaded. You must choose the correct board if, however, you are using a different board (one other than the Microcontroller Uno). This study uses an Android smartphone-based home automation system that is Bluetooth-based, along with a Microcontroller UNO microcontroller board. Users of such a system will be able to utilise Bluetooth to manage their home's lighting, water pump, garage motor, and smoke detection. An Android smart phone, which is in practically everyone's hand these days, and a control circuit are the user's primary requirements. An Microcontroller Uno microcontroller makes up the control circuit. It handles user-controlled device switching and alert detection. Bluetooth wireless technology is used to connect the microcontroller and the smartphone since it is an inexpensive and secure wireless network. Additionally focusing on smoke detection, this programme is protected against unwanted users. Any Android-powered smart phone, tablet, etc.

The programme that is installed on a smart phone uses a relay switch to control the Microcontroller UNO digital output pin numbers 13, 12, 11, 10, 9 and 8 to turn on and off lights and fans. For switch control action of 220V AC home applications, pins 13, 12, 11, 10, 9 and 8 are connected to 5 V DC Relay units. The successfully tested and operational design of the home automation system.

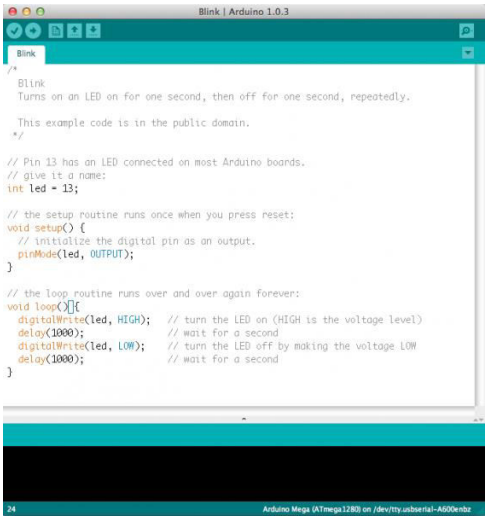

Figure2. Microcontroller IDE

Bluetooth Module (HC-05)

An intuitive Bluetooth SPP (Serial Port Protocol) module called the HC-05 is made for setting up transparent wireless serial connections. A fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps modulator with a full 2.4GHz radio transceiver and baseband is available as a serial port Bluetooth module. It utilises the CMOS and AFH-enabled CSR Blue core 04-External single chip Bluetooth system (Adaptive Frequency Hopping Feature). Its footprint measures just 12.7 mm by 27 mm. I hope it will make your design and development cycle more straightforward. The HC-05 is a really cool module that can give your

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projects two-way (full-duplex) wireless functionality. You can use this module to interact with any Bluetooth-enabled device, such as a phone or laptop, or to communicate between two microcontrollers. This approach is greatly facilitated by the abundance of existing Android applications. The module uses USART to communicate at 9600 baud speeds. As a result, any microcontroller that supports USART can be easily interfaced with. Using the command mode, we can also set the module's default values. Therefore, this module can be the best option for you if you're seeking for a wireless module that can send data from your computer or mobile phone to a microcontroller or vice versa. However, do not count on this module to transfer multimedia files like pictures or music; instead, you may want to take a look at the CSR8645 module.

Figure3. HC-05 Bluetooth module

Implementation of the Project

Our design offers a low-cost, effective smart home solution. The hardware interface module and the software communication module are the two primary modules of this system. The Microcontroller Mega 626P microcontroller, which can also work as a mini web server and the interface for all the hardware components, is the brains of this system. In this system, the microcontroller serves as the conduit for all communication and control.

The project can be developed further into a smart home automation system by adding other sensors, such as light, temperature, and safety sensors. and transfer the information to the user's phone after automatically adjusting various factors such as the room's lighting, air conditioning (room temperature), door locks, etc. Block diagram of the finished project may be found in Fig. 5.

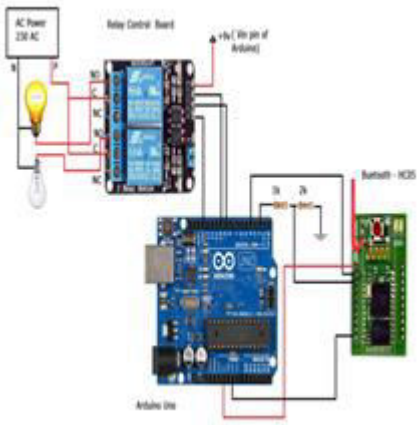

Figure5. Block diagram of the implemented project

Flowchart

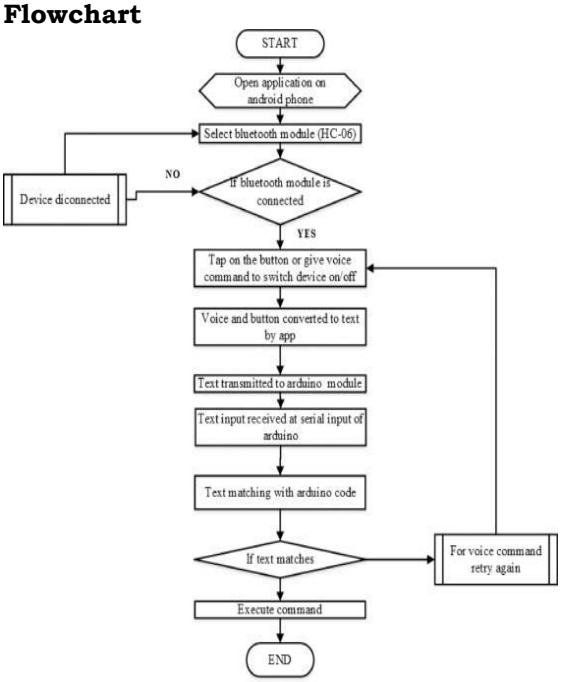

Figure8. Flow chart of the system operation

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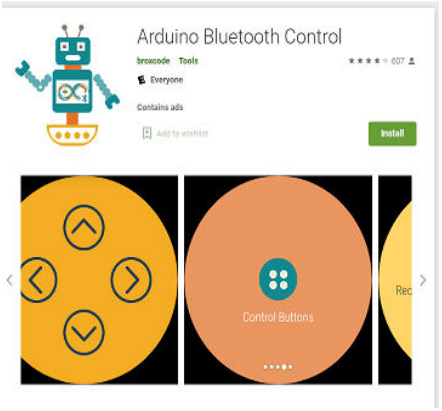

Figure9. App for home automation system

With smartphones, a remote-controlled home automation system offers the most cutting-edge solution. To do this, a Bluetooth module is linked to the Microcontroller board at the home end, and a GUI programme on a mobile phone is used to communicate ON/OFF orders to the receiver, where connected loads are located. Through this technique, the loads can be remotely turned on or off by tapping the designated area of the GUI. In the project at hand, the controller and the smartphone application are connected via a Bluetooth module that is configured in slave mode. This includes buttons, text boxes, and labels when the app is launched. The term "graphical user interface" is frequently used to describe them (GUI). Components that are not visible cannot be seen, hence they are not a part of the user interface. Instead, they give users access to the gadget's built-in features. The device's internal technology is made up of inconspicuous parts that function as miniature worker bees to control the application. App Inventor 2 makes it simple to design user-friendly GUI interfaces, and block editors make it simple to add the necessary functionality to each application button without writing any code.

The programme that is installed on a smart phone uses a relay switch to control the Microcontroller UNO digital output pin numbers 13, 12, 11, 10, 9 and 8 to turn on and off lights and fans. For switch control action of 220V AC home applications, pins 13, 12, 11, 10, 9 and 8 are connected to 5 V DC Relay units. The successfully tested and operational design of the home automation system is depicted in Figure 10.

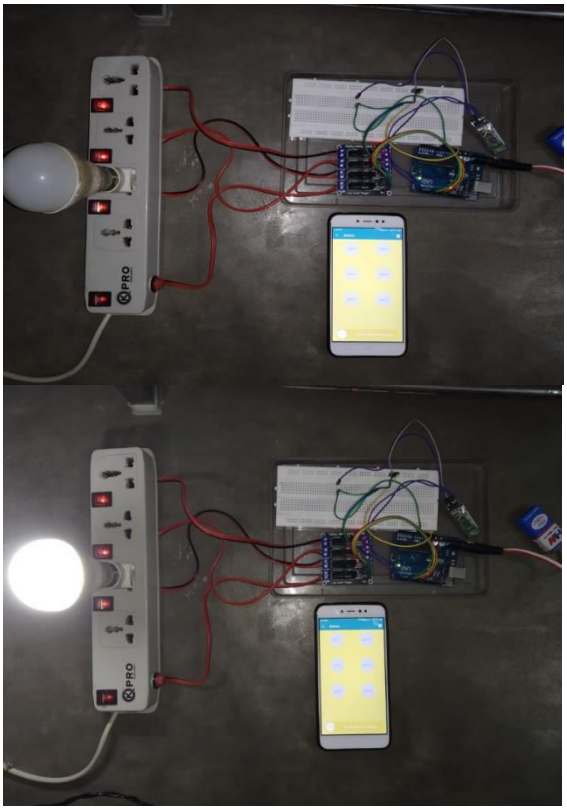

Figure10. Test run controlled output results- OFF & ON

Home security systems operate more effectively as a result of automation. For instance, you may use your phone to turn on or off lights and schedule doors to automatically lock at specific times. When motion is detected, smart cameras can send alerts, start recording automatically, and save video in the cloud.

Smart thermostats and water leak detectors are two examples of home automation technology that may not necessarily deter robbers but are nonetheless useful. Typically, a central hub or your phone can be used to set up and control smart equipment.

It can be challenging to find a home security system these days that doesn't include some kind of smart automation technology. You must strike the correct balance between what your family needs to be protected from and what your

budget will allow if you're looking to purchase a new home security system.

We've listed our top picks for a smart home security system below so you can compare brands and choose the one that suits your needs the best.

Top 6 smart home security systems:
Our selections for the best smart security systems of 2021 are Vivint, Vector, ADT, Ring, Frontpoint, and Simpli Safe based on verified user evaluations, equipment options, and availability. For more details on how we chose, read our methodology.

- Our top picks are Vivint for smart security cameras, Vector for technical help, ADT for professional monitoring, and Ring for value.
- • Frontpoint is our choice for adaptable systems
- • SimpliSafe is our choice for no contracts.
- The smart security camera we recommend Authorized Partner for Vivint Smart Homes; Professional Monitoring; Professional Installation; Alexa, Google, and Nest IntegrationsTrial period: None
- Availability: Most of North America

With customisable systems from Vivint, you may simply get the equipment you need without having to pay for extra parts. Both verified customers and business professionals give the Vivint home security system high marks. The smart thermostat, remote-access door lock, and water leak monitors have received particular praise from delighted consumers.

The Smart Hub enables devices to connect to pre-existing systems like Google Nest and Amazon Echo, allowing you to control anything in your home and obtain support with a single touch. Additionally, it offers voice-activated controls that work with current products like Google Assistant and Amazon Alexa.

Costs and contracts: Vivint does not need contracts, although clients who want to finance equipment costs and lock in rates can choose to sign one for up to five years. Starting at $99 for a simple system and going up to $199 for more feature-rich systems or for consumers with poorer credit ratings, are the activation fees. Equipment can be purchased up front or financed over the course of a contract. Fees for 24-hour monitoring per month range from $19.99 to $44.99 (plus equipment purchase). This study uses an Android smartphone-based home automation system that is Bluetooth-based, along with a Microcontroller UNO microcontroller board. Users of such a system will be able to utilise Bluetooth to manage their home's lighting, water pump, garage motor, and smoke detection. An Android smart phone, which is in practically everyone's hand these days, and a control circuit are the user's primary requirements. An Microcontroller Uno microcontroller makes up the control circuit. It handles user-controlled device switching and alert detection. Bluetooth wireless technology is used to connect the microcontroller and the smartphone since it is an inexpensive and secure wireless network. Additionally focusing on smoke detection, this programme is protected against unwanted users. Any Android-powered smart phone, tablet, etc.

Conclusion
Our daily lives require some level of mechanisation. The automated household items that can be operated from a distance when connected to a power source are in demand. By attaching test appliances to the home automation system and effectively controlling the appliances with a wireless mobile device, the system has been experimentally demonstrated to operate well. The Bluetooth client has been tested successfully on a wide range of mobile phones from various manufacturers. Consequently, a low-cost home automation system was successfully created, put into use, and tested. Yes, this project is affordable and effective for use at home. This idea is both affordable and has a user-friendly interface for elderly and physically disabled people. This technology enables consumers to conveniently control home appliances while preventing the risk of electric shock. By warning individuals when smoke or gas leaks are discovered inside the house, it can help make the place more secure. This project can provide commercial-scale items for the home automation system

with a few tweaks and improvements. In the future, we can upgrade the connectivity by using Internet web base technology and temperature sensors so that it can monitor some surrounding temperature parameters around the house. The Smart Home Automation System's other security capabilities can be incorporated into this project by promoting the use of wireless cameras. Doors and windows are mounted with alarms set in case of any type of thief or sabotage as part of increasing house security.

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