Project Report

on

Home Automation System

in partial fulfilment for the award of the degree of

BACHELOR OF ENGINEERING

IN

CSE AIML

Submitted by:

Jatin Kumar (24BAI70186)

Tanuj (24BAI70189)

Prince Rajput (24BAI70389)

Krrish Jaglan (24BAI70368)

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Under the Guidance of

Dr. Divneet Singh Kapoor

ACADEMIC UNIT-I

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Index

1. Project Overview

What is your project about?

The **Home Automation System** is a smart home solution designed to enable remote control of various household appliances and systems. These devices include lighting, HVAC systems, security cameras, door locks, and more. The idea is to integrate these home devices into a network that can be controlled through a smartphone app or web interface. By doing so, the user can control these devices from anywhere, be it within the house or remotely when away from home.

The automation system can work on preset schedules or be activated based on real-time inputs from sensors (like motion or temperature sensors). It's designed to make home management more convenient, energy-efficient, and secure.

Why is it important?

This system is important for several reasons:

- **Convenience**: Homeowners can manage and monitor devices from any location, enhancing daily convenience. This includes turning lights on/off, adjusting the thermostat, or checking security cameras without physically being present.
- **Energy Efficiency**: By automating appliance use based on conditions (e.g., turning off lights when no one is in a room or adjusting the thermostat when away), users can reduce energy consumption and save on utility bills.
- **Security**: The system offers enhanced home security by allowing for remote monitoring of security cameras and automated actions (like turning lights on/off) to give the illusion of someone being home when they're not.
- **Cost-Effective**: Automating home systems can prevent appliances from running unnecessarily, leading to a reduction in long-term energy costs.

Brief background or context

Home automation has evolved from simple manual systems to highly sophisticated and interconnected networks of devices, thanks to advancements in the **Internet of Things (IoT)**. In the past, automation was limited to mechanical systems or wired solutions, but now, with the proliferation of wireless technologies like Wi-Fi, Bluetooth, and Zigbee, home automation is becoming more accessible to everyday consumers. Companies like Google, Amazon, and Apple have contributed to the mainstream adoption of home automation with products like Google Home, Amazon Alexa, and Apple HomeKit.

2. Objective and Problem Statement

What problem are you trying to solve?

The primary problem being addressed is the inefficient and inconvenient manual control of household appliances. Homeowners often forget to turn off appliances, leading to unnecessary energy consumption. Additionally, managing multiple devices (lights, thermostats, security cameras) throughout the home can be cumbersome and inefficient. Without a centralized control system, these devices operate independently, creating confusion and wasted effort.

In terms of security, traditional systems often lack remote monitoring, which could be crucial in emergencies. Lastly, managing the comfort levels within the home (temperature, lighting, etc.) requires constant manual adjustments.

What are your main goals?

- **Convenience**: Provide users with a simple, intuitive way to control all their home appliances from a mobile phone or tablet, no matter their location.
- **Energy Efficiency**: Automate appliance use to minimize energy waste, turning off lights when not needed, and adjusting the temperature based on occupancy.
- **Security**: Enhance security by enabling remote monitoring and control of cameras, motion detectors, and lighting to simulate occupancy when away.
- **User Control**: Offer a customizable user interface that allows for personalized automation, such as setting schedules for appliances or creating different 'scenes' (e.g., "movie time," "bedtime").

3. Proposed Solution & Methodology

What did you plan to do and how?

The proposed solution involves creating a **smart home network** controlled by a microcontroller (e.g., Arduino or Raspberry Pi). The network connects various sensors (motion, temperature, light) and devices (lights, fans, thermostats) via **Wi-Fi**. A **mobile app** is used as the interface to control the devices. This app communicates with the microcontroller, which in turn sends commands to the connected appliances.

The solution includes:

- **Remote Control**: A mobile app that allows users to control devices such as lights, fans, or thermostats.

- **Sensors**: Motion, temperature, and light sensors to automate appliances based on real-time data.
- **Cloud Integration**: Integration with cloud services (e.g., Firebase) to store and manage settings, logs, and preferences.
- **Scheduling and Automation**: Users can set schedules for when devices should turn on or off, or when they should adjust to specific conditions (e.g., cooling the house when the temperature exceeds a certain threshold).

Tools/Software/Materials used

- **Microcontroller**:
    - **Arduino** or **Raspberry Pi** for controlling devices
    - **ESP8266** or **ESP32** for Wi-Fi communication
- **Sensors**:
    - Motion sensors (PIR)
    - Temperature sensors (DHT11/DHT22)
    - Light sensors (LDR)
- **Actuators**:
    - Relay modules for switching devices on and off
    - Smart plugs or bulbs
- **Software**:
    - **Arduino IDE**: For programming the microcontroller
    - **Blynk**: For developing the mobile app that interfaces with the hardware
    - **Firebase**: For storing data and providing cloud-based control
- **Other Components**:
    - Jumper wires, breadboards, resistors, and other basic electronics components

Steps you followed

1. **System Design**: We started by designing the overall architecture of the system, which includes a microcontroller (Arduino) connected to various sensors and actuators, with Wi-Fi connectivity.
2. **Component Assembly**: We connected sensors like motion sensors and temperature sensors to the microcontroller and configured the relays to control devices.

3. **Programming the Microcontroller**: Using the Arduino IDE, we programmed the microcontroller to handle sensor inputs and send commands to the appliances.

4. **Mobile App Creation**: Using the Blynk platform, we created a mobile app that allows users to monitor and control the devices remotely.

5. **Testing & Calibration**: We tested the system by running several scenarios, such as adjusting the thermostat or switching lights on/off based on motion detection.

4. Key Findings / Results

What did you observe, build, or find out?

The system successfully achieved the following:

- **Remote Control**: Devices like lights, fans, and thermostats could be controlled from the mobile app, making it easier for users to manage their home.
- **Energy Saving**: The system automatically turned off lights and appliances when they were not in use, which could reduce energy consumption significantly.
- **Security Enhancement**: Motion sensors and cameras worked together to create a more secure environment by notifying users of any suspicious movements.
- **User Interface**: The app interface was simple and intuitive, making it easy for users to control and monitor all connected devices.
- **Circuit Diagram**: Here's the diagram showing how relays and sensors are connected to the Arduino.
- **Project Images**: Images of the physical setup, including the microcontroller, sensors, and devices.
- **Sample Outputs**: Screenshots of the mobile app displaying the status of devices and sensors.

5. Conclusion & Learnings

What did you learn through this project?

This project gave me hands-on experience with **IoT systems** and **embedded programming**. I gained a deeper understanding of how smart devices communicate through protocols like **Wi-Fi** and how to integrate hardware with software to build a functional and user-friendly

system. Additionally, I learned how important it is to consider the **user interface (UI)** for ease of use, especially in home automation systems where simplicity is key.

Any improvements or next steps?

- **Voice Control Integration**: I plan to integrate voice commands using Amazon Alexa or Google Assistant for hands-free operation of devices.
- **Energy Monitoring**: Add sensors that can monitor the energy consumption of connected devices and provide feedback to users on how to reduce power consumption.

6. References

Bahga, A., & Madisetti, V. (2014). *Internet of Things: A Hands-On Approach*. Universities Press.

Geddes, M. (2017). *Arduino Project Handbook: 25 Practical Projects to Get You Started*. No Starch Press.

7. Appendix (if needed)

Extra content like code snippets, supplementary material, etc.

- **Code Snippets**:
  Example code for controlling a light based on motion detection:

```
cpp

int motionPin = 2;     // Pin connected to motion sensor
int lightPin = 3;      // Pin connected to relay
controlling light

void setup() {
  pinMode(motionPin, INPUT);
  pinMode(lightPin, OUTPUT);
}

void loop() {
  if (digitalRead(motionPin) == HIGH) {
    digitalWrite(lightPin, HIGH);  // Turn light ON
  } else {
    digitalWrite(lightPin, LOW);   // Turn light OFF
```

```
    }
}
```

- **Supplementary Materials**: Additional resources, datasheets for sensors and microcontrollers, and more detailed technical documentation.