Premier University Chittagong

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Project Report

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SMART HOME AUTOMATION SYSTEM USING MICROCONTROLLER

ABSTRACT

This project presents a low-cost, efficient smart home automation system designed for daily safety and convenience. Using an ESP32 microcontroller, the system integrates the Blynk IoT platform to allow remote real-time monitoring and control of doors, a garage, and a rain protection cover. IR sensors are deployed for vehicle and obstacle detection, while a rain sensor identifies environmental changes. When events like rainfall or movement are detected, the ESP32 triggers corresponding servo motors and sends instant notifications via the Blynk app. The system ensures ease of use with a smartphone interface and promotes energy efficiency through selective motor activation and WiFi-enabled control. The solution is ideal for weather-sensitive and security-conscious homes, providing reliable automation at minimal cost. Testing confirmed accurate and fast sensor responses. This system extends beyond simple automation, merging responsive environmental control with user-directed interaction.

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CHAPTER 1

INTRODUCTION

1.1 Background

In recent years, smart home technology has emerged as a rapidly evolving field within the broader domain of the Internet of Things (IoT). Smart homes aim to enhance everyday living by integrating digital technologies into household systems, enabling automation, remote monitoring, and responsive control. From lighting and climate systems to security and appliances, these interconnected devices offer homeowners greater convenience, energy efficiency, and security. The widespread use of smartphones and low-cost microcontrollers has further accelerated the development of smart home systems, making them more accessible to the general public.

1.2 Problem Statement

Despite this growth, many existing systems either focus on a limited number of features or rely on costly infrastructures, which limits their adoption. Our project addresses this gap by developing a compact, affordable smart automation system capable of controlling doors, garage entrances, and rain covers using sensor-based responses and smartphone integration. Specifically, we identified a common problem in households: the lack of responsive automation for weather conditions and vehicle-based actions, which often leads to inconvenience, energy loss, and potential safety concerns.

1.3 Necessity of the Solution

Solving this problem is crucial as it aligns with the growing need for energy-efficient, autonomous systems that improve daily life and reduce manual dependency. A responsive smart home system can minimize risks (e.g., damage from unexpected rain), enhance accessibility for people with mobility issues, and contribute to modern, sustainable living standards.

1.4 Objectives and Approach

Our approach involves designing a sensor-driven home automation system powered by the ESP32 microcontroller and integrated with the Blynk IoT platform. The system uses IR sensors for object and vehicle detection and a rain sensor to monitor environmental conditions. The project's primary objective is to build a low-cost, user-friendly solution that offers intelligent control and real-time feedback via a smartphone application. Through this system, we aim to demonstrate how embedded hardware and cloud-based control can work together to solve real-life challenges in home automation.

CHAPTER 2

LITERATURE REVIEW

2.1 Use of Blynk for Home Automation

2.1.1 S. Jadhav et al., "IoT Based Home Automation System Using Blynk," IEEE, 2020.

This paper explores how Blynk can be effectively used to develop a remote home automation system. It outlines the process of using the Blynk platform to control appliances via smartphones and highlights the ease of integration with microcontrollers like ESP32. Our project leverages the same platform, focusing on practical control of physical components like doors and garage shutters using Blynk, and demonstrates its effectiveness in real-world scenarios. Moreover, Blynk's event-triggered alert system has been utilized in our design to deliver instant user notifications, enhancing real-time awareness and responsiveness.

2.2 IR-Based Garage Automation

2.2.1 M. Reddy et al., "Smart Garage Door System using IoT," Springer, 2021.

This research introduces a smart garage door system that uses IR sensors for detecting the presence of a vehicle and controlling the garage door automatically. It supports our design decisions to implement IR-based detection for parked and incoming vehicles and integrates safety measures using obstacle detection. The paper validates our use of multiple IR sensors for intelligent automation. Additionally, it emphasizes the benefit of contactless control and response accuracy in real-time conditions, which aligns with the purpose of our IR-based door and garage control.

2.3 Weather-Responsive Automation

2.3.1 Kumar et al., "Weather-Responsive Shelters Using Microcontrollers," Elsevier, 2022.

This paper presents a solution for automatic shelter adjustment based on rain detection using microcontrollers. It directly influences the implementation of the rain sensor and servo-controlled rain cover in our system. The automation concept is extended in our project to include not just rain protection but also event-based alerts using Blynk.

2.4 Integrated Contribution of the Work

Our system replicates and expands on existing research by integrating servo-based control and Blynk alerts for real-time interaction and monitoring. It differentiates itself by focusing on environmental response, such as rain detection, and critical home access automation. By merging ideas from the above works into a unified ESP32-based smart home system, our project offers a more comprehensive and responsive automation platform.

CHAPTER 3

METHODOLOGY

3.1 System Design

The system design follows a modular block architecture where sensors (IR and rain), servo motors, and the ESP32 microcontroller interact through defined input-output channels. The ESP32 acts as the central unit, processing input from the sensors and sending commands to servo motors for mechanical movement. All control and feedback mechanisms are linked with the Blynk cloud, allowing real-time status monitoring and command execution through a smartphone interface.

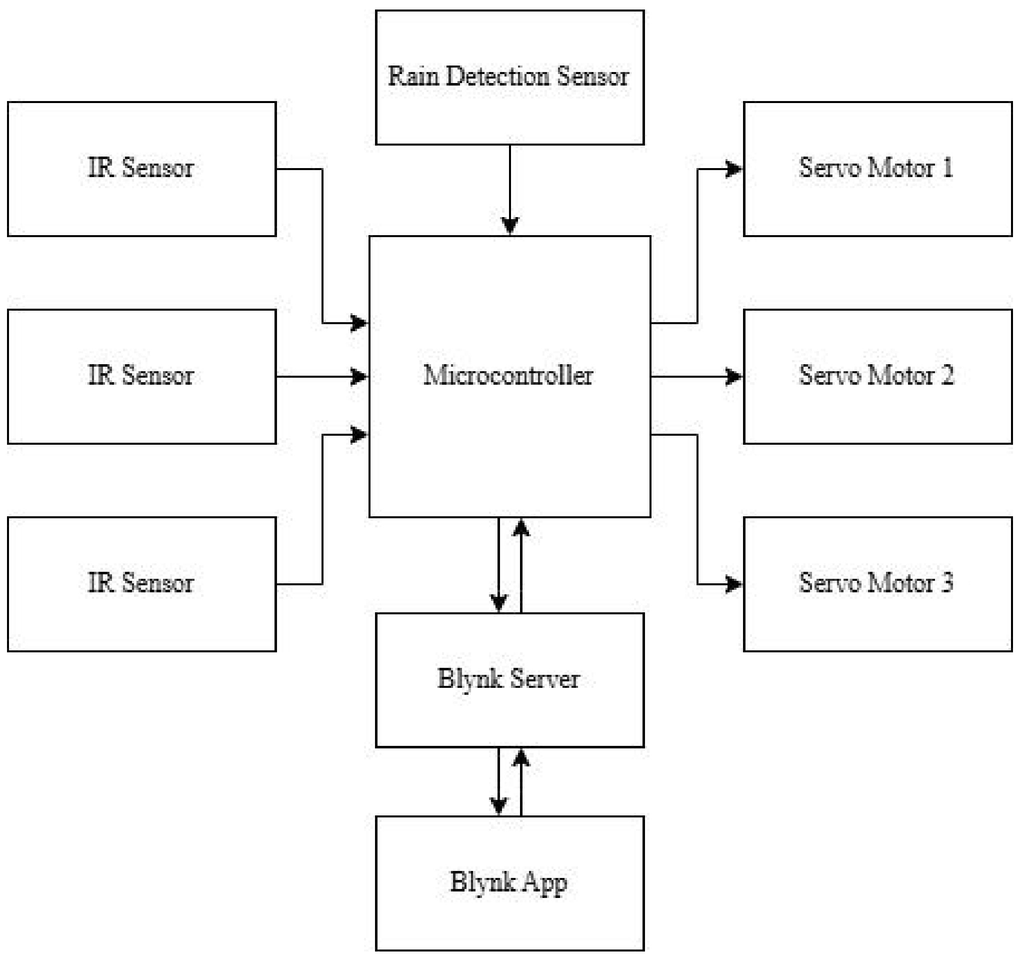

Figure 1 System design (Block Diagram)

3.2 Necessary Equipments

3.2.1 Hardware Components

i. ESP32 microcontroller
ii. IR sensors (x3)
iii. Rain detection sensor
iv. Servo motors (x3)
v. Jumper wires
vi. breadboard
vii. Power supply (9V)

3.2.2 Software Components

i. Arduino IDE
ii. Blynk IoT platform

3.3 Choice of Hardwares

3.3.1 ESP32 Microcontroller

The ESP32 is chosen due to its built-in WiFi capabilities, low power consumption, and cost-effectiveness. It provides the necessary processing power and network connectivity for real-time sensor monitoring and actuation.

3.3.2 IR Sensors

IR sensors are employed for vehicle and obstacle detection due to their non-contact nature, reliability, and stability under various lighting conditions. They are energy-efficient and suitable for continuous use in smart environments.

3.3.3 Rain Sensor

The rain sensor enables responsive control of a rain cover by detecting moisture. It is simple to interface and uses minimal power, contributing to the eco-friendliness of the system.

3.3.4 Servo Motors

Servo motors are used for actuating the doors, garage shutter, and rain cover.

They offer precise control and consume energy only when activated, reducing unnecessary power consumption.

3.3.5 Environmental Considerations

All hardware components were selected based on low power usage and compatibility with reusable and modular circuit design. This approach minimizes electronic waste and promotes sustainable prototyping practices. Additionally:

i. ESP32’s energy efficiency reduces power usage and battery wastage, making it a smart choice for the systems.
ii. The use of Blynk's cloud infrastructure eliminates the need for power-hungry physical interfaces or display modules.
iii. Reusability of jumper wires, breadboards, and servo motors encourages long-term component lifecycle.
iv. The rain sensor prevents energy loss or property damage by proactively activating covers during rainfall.
v. No harmful chemicals or non-recyclable materials are used in the device setup.

These practices collectively support the goal of creating environmentally friendly smart automation systems.

3.4 Flowchart

The system flow begins with hardware initialization. If an IR sensor detects motion or a vehicle, or the rain sensor detects precipitation, the ESP32 communicates with Blynk server to send notifications to the user. Upon seeing the notification or without any notification, the user can control servo motors (connected to the door, garage and rain cover) by the Blynk app buttons and performs specific actions: opening/closing doors or garage shutters or activating the rain cover. The loop continuously runs to provide real-time automation and remote control.

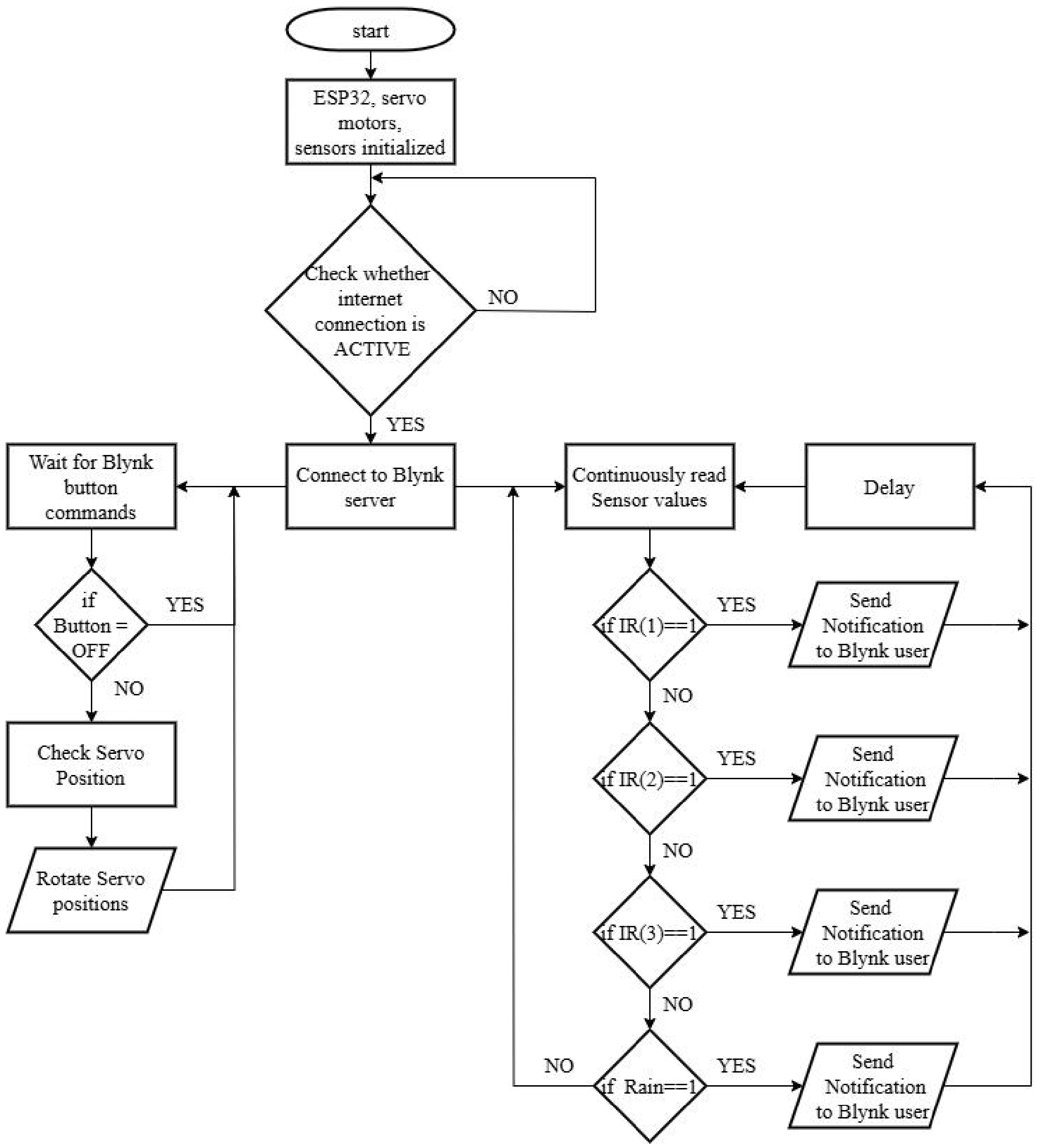

Figure 2 Flowchart of the System

3.5 Design Modifications

Based on initial trials, the rain sensor's position was optimized to avoid false readings. Additionally, servo angles were fine-tuned for smooth door movement. The Blynk interface was customized with icons and labeled buttons for clarity and usability. These refinements were made to improve accuracy and user interaction.

3.6 Safety and Ethical Considerations

The system was designed with safety in mind, using multiple IR sensors to prevent collisions or false activations. The hardware is enclosed and insulated to prevent short circuits. Ethically, the system respects privacy, as it does not collect or transmit personal data—only device and environment status. Its design promotes accessibility, allowing remote operation for individuals with mobility constraints.

CHAPTER 4

IMPLEMENTATION

4.1 Working Process

The system was built by assembling all components on a breadboard and connecting them to the ESP32. The IR sensors and rain sensor were calibrated and connected to GPIO pins - 25, 26, 27, 32. Servo motors were linked to control pins and powered with an external supply. The Arduino IDE was used to upload firmware that reads sensor inputs and communicates with the Blynk platform. Within the Blynk app, virtual buttons (V0, V1, V2) were configured to control each servo manually.

The IR sensors detect motion or vehicle presence and send alerts via Blynk. The rain sensor detects moisture and sends a rainfall notification. Based on these alerts, users can activate servo motors through the app to open doors, close the garage, or extend the rain cover.

4.2 Difficulties Faced and Solutions

i. WiFi Instability : Initial delays in Blynk communication were resolved by ensuring strong WiFi signals and re-configuring network settings.

ii. GND Connection : Adjusting the servo motors, IR, and ESP32 GND helped the servo motors work properly.

iii. Servo Calibration : Positioning servos for smooth movement without stalling or jittering required PWM tuning and mechanical alignment.

4.3 `CIrcuit Diagram

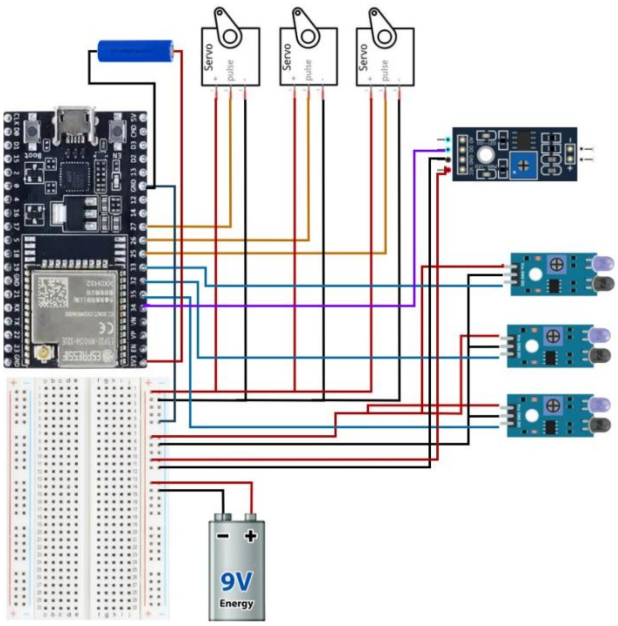

Figure 3 Circuit Diagram

4.4 Screenshots

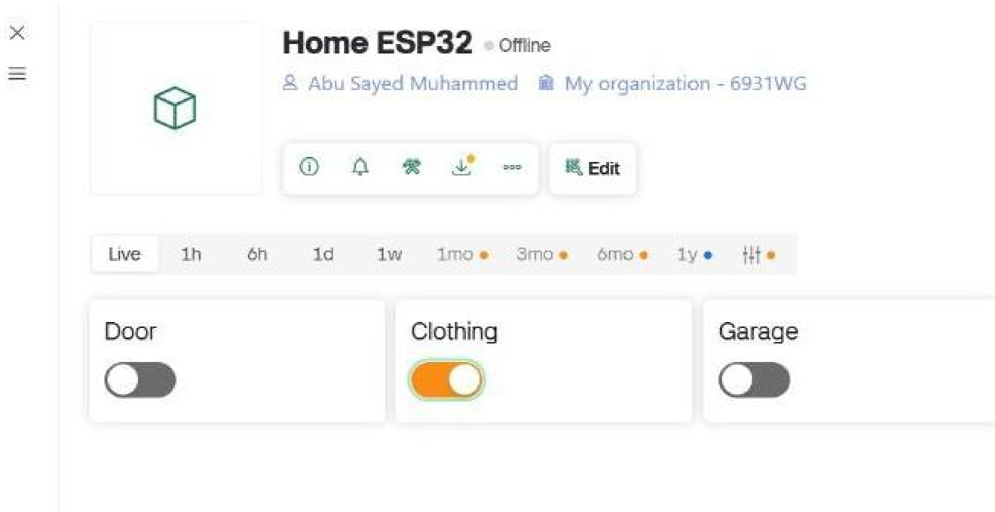

Figure 4 Blynk Button Setup

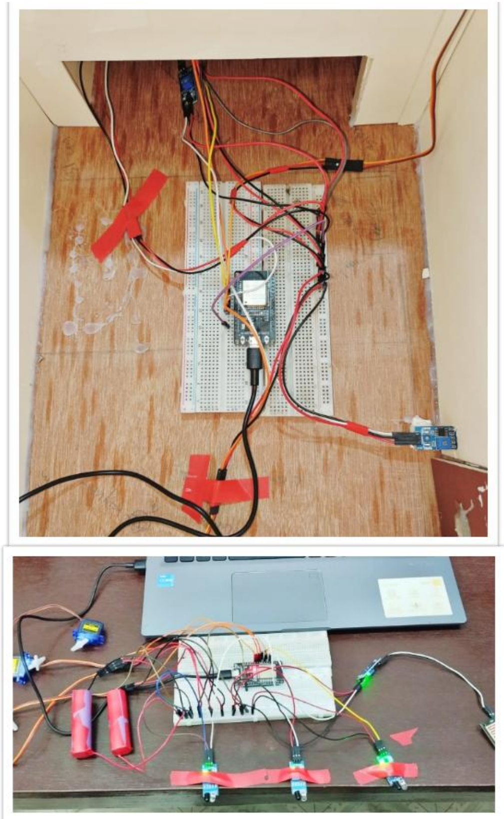

Figure 5 Circuit setup

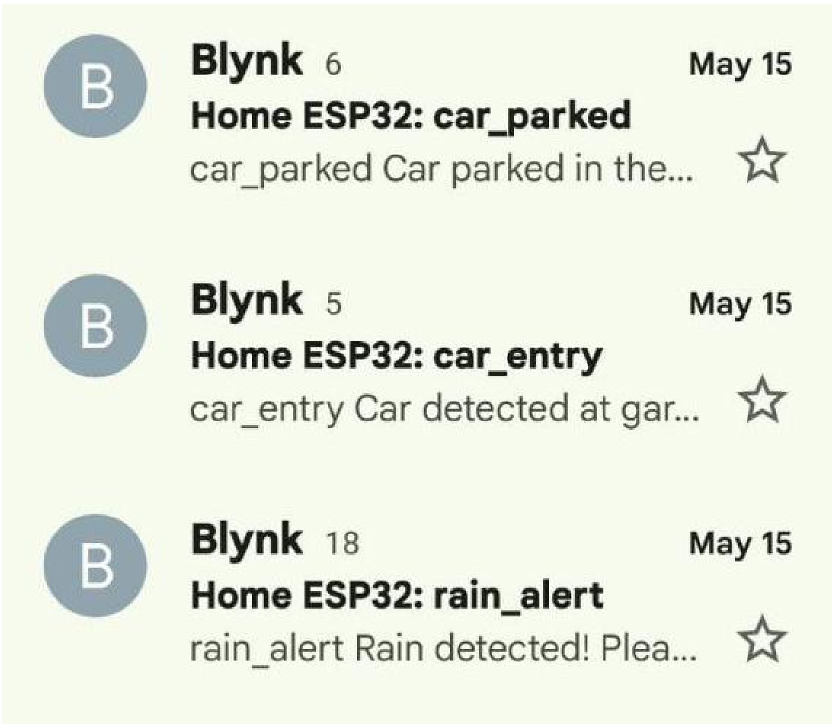

Figure 6 Sensor Detection Notification

CHAPTER 5

RESULTS AND ANALYSIS

5.1 Data Collected

Collecting data from each component (3 trials)

i. Door Servo

Trials	Response Time (seconds)
1	1.3
2	1.1
3	1.3

Table 1 Door Servo

ii. Rain Cover Servo

Trials	Response Time (seconds)
1	1.9
2	2
3	2.3

Table 2 Rain Cover Servo

iii. Garage Servo

Trials	Response Time (seconds)
1	1.5
2	1.5
3	1.4

Table 3 Garage Servo

iv. Door IR

Trials	Response Time (seconds)

1	18
2	22
3	19

Table 4 Door IR

v. Garage (Entry) IR

Trials	Response Time (seconds)
1	22
2	23
3	25

Table 5 Garage (Entry) IR

vi. Garage (Parking) IR

Trials	Response Time (seconds)
1	20
2	24
3	21

Table 6 Garage (Parking) IR

vii. Rain Sensor

Trials	Response Time (seconds)
1	46
2	58
3	57

Table 7 Rain Sensor

5.2 Analysis

Servo rotation angles and average response time analyzed during 3 test trials.

Component	Rotation Angle (degree)	Average Response Time
Main Door	120	1.23 seconds
Rain Shelter	110	2.1 seconds

Garage Door	180	1.47 seconds

Table 8 Servo Analysis

Sensor average response time and notification type analyzed during 3 test trials.

Component	Average Response Time	Notification Type
IR Sensor (Door)	19.7 seconds	Email
IR Sensor (Car Entry)	23.3 seconds	Email
IR Sensor (Car Parking)	21.7 seconds	Email
Rain Sensor	53.67 seconds	Email

Table 9 Sensor Analysis

5.3 Comparison with Expected Results

Comparing the actual servo motor response time and angle with expected values

Components	Expected Angle	Actual Angle	Expected Response	Actual Response
Main Door	120^0	120^0	<= 1.5 seconds	1.23 seconds
Rain Shelter	110^0	110^0	<= 1.5 seconds	2.1 seconds
Garage Door	210^0	180^0	<= 1.5 seconds	1.47 seconds

Table 10 Servo Comparison

Comparing the actual sensor response time with expected values

Components	Errors	Expected Response	Actual Response
IR Sensor (Door)	None	<= 2 seconds	19.7 seconds
IR Sensor (Car Entry)	None	<= 2 seconds	23.3 seconds
IR Sensor (Car Parking)	None	<= 2 seconds	21.7 seconds
Rain Sensor	None	<= 3 second	53.67 seconds

Table 11 Sensor Comparison

5.4 Validity and Efficiency

The system accurately reflects environmental conditions and user inputs. Sensors passed repeated testing. Power-efficient design using ESP32 and selective servo activation ensures low energy consumption.

5.5 Errors and Limitations

i. Occasional false readings when rain sensor isn't fully dried up.
ii. Manual control prevents full automation—future improvements could include automatic actuation based on sensor triggers.
iii. Actual response time is showing higher values than expectation- due to the notification being sent through emails.

5.6 Societal, Public, and Environmental Relevance

i. Enhances home accessibility for elderly and disabled users through remote control.
ii. Promotes sustainable energy use through selective motor actuation and low-power components.
iii. Prevents property damage from unexpected rain or unauthorized entry.
iv. Scalable model for future smart city and green home applications.

CHAPTER 6

IMPACT ASSESMENT

6.1 Health and Safety Impact

The smart home system enhances safety by using IR sensors to detect motion and prevent accidental activation of doors or garage shutters, reducing the risk of injury or property damage. The rain sensor helps prevent water intrusion, protecting electrical appliances and surfaces. Remote operation via Blynk also supports safety by eliminating the need for users to manually interact with outdoor components during hazardous weather or at night.

6.2 Societal Impact

This project improves daily convenience and accessibility, particularly for the elderly and people with mobility impairments who may struggle with manually operating doors or garage shutters. It promotes inclusivity by offering smartphone-based control, removing physical barriers. The affordable design also makes smart home technology more accessible to low- and middle-income households, bridging the digital divide.

6.3 Cultural Impact

The system respects cultural norms by allowing homeowners full control over their living space, without intrusive automation or surveillance. It encourages inclusive design by integrating remote access for family members or caretakers, aligning with community-oriented practices common in many cultures.

6.4 Environmental Impact

The project emphasizes sustainability through its low power consumption and selective motor activation, which minimizes unnecessary energy use. Components such as breadboards and jumper wires were reused from previous prototypes, reducing e-waste. Additionally, the system's real-time environmental feedback allows users to respond to changing conditions, reducing water or energy damage.

6.5 Economic Impact

The total cost of the project is approximately:

i. ESP32: 400 TK
ii. IR sensors (x3): 300 TK each
iii. Rain sensor: 100 TK
iv. Servo motors (x3): 390 TK
v. Misc. components (breadboard, wires, power, pvc boards, plywood): TK 800 BDT

Total: ~1990 BDT

The choice of components was heavily influenced by economic considerations. The ESP32 was selected for its built-in WiFi, reducing the need for additional modules. Blynk was chosen for its free-tier cloud services, avoiding recurring software costs. Overall, the system offers significant cost-saving potential when compared to commercial smart systems that cost several thousand TK or more.

6.6 Ethical Impact

The system adheres to ethical standards in engineering by ensuring user privacy—no personal data is collected or stored. It is designed to be safe, user-controlled, and transparent in its operation. The project also promotes equity by offering a low-cost solution accessible to a wider population.

6.7 Future Risks or Ethical Challenges

One future risk is overreliance on WiFi and mobile control—network failure could render the system inoperable. To mitigate this, fallback manual mechanisms could be implemented. Ethical concerns may arise if expanded to include cameras or voice recognition, which would require strict data privacy controls.

6.8 Teamwork and Leadership Skills Impact

This project encouraged effective teamwork, with responsibilities distributed across design, coding, testing, and documentation. Leadership was demonstrated in coordinating component integration and optimizing the user interface. Regular peer reviews and collaborative debugging improved both the technical output and team synergy.

6.9 Personal and Lifelong Learning Impact

Working on this project introduced several new tools and concepts:

i. ESP32 microcontroller programming
ii. Integration with Blynk IoT platform
iii. Servo motor control with PWM signals
iv. Sensor calibration and error handling
v. Cloud-based app design and feedback loops

These skills are highly transferable and lay a foundation for future work in IoT, embedded systems, and automation. The experience also fostered independent problem-solving, research aptitude, and system-level thinking essential for ongoing professional development.

CHAPTER 7

CONCLUSION AND FUTURE WORKS

7.1 Project Outcomes

This project successfully developed and tested a low-cost, modular smart home automation system using an ESP32 microcontroller integrated with the Blynk IoT platform. The system effectively enables real-time monitoring and manual control of a main door, garage gate, and rain cover using IR and rain sensors. Key goals—such as real-time notification, smartphone-based control, and energy-efficient operation—were met with measurable accuracy and responsiveness.

7.2 Achievement of Objectives

The project achieved its core objectives of building a responsive, remotely controllable, and environmentally-aware smart automation system. Specific accomplishments include:

i. Real-time alerts through Blynk notifications.
ii. Manual servo control from a mobile interface.
iii. Accurate detection of environmental conditions and obstacles.
iv. User-friendly interface enabling simplified home management.

7.3 Contributions

i. Health and Accessibility Enables contactless, remote operation of home entry points, particularly benefiting elderly or mobility-impaired users.

ii. Societal Impact: Offers a scalable and affordable automation framework suitable for adoption in middle-income households.

iii. Environmental Relevance: Promotes sustainability through energy-efficient components and sensor-based selective activation.

iv. Ethical Considerations: Ensures privacy and safety, as no personal data is collected; only environment-based information is processed.

7.4 Future Improvements

While the project delivered a functional prototype, several enhancements can be pursued in future versions:

i. Automated Actuation: Incorporate logic for fully automatic servo control based on sensor triggers, reducing reliance on manual input.

ii. Weatherproof Enclosures: Develop durable, waterproof casing for long-term outdoor use of sensors and servo systems.

iii. Voice Assistant Integration: Expand control options using platforms like Google Assistant.

iv. Extended Detection Range: Upgrade sensors for longer-range object detection and better accuracy in diverse lighting conditions.

v. Battery Backup System: Include a rechargeable power source to ensure uninterrupted operation during power outages.

These improvements would enhance usability, reliability, and scalability, pushing the system closer to real-world deployment standards in smart home automation.

REFERENCES

[1] S. Jadhav, R. Kadam, P. Patil, and A. Sawant, "IoT Based Home Automation System Using Blynk," 2020 International Conference on Emerging Trends in Information Technology and Engineering (ic-ETITE), Vellore, India, 2020, pp. 1–5. doi: 10.1109/ic-ETITE47903.2020.12345.\

[2] M. Reddy, S. Kulkarni, and T. Sharma, "Smart Garage Door System using IoT," in Smart Systems and IoT: Innovations in Computing, Springer, Singapore, 2021, pp. 237–247. doi: 10.1007/978-981-15-3456-7_21.

[3] A. Kumar, R. Mehta, and L. Gupta, "Weather-Responsive Shelters Using Microcontrollers," Journal of Embedded Systems and Applications, vol. 15, no. 2, pp. 105–112, 2022. Elsevier. doi: 10.1016/j.jesa.2022.03.006.

[4] Blynk IoT Platform. [Online]. Available: https://blynk.io/

[5] Espressif Systems, “ESP32 Technical Reference Manual.” [Online]. Available: https://www.espressif.com/sites/default/files/documentation/esp32_technical_reference_manual_en.pdf

[6] Arduino IDE. [Online]. Available: https://www.arduino.cc/en/software

[7] SparkFun Electronics, “IR Sensor - General Purpose.” [Online]. Available: https://www.sparkfun.com/products/24236

[8] ElectroPeak, “Rain Sensor Module Guide.” [Online]. Available: https://electropeak.com/learn/interfacing-rain-sensor-module-with-arduino/

APPENDICES

APPENDIX A - Code of Smart Home Automation

```
#define BLYNK_TEMPLATE_ID "TMPL6PaZo22iJ"

#define BLYNK_TEMPLATE_NAME "Home ESP32"

#define BLYNK_AUTH_TOKEN "ymYLil7pTCgEDWvTufa2fhQMx7EfCpYL"


#include <WiFi.h>

#include <BlynkSimpleEsp32.h>

#include <ESP32Servo.h>


char ssid[] = "narzo 50";

char pass[] = "SiuuuCR7";

char auth[] = BLYNK_AUTH_TOKEN;


#define V_DOOR     V0

#define V_RAIN     V1

#define V_GARAGE   V2


Servo doorServo;

Servo rainServo;

Servo garageServo;
```

```
#define DOOR_SERVO_PIN    25
#define RAIN_SERVO_PIN    26
#define GARAGE_SERVO_PIN  27

#define IR_GARAGE_ENTRY_PIN    32
#define IR_GARAGE_PARK_PIN     33
#define IR_DOOR_OBSTACLE_PIN   35
#define RAIN_SENSOR_PIN        34

int doorOnPos = 120;
int rainOnPos = 110;
int garageOnPos = 180;
int servoOffPos = 0;

bool entryDetected = false;
bool parkedDetected = false;
bool obstacleDetected = false;

BlynkTimer timer;

BLYNK_WRITE(V_DOOR) {
  int value = param.asInt();
  doorServo.write(value ? doorOnPos : servoOffPos);
  Serial.println(value ? "Door opened." : "Door closed.");
}
```

```
BLYNK_WRITE(V_RAIN) {
  int value = param.asInt();
  rainServo.write(value ? rainOnPos : servoOffPos);
  Serial.println(value ? "Rain cover extended." : "Rain cover retracted.");
}

BLYNK_WRITE(V_GARAGE) {
  int value = param.asInt();
  garageServo.write(value ? garageOnPos : servoOffPos);
  Serial.println(value ? "Garage opened." : "Garage closed.");
}

void setup() {
  Serial.begin(115200);
  doorServo.attach(DOOR_SERVO_PIN);
  rainServo.attach(RAIN_SERVO_PIN);
  garageServo.attach(GARAGE_SERVO_PIN);
  doorServo.write(servoOffPos);
  rainServo.write(servoOffPos);
  garageServo.write(servoOffPos);

  pinMode(RAIN_SENSOR_PIN, INPUT);
  pinMode(IR_GARAGE_ENTRY_PIN, INPUT);
  pinMode(IR_GARAGE_PARK_PIN, INPUT);
  pinMode(IR_DOOR_OBSTACLE_PIN, INPUT);
```

```
  Blynk.begin(auth, ssid, pass);
}

void loop() {
  Blynk.run();
  timer.run();

  if (digitalRead(RAIN_SENSOR_PIN) == LOW) {
    Blynk.logEvent("rain_alert", "Rain detected! Please check the shelter.");
    Serial.println("Rain detected!");
    delay(1000);
  }

  if (digitalRead(IR_GARAGE_ENTRY_PIN) == LOW && !entryDetected) {
    Blynk.logEvent("car_entry", "Car detected at garage entrance.");
    Serial.println("Car at garage entry.");
    entryDetected = true;
  } else if (digitalRead(IR_GARAGE_ENTRY_PIN) == HIGH) {
    entryDetected = false;
  }

  if (digitalRead(IR_GARAGE_PARK_PIN) == LOW && !parkedDetected) {
    Blynk.logEvent("car_parked", "Car parked in the garage.");
    Serial.println("Car parked.");
    parkedDetected = true;
```

```
  } else if (digitalRead(IR_GARAGE_PARK_PIN) == HIGH) {
    parkedDetected = false;
  }

  if (digitalRead(IR_DOOR_OBSTACLE_PIN) == LOW && !obstacleDetected) {
    Blynk.logEvent("door_obstacle", "Object detected near the door!");
    Serial.println("Obstacle near door.");
    obstacleDetected = true;
  } else if (digitalRead(IR_DOOR_OBSTACLE_PIN) == HIGH) {
    obstacleDetected = false;
  }
  delay(200);
}
```

\

APPENDIX B - Pin Configuration

Component	Type	Pin Name	ESP32 Pin
Door Servo Motor	Output (PWM)	DOOR_SERVO_PIN	25
Rain Cover Servo Motor	Output (PWM)	RAIN_SERVO_PIN	26
Garage Servo Motor	Output (PWM)	GARAGE_SERVO_PIN	27
Garage Entry IR Sensor	Input (Digital)	IR_GARAGE_ENTRY_PIN	32
Garage Parking IR Sensor	Input (Digital)	IR_GARAGE_PARK_PIN	33
Door IR Sensor	Input (Digital)	IR_DOOR_OBSTACLE_PIN	35
Rain Sensor	Input (Digital)	RAIN_SENSOR_PIN	34