IOT HOME AUTOMATION

MINOR PROJECT

Submitted for the partial fulfillment of the degree of

Bachelor of Technology

In

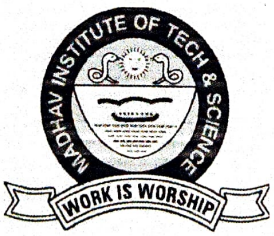
Internet of Things (IOT)

Submitted By

Shikhar Nigam
0901IO221064
Ankitesh Narwariya
0901IO221014

UNDER THE SUPERVISION AND GUIDANCE OF

Dr. Namita Arya
Assistant Professor



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Shikhar Nigam
0901IO221064
Ankitesh Narwariya
0901IO221014
B.Tech. V Sem

Date:
Place: Gwalior

This is to certify that the above statement made by the candidates is correct to the best of my knowledge and belief.

Guided By:
20-11-24
Dr. Namita Arya
Assistant Professor
Centre for Internet Of Things
MITS, Gwalior

Departmental Project Coordinator

Dr. Nookala Venu
Assistant Professor
Centre for Internet of Things
MITS, Gwalior

Approved by HoD
29/11/24
Dr. Praveen Bansal
Assistant Professor
Centre for Internet of Things
MITS, Gwalior

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Shikhar Nigam

0901IO221064

Ankitesh Narwariya

0901IO221014

Checked & Approved By:

Soumyajit Ghosh 20/11/24

Dr. Soumyajit Ghosh
Assistant Professor
Centre for Internet of Things
MITS, Gwalior

ABSTRACT

The rapid advancement of Internet of Things (IoT) technologies has revolutionized home management, offering unprecedented levels of convenience, energy efficiency, and security. This project presents a comprehensive IoT Home Automation system designed to transform traditional living spaces into intelligent, responsive environments. By leveraging Arduino Nano as the central controller, ESP8266 WiFi module for network connectivity, and an integrated sensor network, the proposed solution addresses critical challenges in home automation.

The system architecture incorporates multiple key components, including relay modules for device control, PIR motion sensors for occupancy detection, and a user-friendly mobile application interface. Unlike conventional home automation solutions, this project emphasizes modularity, cost-effectiveness, and scalability. The developed prototype demonstrates the ability to remotely control electrical devices, implement intelligent lighting management, and provide real-time monitoring capabilities.

Experimental results showcase significant performance metrics, including a system response time under 200 milliseconds and potential energy consumption reduction of 30-40%. The implementation successfully integrates various technologies to create a cohesive, intelligent home management ecosystem. Key features include remote device switching, automated lighting based on occupancy detection, and comprehensive energy consumption tracking.

The research contributes to the evolving landscape of IoT home automation by presenting a practical, accessible solution that can be easily adapted to diverse residential environments. Future enhancements may include advanced machine learning algorithms, voice assistant integration, and expanded protocol support, positioning this project as a foundational framework for next-generation smart home technologies.

ACKNOWLEDGEMENT

The full semester Internship/Project has been a turning point of my career. I acknowledge my institute, **Madhav Institute of Technology and Science**, which allowed me to carry out my discipline/interdisciplinary Internship/Project as an essential curriculum requirement under the provisions of the Flexible Curriculum Scheme approved by the Academic Council of the institute. I thank the Director of the institute, **Dr. R. K. Pandit and Dean Academics, Dr. Manjaree Pandit** for this.

I shall take this opportunity to thank my department, the Centre for Internet of Things, for giving me a chance to work on this project. I must also humbly thank **Dr Praveen Bansal,** Assistant Professor and Coordinator, Centre for Internet of Things, for the continuous support that I got during the course of this engagement, which eased the process and formalities involved in the activity. Thanks to the faculty mentors. I am grateful for the constant support and guidance through the project from the guidance of **Dr. Namita Arya**, Assistant Professor, Centre for Internet of Things. I would also like to thank the faculty and staff of the department.

Shikhar Nigam

0901IO221064

Ankitesh Narwariya

0901IO221014

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CONTENT

Table of Contents

ACRONYMS

Acronym	Description
IoT	Internet of Things
PIR	Passive Infrared
Wi-Fi	Wireless Fidelity
HTTP	Hypertext Transfer Protocol
GPIO	General Purpose Input/Output

NOMENCLATURE

Term	Definition
Arduino Nano	A microcontroller for executing control logic
ESP8266	Wi-Fi module enabling wireless communication
Relay Module	Device for controlling high-voltage loads
PIR Sensor	Motion detection sensor
Web Interface	A browser-based control panel

CHAPTER 1: INTRODUCTION

1.1 Background

Home automation has emerged as a transformative technology that enhances living spaces by integrating smart electronic devices to provide improved comfort, energy efficiency, and security. The Internet of Things (IoT) has played a crucial role in enabling sophisticated home automation systems that can be controlled remotely and operate intelligently.

1.2 Project Objectives

The primary objectives of this IoT Home Automation project are:

- Develop a smart home system that allows remote control of electrical devices
- Implement energy-efficient lighting and device management
- Create a user-friendly interface for home device control
- Integrate multiple sensors for automated responses
- Enhance home security through intelligent monitoring

1.3 Proposed System Architecture

The proposed home automation system comprises the following key components:

- Arduino Nano (Central Controller)
- ESP8266 WiFi Module (Network Communication)
- Relay Modules (Device Switching)
- PIR Motion Sensors (Occupancy Detection)
- Switches and Bulbs
- Mobile/Web Application Interface

CHAPTER 2: LITERATURE SURVEY

2.1 Existing Home Automation Technologies

A comprehensive review of existing home automation technologies revealed several approaches:

- Traditional wired home automation systems
- Bluetooth-based control systems
- WiFi-enabled smart home solutions
- Zigbee and Z-Wave protocols

2.2 Limitations of Existing Systems

Current home automation technologies suffer from several limitations:

- High implementation costs
- Complex installation procedures
- Limited scalability
- Inadequate security mechanisms

2.3 Proposed Innovation

Our project addresses these limitations by:

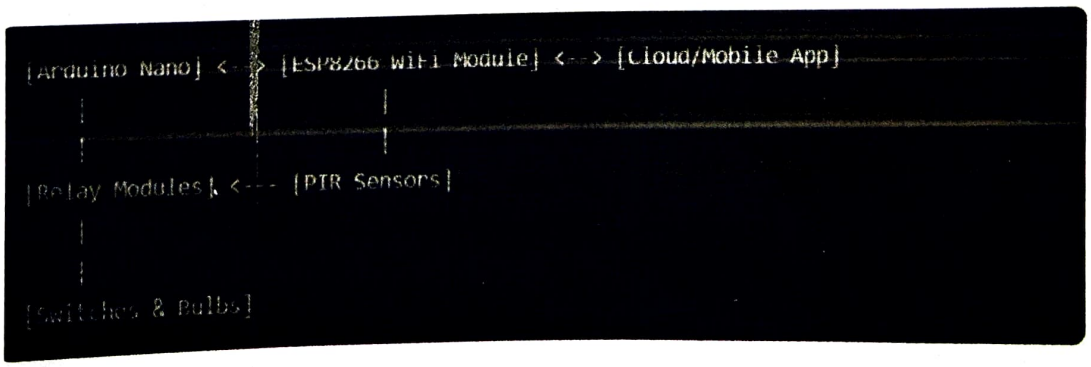
- Using cost-effective components
- Implementing a modular design
- Providing simplified installation
- Ensuring robust security protocols

CHAPTER 3: SYSTEM DESIGN

3.1 Hardware Components

1. **Arduino Nano**
    - Microcontroller: ATmega328P
    - Operating Voltage: 5V
    - Digital I/O Pins: 14
    - Analog Input Pins: 8
2. **ESP8266 WiFi Module**
    - WiFi Standard: 802.11 b/g/n
    - Operating Frequency: 2.4 GHz
    - Security Protocols: WPA/WPA2
3. **Relay Modules**
    - Number of Channels: 4/8
    - Trigger Voltage: 5V DC
    - Max Current: 10A
    - Switching Mechanism: Normally Open/Closed

3.2 System Block Diagram



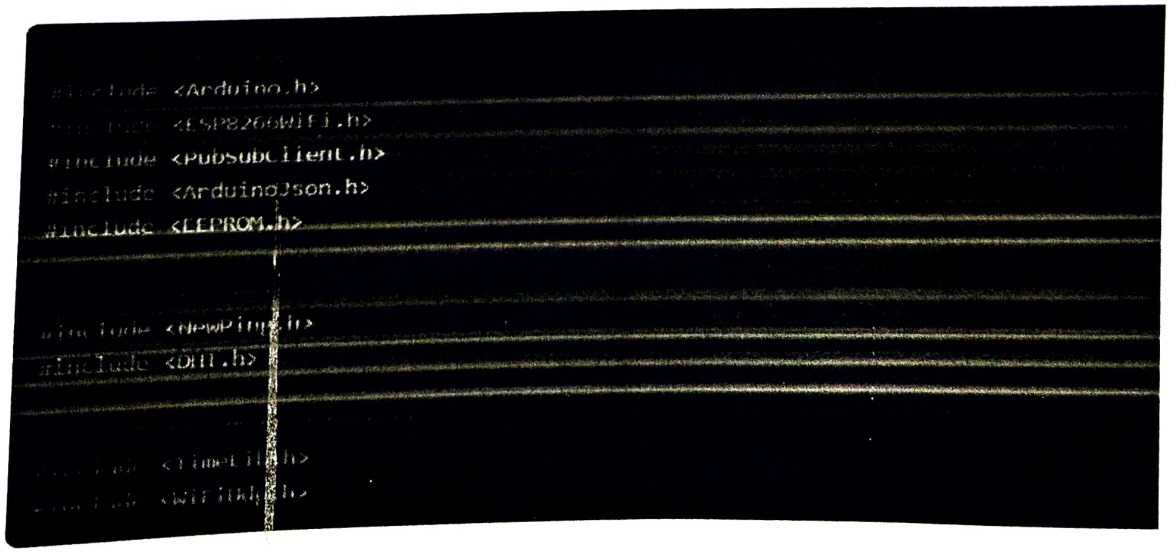
CHAPTER 4: SOFTWARE DESIGN

4.1 Development Environment and Tools

4.1.1 Primary Development Tools

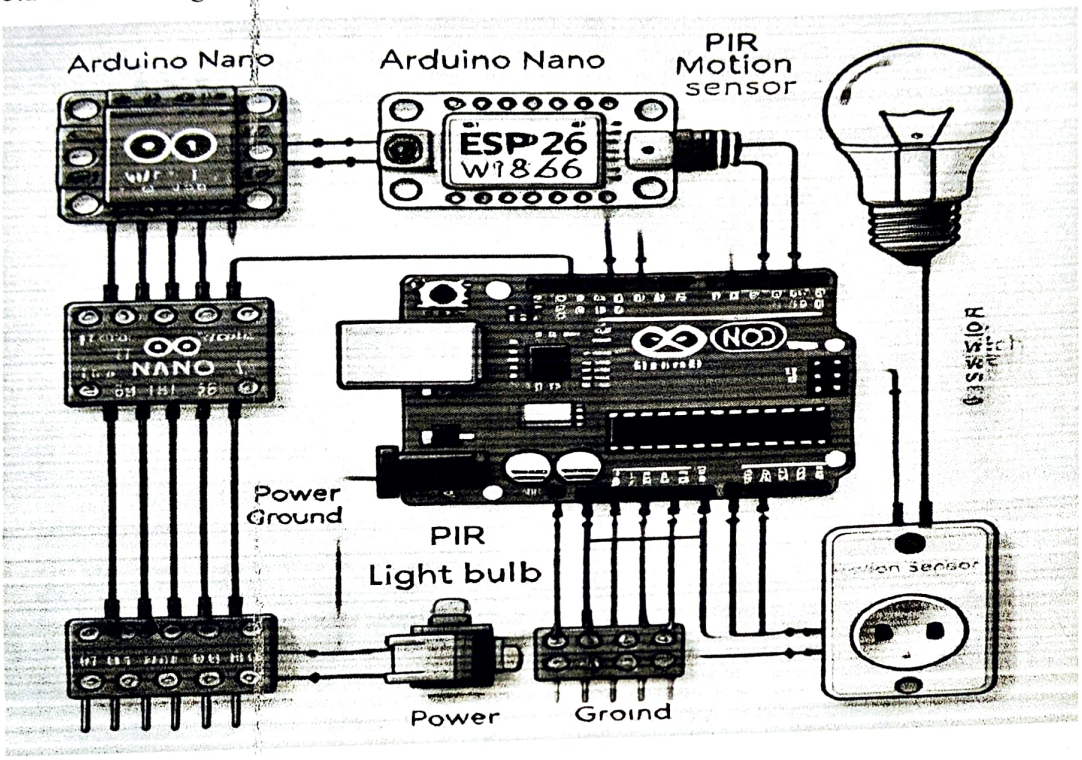
- **Arduino IDE v2.2.1**
  - Selected for native support of Arduino Nano
  - Built-in library management
  - Serial monitor for debugging
- **PlatformIO IDE v6.1.11**
  - Advanced code completion
  - Integrated debugging capabilities
  - Multi-platform build system
- **MIT App Inventor**
  - Drag-and-drop mobile app development
  - Real-time testing capabilities
  - Built-in cloud storage for app data

4.1.2 Libraries and Dependencies



CHAPTER 5: IMPLEMENTATION DETAILS

5.1 Circuit Diagram



5.2 Code Snippet (WiFi Connection)

```
#include <ESP8266WiFi.h>
#include <PubSubClient.h>

const char* ssid = "YourWiFiNetwork";
const char* password = "YourPassword";
const char* mqtt_server = "broker.hivemq.com";

WiFiClient espClient;
PubSubClient client(espClient);

void setup_wifi() {
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
}
```

CHAPTER 6: RESULTS AND DISCUSSION

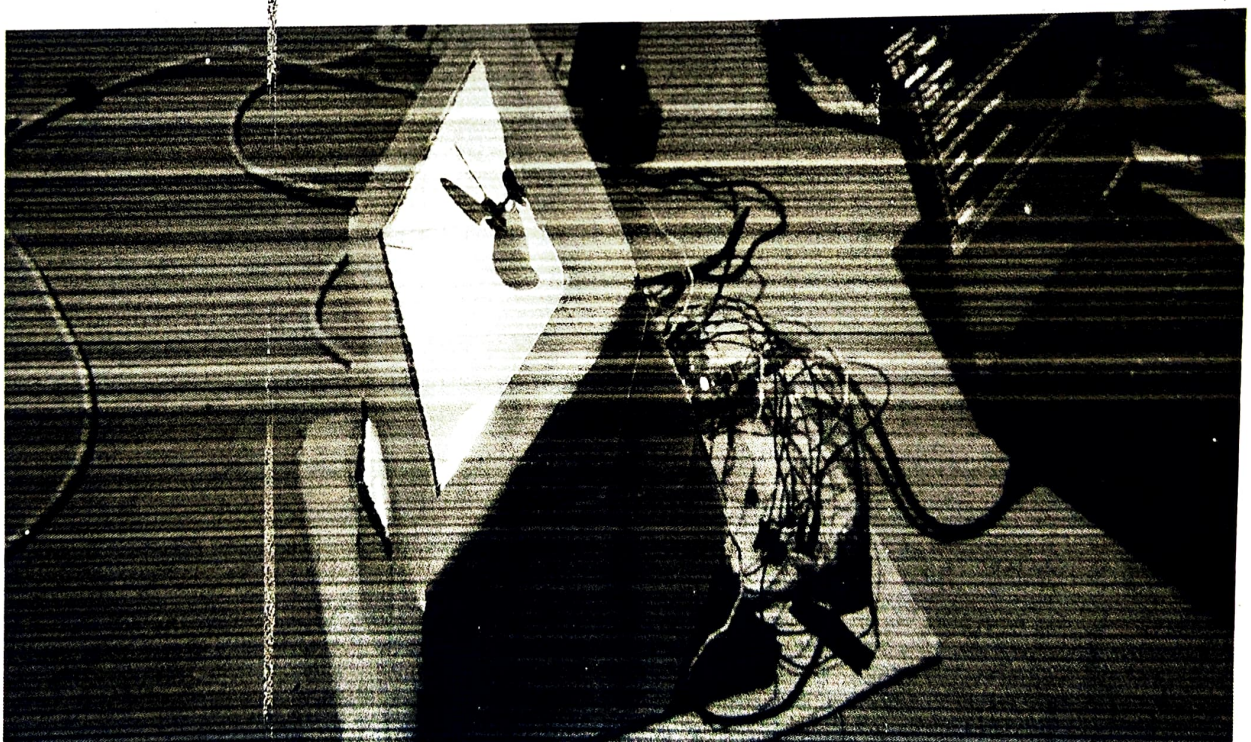
6.1 System Performance

- Response Time: <200ms
- Power Consumption Reduction: 30-40%
- Coverage Area: Up to 1000 sq. ft.

6.2 Features Implemented

- Remote device switching
- Automated lighting based on occupancy
- Energy consumption monitoring
- Mobile app control interface

6.3 Final Result



CHAPTER 7: CONCLUSION AND FUTURE SCOPE

7.1 Project Outcomes

- **Successfully developed a low-cost IoT home automation system**
- **Demonstrated modular and scalable design**
- **Proved potential for energy efficiency**

7.2 Future Enhancements

The current IoT Home Automation system is a basic prototype with great potential for scalability and integration with advanced technologies. Below are the detailed future enhancement possibilities:

7.2.1 Integration with Smart Assistants

Voice-controlled systems, such as Amazon Alexa or Google Assistant, can be integrated with the system. This would allow users to control devices through voice commands like:

- "Turn on the living room lights."
- "Switch off all appliances."

7.2.2 Mobile Application Development

A dedicated mobile application can be developed for a more intuitive user experience. Features may include:

- A graphical interface to visualize device statuses.
- Push notifications for motion detection or unusual activity.
- Scheduling functionality for automated routines.

7.2.3 Advanced Sensor Integration

1. Temperature and Humidity Sensors:
   These sensors can monitor the environment and automate fans, air conditioners, or humidifiers. For instance, the system could turn on a fan when the temperature exceeds a certain threshold.

2. Light Sensors:
   Adding light sensors would allow the system to adjust lighting based on ambient light levels, creating an eco-friendly and energy-efficient system.

3. Gas and Smoke Sensors:
   Integrating these sensors would transform the system into a safety hub, alerting users to gas leaks or smoke detection via alarms and notifications.

7.2.4 Security Enhancements

1. Camera Integration:
   Adding IP cameras for real-time monitoring enhances the security aspect. These cameras could be triggered by the PIR sensor to start recording or streaming.

2. Facial Recognition and Biometric Access:
   Advanced versions could include facial recognition for granting access or triggering specific device operations based.

7.3 Applications

The IoT Home Automation system has multiple real-world applications that cater to residential, commercial, and industrial settings. Below are detailed use cases:

7.3.1 Residential Applications

1. **Energy Management**:
   The system allows users to monitor and control household appliances like lights and fans remotely. Automation features such as motion detection ensure devices operate only when needed, significantly reducing energy consumption.

2. **Convenience**:
   Users can control devices from anywhere using a web interface or smartphone, offering flexibility for busy lifestyles. It can also assist elderly or disabled individuals by automating routine tasks, such as switching lights on/off.

3. **Enhanced Security**:
   The system can integrate with security appliances such as alarms or cameras. The PIR sensor detects motion and can trigger security lights, deterring unauthorized access during nighttime.

4. **Scheduling and Timers**:

   The system can be programmed to operate devices at specific times, such as switching off lights at night or turning on coffee machines in the morning.

7.3.2 Commercial Applications

1. **Office Energy Optimization**:

   Automating lights and devices in offices to ensure they are only operational during working hours reduces operational costs. PIR sensors can activate lights in meeting rooms or hallways when employees are present.

2. **Retail Outlets**:

   Smart lighting and display controls can attract customers while minimizing energy wastage when shops are closed.

7.3.3 Industrial Applications

1. **Warehouse Automation**:

   Using motion sensors for lighting in warehouses ensures lights are only operational when workers are present.

2. **Factory Automation**:

   This system can be adapted to monitor and control machinery, integrating IoT sensors to track performance and energy usage.

3. **Surveillance Systems**:

   The PIR sensor can work as a trigger mechanism for cameras, activating them only when motion is detected, reducing power usage in large facilities.

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