Home Automation System using Arduino Microcontroller

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Abstract: Modern homes are gradually shifting away from traditional switches and towards centralised control systems with remote-controlled switches. Currently, conventional wall switches located in various parts of the house make it difficult for the user to get close to them in order to operate them. It becomes even more difficult for the elderly or physically disabled people to do so. With smart phones, a remote-controlled home automation system provides the most modern solution. Technology is an ongoing process. Being able to design a product using current technology that will improve the lives of others is a significant contribution to the community. This paper describes the design and implementation of a low-cost, flexible, and secure home automation system based on cell phones.

Keywords: Home automation, Arduino, Circuit Schematic, Arduino Microcontroller, Automation System

INTRODUCTION:

We now have remote controls for our televisions and other electronic systems, which has greatly simplified our lives. Have you ever considered home automation, which would allow you to control tube lights, fans, and other electrical appliances in your home using a remote control? Yes, of course! But, are the available options affordable? If the answer is no, we have a solution for you. We developed a new system called Arduino-based home automation with Bluetooth. This system is extremely cost effective and allows the user to control any electronic device without the need for a remote control. This study enables the user to control all electronic devices from his or her smartphone. Because of the rapid advancement of technology, we now use smartphones to remotely control our home appliances. An automated device can work with versatility, diligence, and the lowest possible error rate. The concept of a home automation system is an important issue for researchers and home appliance manufacturers. Automation systems not only reduce human labour but also save time and energy. [1-2]

ARDUINO UNO

Arduino is a computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for the construction of digital devices and interactive objects that can sense and control objects in the physical and digital worlds. The project's products are distributed as open-source hardware and software licenced under the GNU Lesser General Public Licence (LGPL) or the GNU General Public Licence (GPL), allowing anyone to build Arduino boards and distribute software. Arduino boards are commercially available preassembled or as do-it-yourself (DIY) kits. [3]

Arduino board designs make use of a wide range of microprocessors and controllers. The boards have sets of digital and analogue input/output (I/O) pins that can be connected to various expansion boards or Breadboards (shields) and other circuits. Serial communications interfaces, including Universal Serial Bus (USB) on some models, are provided on the boards, which are also used to load programmes from personal computers. Typically, microcontrollers are programmed using a dialect of features from the programming languages C and C++. The Arduino project, in addition to using traditional compiler toolchains, provides an integrated development environment (IDE) based on the Processing language project.

The Arduino project began in 2003 as a programme for students at the Interaction Design Institute Ivrea in Ivrea, Italy, with the goal of providing a low-cost and simple way for beginners and professionals to create devices that interact with their surroundings using sensors and actuators. Simple robots, thermostats, and motion detectors are common examples of such devices aimed at beginning hobbyists. [4] Arduino projects can be standalone or communicate with software running on your computer (for example, Flash or Processing.)
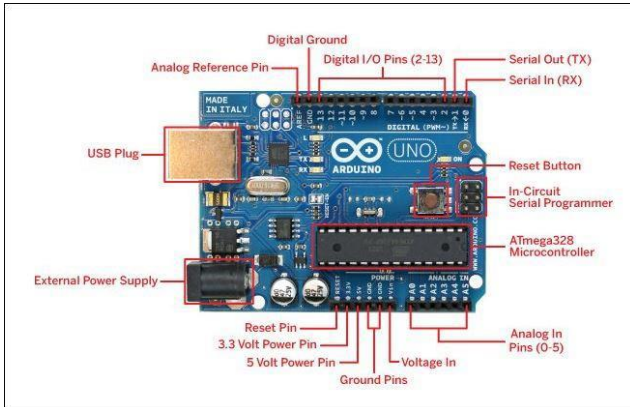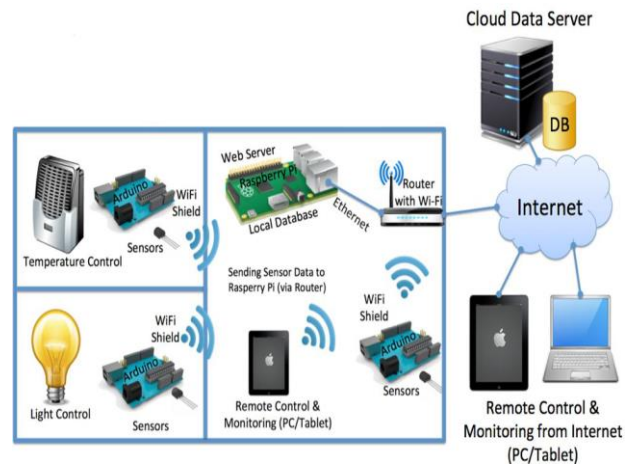
Figure 1: ARDUINO UNO R3

Figure 2: Block Diagram

The boards can be assembled by hand or purchased preassembled; the open-source IDE is available for free download. The ATmega328-based Arduino Uno is a microcontroller board. It has 14 digital I/O pins (six of which are PWM outputs), 6 analogue inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It comes with everything you need to support the microcontroller; simply connect it to a computer via USB or power it via an AC-to-DC adapter or battery to get started. [5-6]

Hardware

- Arduino / Arduino Clone
- A 5v TTL -UART Bluetooth module like JY-MCU BT_BOARD (Cheaper) or Bluesmirf Gold/Silver.
- Five 5V SPDT relays like: 5V relayPrototype board or breadboard.
- Connecting wires.

Software

- Arduino IDE
- DIY smart home Android App

As stated in [7], a home automation system consists of various software and hardware components that are intertwined to connect various electrical devices. Using the buttons on the user interface, a user from any remote location can manipulate or regulate the HVAC system, as well as turn on/off lights or other appliances to save energy. The entire system is networked wirelessly, with TCP/IP connections between the interfaces. The use of IP and MAC addresses makes it easier to identify any device under consideration. The use of microcontrollers, sensors, and actuators aids the system's functionality and efficiency, saving electricity and thus money. When all three components work together in an orderly fashion, the user saves valuable time.

REVIEW OF LITERATURE:

A number of remote-controlled home automation systems have been investigated. The research work of R.Piyare and M.Tazil provided full functionality for remotely controlling home appliances via wireless communication between the Arduino BT and a cell phone using Bluetooth technology. A Symbian OS cell phone application controlled an Arduino BT board that was connected to a home appliance. Another study presented a home automation system based on Bluetooth and an Android application. However, this was only intended to control four lights and could not control more than four Home appliances. Another study introduced an XBee-based home automation system for the disabled and elderly. Wireless communication between the master control panel board and the remote control device was accomplished using XBee transceivers. [8] A home monitoring and automation system was also investigated, and it was built using an Arduino Uno and a Digilent chipKIT. Although this system is marketed as low-cost, it is significantly more expensive than a Bluetooth-based home automation system. Researchers created a low-cost, wirelessly controlled automation system. Bluetooth technology was used to provide the user with remote controlled wireless access.

As mentioned in [9], a Home Automation System based on Wi-Fi technology was designed and implemented to control and manage several local home devices. It allowed users to manage and control home devices locally (via LAN). The system is made up of two modules: the server and the interface module. The Server monitors the devices, while the Hardware module interfaces with the sensors. The system only allowed users to connect to the server from within the same LAN. Microcontrollers were the automation device used in this project. A Wi-Fi module connected to the Micro-controller received the data or signal sent by the user. The system outperformed the competition due to its scalability and flexibility, as well as its ability to provide wireless data

transfer and signal response to hardware-controlled devices. However, due to its static nature, it lacked operability and durability.

Objectives:
- Home Automation System using Arduino Microcontroller
- Define ARDUINO UNO
- Designed A Circuit Whose Schematic
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Research Methodology:
The microcontroller reads the data and sends it to the relay drivers, which act as switches. We upload the programme to Arduino as needed, and it then performs some mathematical and logical operations to control the relay drivers. We also declare the water level and temperature to control the pump's on/off and fan speed. We also configured the light/fan button in the application. Water motor turns on and off automatically when the water level is declared. In addition, we use a buzzer for motor confirmation by hearing a beep.

Result and Discussion:

Home automation using Arduino Uno

Home automation is the remote control and monitoring of household appliances. We used two AC powered bulbs as two appliances to demonstrate how we can control multiple appliances using the Arduino Uno and wireless technology. We controlled them with the Bluetooth module (HC-05) by sending commands to it from the application we created with the MIT app inventor. [10]

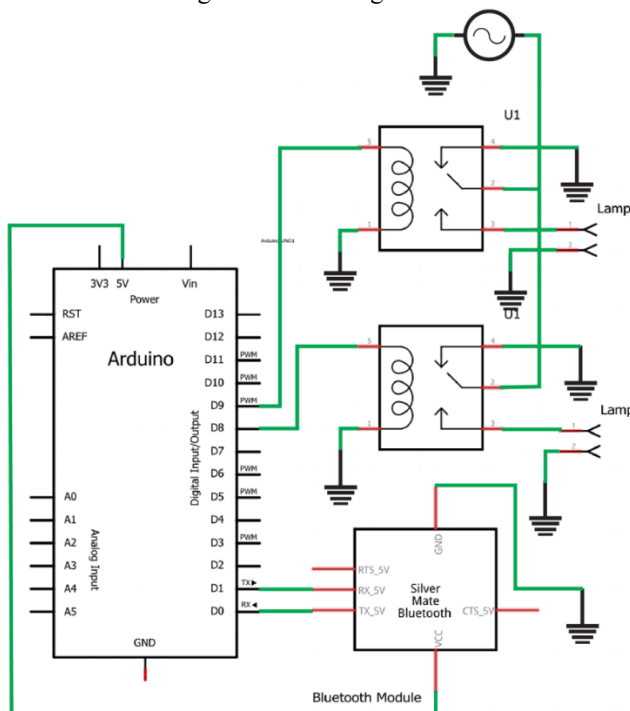To make the home automation we have designed a circuit whose schematic is given in the image below:

Figure 3: Designed A Circuit Whose Schematic

We can use relays to control high-voltage electronic devices. A relay is essentially a switch that is powered by an electromagnet. When a low voltage, such as 5 volts from a microcontroller, is applied to the electromagnet, it pulls a contact to make or break a high voltage circuit.

Figure 4: 2 CHANNEL RELAY

We'll use the HL-52S 2 channel relay module as an example for this Arduino Relay Tutorial, which has two relays rated at 10A @ 250 and 125 V AC and 10A @ 30 and 28 V DC. The high voltage output connector has three pins, the middle of which is the common pin, and one of the two other pins, as indicated by the markings, is for normally open connection and the other for normally closed connection. [11]

Circuit Schematic
Let's take a look at the relay module's circuit schematics in this configuration to get a better understanding. As we can see, the 5 volts from our microcontroller connected to the Vcc pin for activating the relay via the Optocoupler IC are also connected to the JDVcc pin for powering the relay's electromagnet. As a result, there is no isolation between the relay and the microcontroller in this case. [12]
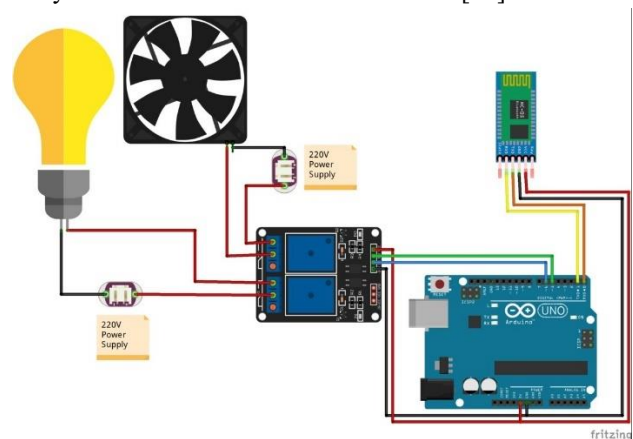

Figure 5 : Home Automation using Arduino

Nowadays, home automation is one of the most popular DIY electronics projects. Consider controlling all of your home's electronic appliances with your phone or tablet. You can

control your lights, fans, refrigerator, air conditioning, microwave, toaster, and even your doorbell with a single click or by programming them to operate in a specific manner or at a specific time. [13-14]

CONCLUSION:

In this paper, we introduced the design and implementation of a low-cost, flexible, and wireless home automation solution. The system is protected against unauthorised access by any user or intruder. To access the home appliances, users must first obtain the pairing password for the Arduino BT and the cell phone. This adds security against unauthorised users. This system can be used as a test bed for any appliances that require on-off switching applications but do not have access to the internet.

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