Salahaddin Universit

College of Engineering

Electrical department

IOT based Smart Home Automation System

Research Project Submitted to the Department of Electrical Engineering in Partial Fulfillment of the Requirements for the degree of B.Sc. in Electrical Engineering

Prepared By:

Mahmood jamal

Mohammed ismael

Supervised By:

Azad N. Abdulla

Abstract

a home automation project employing Arduino microcontrollers for enhanced control and efficiency in household tasks. By integrating sensors, actuators, and communication modules, the system automates routine functions, enhances energy management, and provides remote access to appliances.

Key components include motion, temperature, humidity, and light sensors, alongside relay modules for appliance control. The system is modular, scalable, and programmable using user-friendly environments like Arduino IDE

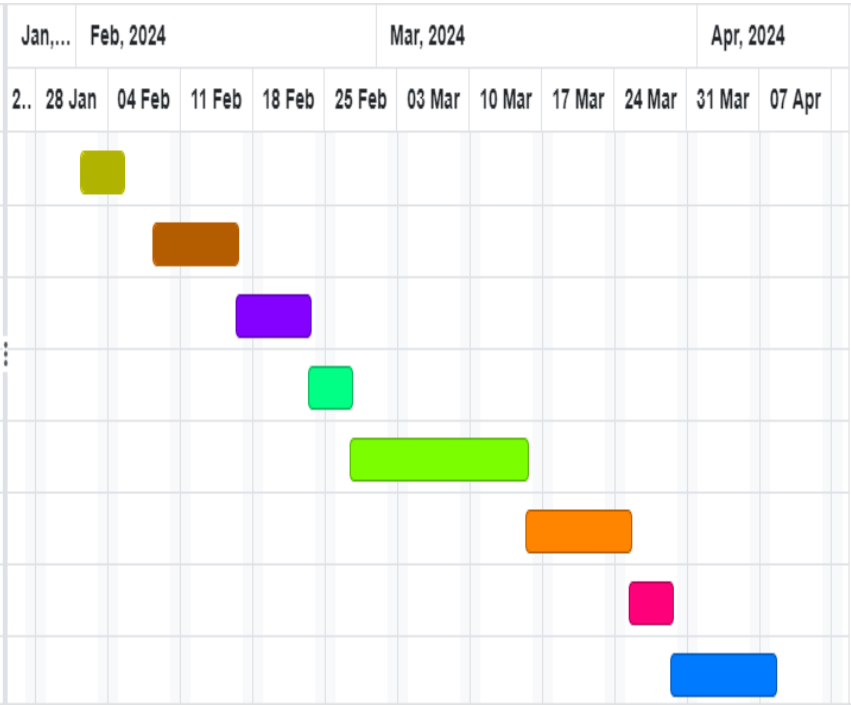
This project offers a cost-effective, customizable solution for transforming homes into smart environments and also controlling home appliance remotely

Table of Contents

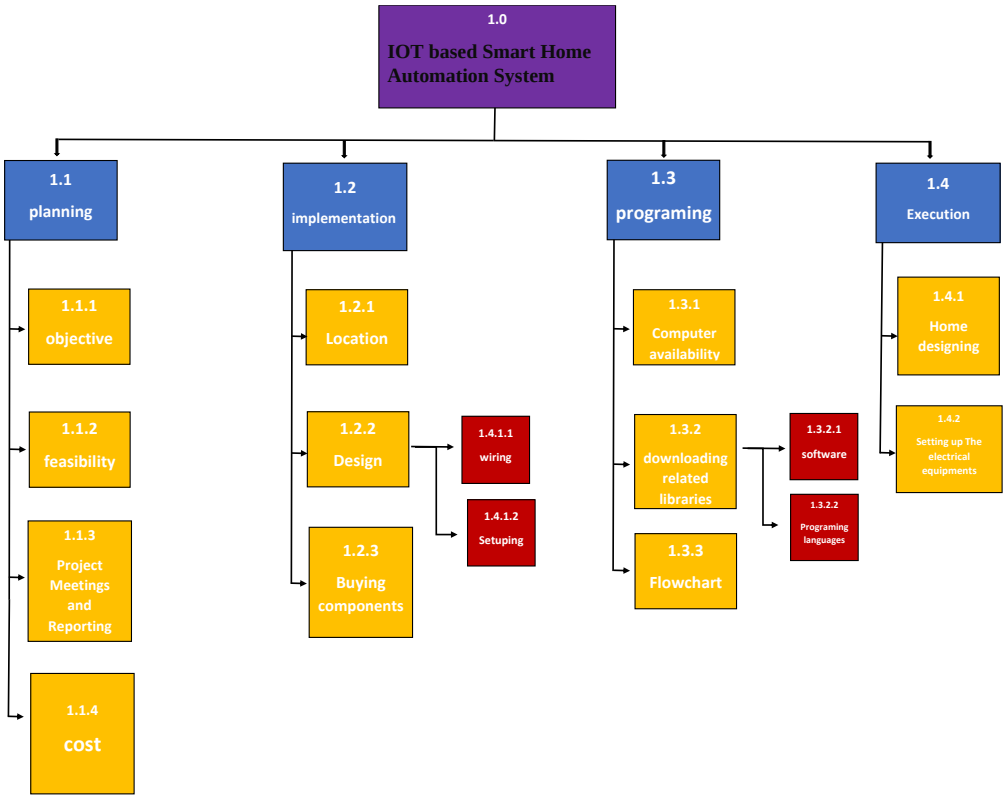
List of Figures

Gantt Chart

ID	Name
1	screening
2	planning
3	research
4	design
5	implementation
6	programming
7	test
8	execution



Work Breakdown Structure



Chapter One: Introduction

Nowadays, we have remote controls for our television sets and other electronic systems, which have made our lives real easy. Have you ever wondered about home automation which would give the facility of controlling tube lights, fans and other electrical appliances at home using a remote control? Off-course, Yes! But, are the available options cost-effective? If the answer is No, we have found a solution to it. We have come up with a new system called Arduino based home automation using wifi. This system is super-cost effective and can give the user, the ability to control any electronic device without even spending for a remote control. This project helps the user to control all the electronic devices using his/her smartphone. Time is a very valuable thing.

1.1 Problem Statement:

Adopting do-it-yourself home automation systems based on Arduino is marked by some difficult issues mainly related to the cost factor. However, Arduino provide a versatile and reachable platform for the DIY enthusiasts who are geared towards realizing their innovations which is not exempted from the partiality of the cost of components and the materials.

1.2 Research Goals/Objectives:

To build and implement an Arduino-based home automation system which improves the domestic convenience, and the saving of energy by combining various sensors, actuators, and communication modules to control and monitor household devices remotely and autonomously.

1.3 Feasibility :

- Technical Feasibility

Arduino Compatibility: Arduino Microcontrollers are generally used with the wide variety of sensors, actuators and modules. They are multipurpose and that's what makes them valuable and essential for home automation.

Scalability: Arduino-based systems can be configured to operate as simple and single-room based based systems as well as complex whole-house automation solutions that can fit various budgetary and personal needs.

Open-Source Community: The open source nature of Arduino allows for participation of a diverse community, which offers a broad range of platforms, libraries, and supporting resources, a factor that makes development and problem-solving simple.

Customization: Through Arduino, one can achieve vast customization, therefore adjusting for a range of activities and incites that fit specific needs and preferences.

- Economic Feasibility

Cost of Components: Arduino boards and components are relatively inexpensive compared to proprietary home automation solutions, reducing initial investment costs.

Energy Savings: Home automation can lead to energy savings through optimized usage of lighting, heating, and cooling systems, resulting in long-term cost benefits.

Potential ROI: Depending on the scale and complexity of the automation, the return on investment (ROI) can be significant, particularly in terms of energy efficiency and increased property value.

Maintenance Costs: Arduino-based systems generally have low maintenance costs due to their simplicity and robustness.

- Cultural Feasibility:

User Acceptance: The increasing popularity of smart home devices indicates a growing cultural acceptance of automation technologies among consumers.

Customization Culture: Arduino's "Do-It-Yourself" philosophy resembles the culture of hacks and tinkering with the devices, hence fans of DIY undertake this system.

Privacy Concerns: Data collection and remote access privacy issues should be a priority with agreement of a right place culture. Therefore, transparancy in policies and robust security will make the cultural acceptance.

Accessibility: It will be vital to achieve this ensuring the availability and simplicity of the technology to people with various age and expertise is primary.

Chapter Two

Theoretical Background

In this project, many electrical components have been used for sensing, switching, controlling…etc. In this chapter, each component will be defined. Components that have been used in this project are as follows:

2.1 ESP-8266

The ESP8266 is one of the most popular and flexible microcontroller module designed by Espressif Systems, Ever. It internally incorporates a Tensilica L106 32-bit MCU that is Wi-Fi ready. This is the reason why the ESP8266 is widely adopted because of its low cost and small size. Besides this, it is relatively easy to use.

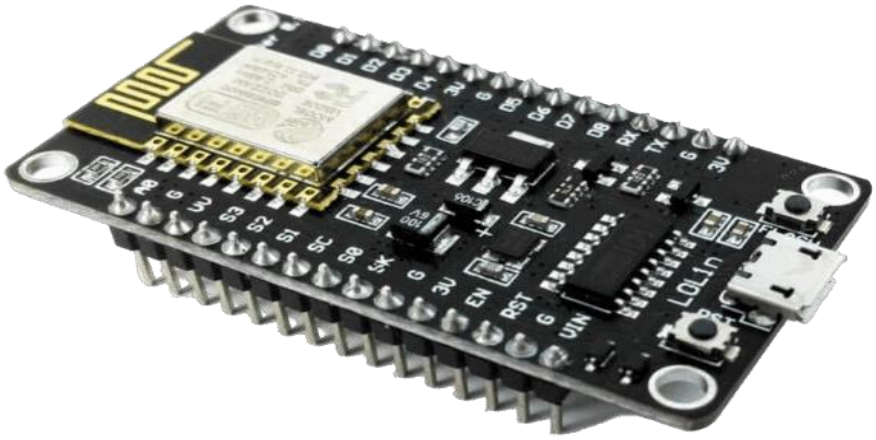


Figure 1: ESP-8266

2.2 Arduino Nano

The Arduino Nano is an extremely tiny yet very flexible microcontroller meant to be based on the atmega328p microcontroller chip. It is a member of Arduino family of development boards; it was implemented to provide more space or smaller form factor, for example. For such projects as wearable devices, small robots, and other compact electrical gizmos, the Nano is widely used.

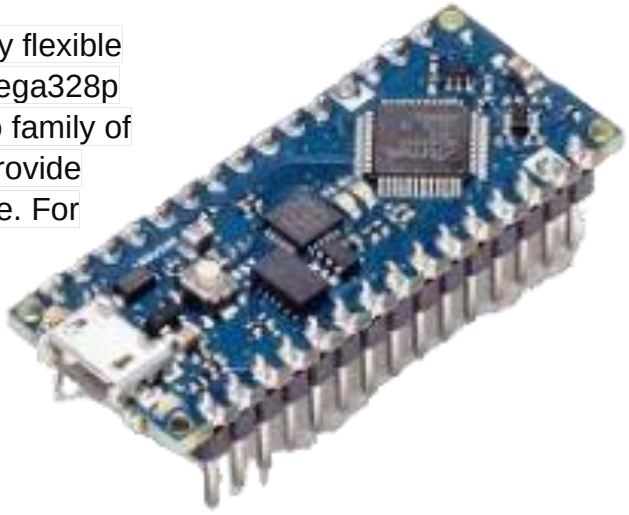


Figure 2 Arduino Nano

2.3 Moisture Sensor

Moisture sensors work by measuring the electro conductivity or resistance of the material they are immersed in. As such, the soil or other material that is moist tends to conduct current better, giving a lower resistance or greater current flow reading. Equally, if the soil is dry, it has higher resistance which means low conductivity.

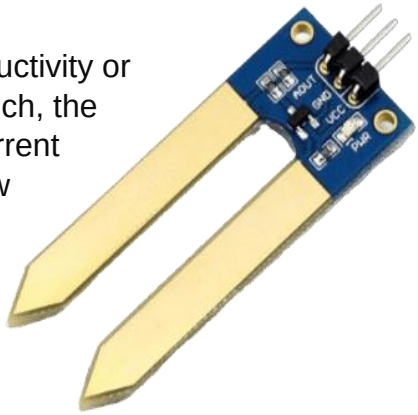


Figure 3 Moisture Sensor

2.4 DHT-22

The DHT22 module is one of the most popular temperature and humidity sensors. Also, it is known as the RHT22, AM2302 and many other nicknames. It is currently implemented in innumerable projects and applications all for its accuracy and reliability. The DHT22 sensor can measure temperature within the range of -40°C to 80°C, having an accuracy of ±0.5°C and also can measure humidity within the range of 0% to 100%. It accuracy depends on the specific conditions.

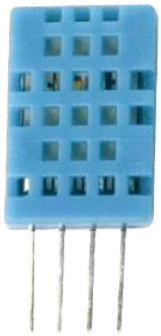


Figure 4 DHT-22

2.5 DC Motor

A DC motor, or direct current motor, is an electrical motor that converts the electrical power into mechanical power. It works on the principle of electromagnetic induction whereby electrical currents within the device produce a magnetic field, which in turn, interacts with another magnetic field or electromagnetic force to produce rotational motion.

Figure 5 DC Motor

2.6 Mosfet

A MOSFET (Metal-Oxide-Semiconductor Field-Effect Transistor) is a negative semiconductor transistor that inverts electronic signals. It is a three-terminal semiconductor device which operates under an electrical field control within a semiconductor.

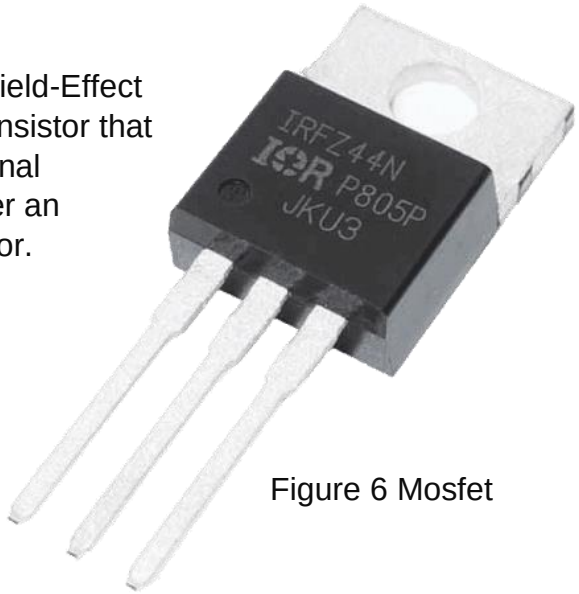


Figure 6 Mosfet

2.7 Relay

An integral part of a relay module is one or more relays mounted on a PCB. The relays are coupled with supporting elements. Relays are the electromechanical devices that used for control of the flows of the current in the circuit. They do so by applying an electromagnetic coil to mechanically open or close one or more switch contacts which means that it is possible to have only one of the contacts closed any given moment.

Figure 7 Relay

2.8 Liquid Crystal Display

Liquid Crystal Display (LCD) is a display technology that is based on the light modulating properties of liquid crystals and renders images, texts or graphics. LCD's are used in television, computer monitors, digital watch, and other calculators, and other electronic devices.

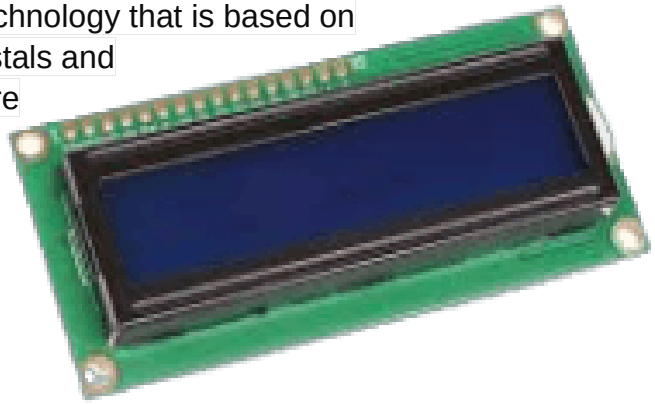


Figure 8 Liquid Crystal Display

Chapter Three

Methodology

1. Define Requirements:

- Clearly define the devices you want to automate (e.g., lights, fans, irrigation system).

- Identify the sensors required for monitoring environmental conditions (e.g., moisture, temperature).

2. Select Hardware:

- Choose an Arduino Nano as the main microcontroller for local control.

- Select an ESP8266 module for Wi-Fi connectivity and remote access.

- Acquire sensors such as a moisture sensor (for plant irrigation) and a temperature sensor (for room temperature monitoring).

- Choose a relay module for controlling high-power devices like lights and fans.

- Include an LCD display for real-time feedback and status display.

- Consider using MOSFETs for low-power switching applications.

3. Setup Arduino Nano:

- Set up the Arduino Nano with the Arduino IDE.

- Install necessary libraries for sensor and display communication.

- Write code to read sensor data and control devices connected to the relay module and MOSFETs.

4. Connect Hardware Components:

- Wire the sensors (moisture sensor, temperature sensor) to the appropriate analog or digital pins on the Arduino Nano.

- Connect the relay module to control high-power devices like lights and fans.

- Wire the MOSFETs to control low-power devices or LED strips.

- Connect the LCD display for real-time feedback and status display.

5. Configure ESP8266 for Wi-Fi Connectivity:

- Flash the ESP8266 module with firmware that supports Wi-Fi connectivity.

- Set up the ESP8266 to connect to your home Wi-Fi network.

6. Develop Control Logic:

- Write code to read sensor data from the moisture sensor and temperature sensor.

- Implement logic to control the relay module and MOSFETs based on sensor readings and user input.

- Display relevant information on the LCD display for user feedback.

7. Test and Debug:

- Test the system thoroughly to ensure all components work as expected.

- Debug any issues with sensor readings, device control, or Wi-Fi connectivity.

- Optimize the code for efficiency and reliability.

8. Documentation and Maintenance:

- Document the setup, including wiring diagrams, code explanations, and configuration details.

- Regularly maintain the system by checking for updates, replacing worn-out components, and addressing any issues that arise.

Chapter Four

Proposed Circuit Design

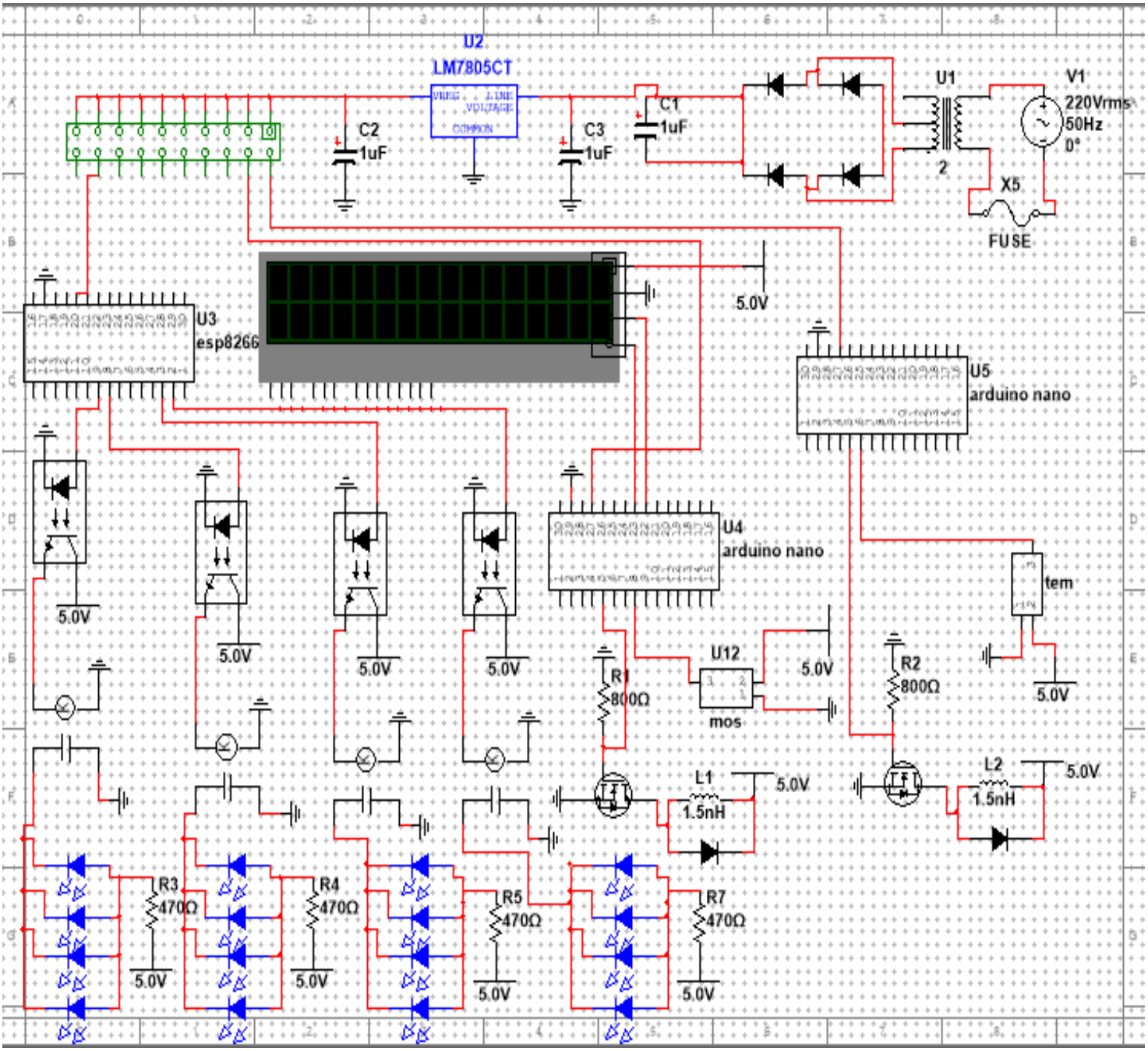


Figure 9: Proposed Circuit

Chapter Five

Conclusion

In conclusion, by following the step-by-step methodology outlined above, you can effectively set up a comprehensive home automation system using Arduino Nano, ESP8266, and a variety of sensors and control modules. By defining requirements, selecting appropriate hardware, setting up the microcontroller and sensors, configuring Wi-Fi connectivity, developing control logic, testing and debugging the system, integrating and expanding functionality, and documenting and maintaining the setup, you can create a robust and customizable home automation solution tailored to your specific needs. This methodology provides a structured approach to designing, implementing, and maintaining home automation systems, ensuring reliability, efficiency, and scalability. Whether you're automating lighting, climate control, or irrigation systems, this methodology serves as a guide to help you achieve your automation goals effectively.

Literature Review

Summary of: IOT based Smart Home Automation System Research Project Submitted to the Department of Electrical Engineering in Partial Fulfillment of the Requirements for the degree of B.Sc. in Electrical Engineering

Project Overview

This scientific article discusses a project that uses Arduino microcontrollers to create a home automation system. This system can help with controlling electronic devices in a house such as lights, fans, and appliances through a smartphone. It uses sensors to monitor things like moisture and temperature, and it can be controlled remotely. The article also talks about the different components used in the project, such as the ESP8266 module for Wi-Fi connectivity, the Arduino Nano microcontroller, and various sensors and control modules.

Setup and Benefits

The article explains how the system can be set up and how it works, including the process of connecting the sensors and control modules and writing the code to make everything function. It also discusses the benefits of using Arduino for home automation, such as its affordability, energy efficiency, and customization possibilities. Lastly, it provides a step-by-step methodology for creating a home automation system using Arduino, ESP8266, and different sensors and control modules.

Conclusion

Overall, the article aims to show how Arduino can be used to create a cost-effective, customizable, and efficient home automation system for controlling various household devices and improving energy management.

References

Arduino Official Website - Home Automation Section

Online Tutorials and Blogs

YouTube Channels-Andreas Spiess

Home Automation Projects with Arduino