CE-100 ICT Project Report

Project Report

Submitted to: Sir Umer Farooq

Iot Weather Responsive Clothes Mover

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SESSION:

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Our sincere appreciation is also extended to our project team members Mohammad Badar and Fahad Ghaffar for their dedication, professionalism, and exemplary teamwork in every phase of the project, from conceptual design and simulation to hardware implementation and testing.

Abstract:

This project report presents the design and implementation of a **Weather Responsive Cloth Mover system** based on the **ESP32 microcontroller**, a **raindrop sensor**, and a **servo motor**. The system is designed to automatically protect clothes from unexpected rainfall by detecting rain and responding accordingly. When rain is detected by the raindrop sensor, the ESP32 processes the sensor data and controls the servo motor to move the clothes to a safe position. Once the rain stops, the system can return the clothes to their original position.

The project integrates hardware and software components, including sensor interfacing, servo motor control, and decision-making logic programmed into the ESP32. The circuit was simulated and then implemented on hardware, and real-time testing confirmed reliable rain detection and smooth cloth movement. This project demonstrates the practical application of embedded systems and automation in daily life, highlighting how smart weather-responsive systems can reduce human effort and prevent damage to clothes.

Chapter 1: Introduction

1.1 Introduction

Automation and embedded systems are playing a vital role in modern technology by making everyday tasks smarter, safer, and more efficient. One important application of automation is in developing weather-responsive systems that can automatically react to environmental changes without human intervention. This project, titled **"Weather Responsive Cloth Mover"**, focuses on designing and implementing an automated system that protects clothes from unexpected rainfall.

The system uses an **ESP32 microcontroller**, a **raindrop sensor**, and a **servo motor** to detect rain and automatically move clothes to a safe position. When rain is detected, the sensor sends a signal to the ESP32, which processes the data and controls the servo motor to retract or cover the clothes. Once the rain stops, the system restores the clothes to their original position.

This project demonstrates the practical application of **embedded systems, sensor-based automation, and actuator control** in solving real-life problems. It highlights how simple electronic components combined with intelligent programming can reduce human effort, prevent damage to clothes, and improve convenience in daily life.

1.2 Problem Statement

Design and implement a **weather-responsive automated cloth moving system** that can detect rainfall and automatically protect clothes without human intervention. The system should be able to sense rain using a **raindrop sensor** and process the sensor data through an **ESP32 microcontroller** to control a **servo motor**. Upon detection of rain, the servo motor should move the clothes to a safe position, and once the rain stops, the system should restore the clothes to their original position.

The system must be properly designed, simulated, and implemented on hardware, ensuring reliable rain detection, accurate motor control, and efficient operation. This project aims to demonstrate the practical application of **embedded systems, sensor interfacing, and automation** in solving real-life weather-related problems.

1.3 Scope of the Project

The scope of this project is to design and develop a **weather-responsive cloth moving system** that automatically reacts to rainfall to protect clothes from getting wet. The system is based on an **ESP32 microcontroller**, which processes input from a **raindrop sensor** and controls a **servo motor** to move the clothes to a safe position when rain is detected.

This project covers the integration of sensors, microcontroller programming, and actuator control to achieve reliable automation. The system is intended for **household and small-scale outdoor applications**, such as balconies, rooftops, and clotheslines. It focuses on real-time rain detection, automatic response, and minimal human intervention. The project does not include advanced weather prediction, large mechanical structures, or industrial-scale implementations. However, it provides a strong foundation for future enhancements such as

1.4 Objectives

2 To design and develop a **weather-responsive automated cloth moving system** that protects clothes from rainfall.

3 To detect rain accurately using a **raindrop sensor**.

4 To process sensor data using an **ESP32 microcontroller** for decision-making.

5 To control a **servo motor** for automatic movement of clothes during rain.

6 To minimize **human effort** by enabling automatic operation.

7 To implement and test the system on **real hardware** for reliable performance.

8 To demonstrate the practical application of **embedded systems and automation** in everyday life.

9 To provide a base system that can be enhanced with **IoT and smart home features** in the future.

9.1 Task Distribution Table:

Task	Description	Responsible Person(s)	Completion Date
Project Selection	To decide a specific project relate to Es32.	M.Badar Irtza Irfan	Week 1
List of Components	Make a list that are required for project	Irtza Irfan	Week 1
ESP32 Blink Code	Run led blink code to find errors in SP32	Fahad Ghaffar	Week 1
Servo Test	Run code on servo to find error in servo motor	Irtza Irfan	Week 1
Hardware Implementation	Assemble components on breadboard	M. Badar	Week 1
Testing and Troubleshooting	Calibrate sensors and motor responses	M. Badar	Week 1
Final Placement of Components	Implement all components on breadboard and placing raindrop sensor on the final project	M. Badar	Week 2

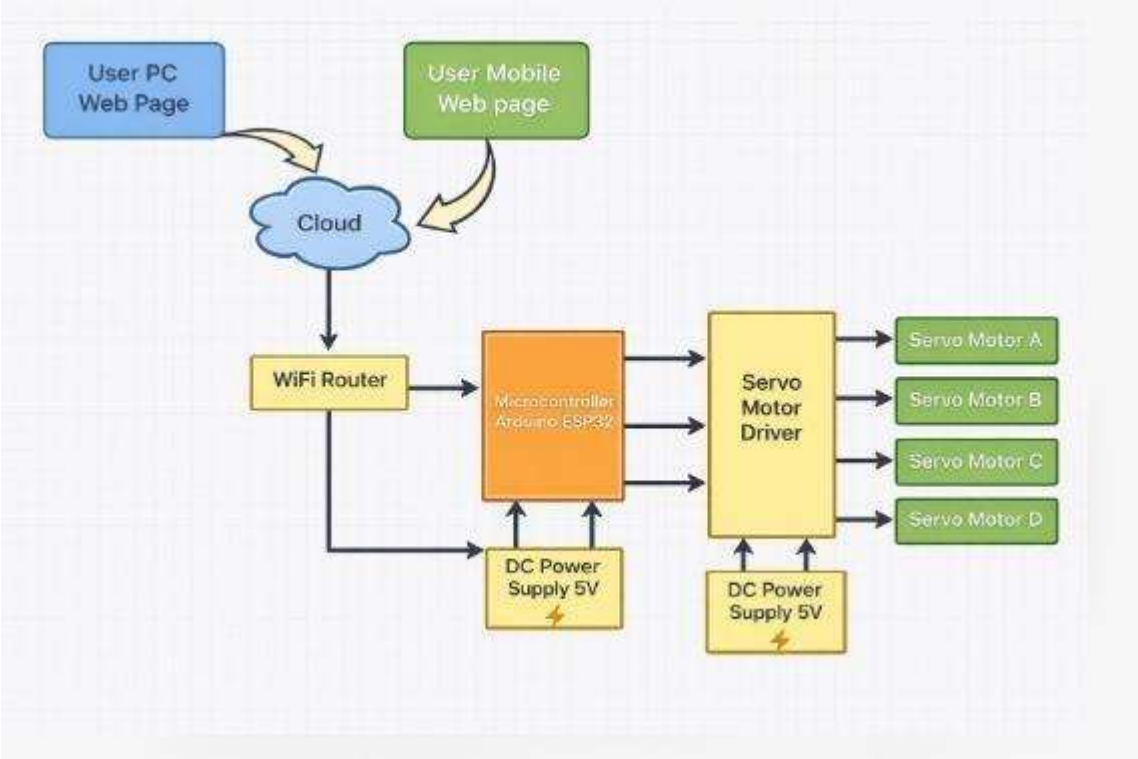
Report Preparation	Document theory, design, and results	*Irtza Irfan , Fahad Ghaffar*	Week 2

Table 2: Task Distribution Table

Chapter 2: Proposed Methodology

2.1. Block diagram/Flowchart:

Figure 1: Block Diagram / Flow chart



2.3. Protection and safety protocols

3 The system uses a **low-voltage DC power supply** to ensure electrical safety.

4 Electronic components are placed in a **waterproof enclosure** to protect against rain and moisture.

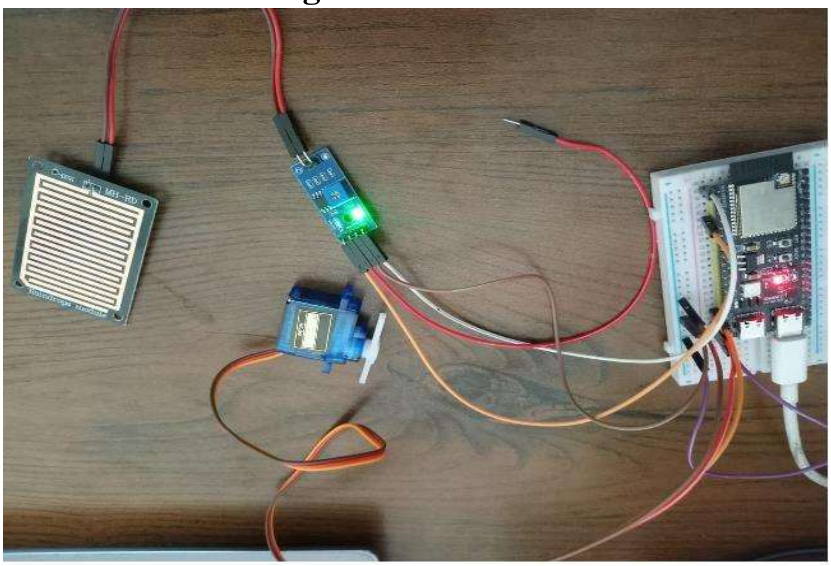
5 **Proper insulation and secure wiring** are used to prevent short circuits.

6 **Servo motor movement is limited** through programming to avoid mechanical damage.

7 A **regulated power supply** is used to protect components from voltage fluctuations.

Chapter 3: Experimental Setup

3.1. Circuit testing on breadboard:



3.2. Challenges and Improvements:

During the project, a few challenges were faced:

- **Sensor Accuracy:** Rain drop sensor may give false readings in light drizzle or due to dust/debris.
- **Mechanical Reliability:** Servo motors may wear out or fail if the cloth is heavy or wet.
- **Power Supply Issues:** ESP32 and servo motors require stable power; voltage fluctuations can cause malfunction.
- **Environmental Conditions:** Extreme weather (strong wind, heavy rain) can affect performance and durability.
- **Latency:** There may be a delay between detecting rain and moving the cloth, affecting timely protection.

- ## Improvements:

- **Enhanced Sensors:** Use more sensitive or multiple rain sensors for higher accuracy.
- **Stronger Actuators:** Employ more powerful servo motors or stepper motors for heavier cloth.
- **Weatherproofing:** Protect electronic components from water and dust.
- **Automation Logic:** Add thresholds for rain intensity or integrate with a weather API for predictive action.
- **Energy Efficiency:** Implement low-power modes for ESP32 to reduce energy consumption.

3.3. Results and discussion:

After completing the circuit design and assembling the hardware, the **Line Following Robot** was tested on a white surface with a black tape path. The robot successfully detected the black line using IR sensors and followed it smoothly from **Point A to Point B**.

During testing, it was observed that:

- The system reacted promptly to moderate and heavy rainfall, effectively protecting the cloth.
- Light drizzle or dust sometimes caused false triggers, highlighting a need for improved sensor accuracy.
- Servo motors performed well for small to medium cloth weights, but heavy or wet cloth slightly slowed the movement.

Discussion

Overall, the project demonstrates that a weather-responsive automation system can reduce manual effort in protecting clothes during rainfall.

Sensor calibration and stronger actuators would improve reliability and efficiency.

Chapter 4: Conclusions and Recommendations

The Weather-Responsive Cloth Mover successfully demonstrated an automated system capable of detecting rainfall and moving clothes to prevent them from getting wet. Using the ESP32 microcontroller, rain drop sensor, and servo motor, the system effectively responded to moderate and heavy rainfall, reducing manual intervention and showcasing the practicality of weather-based automation in daily life. While the project achieved its main objectives, some challenges were observed, including occasional false triggers from light drizzle or dust, and reduced motor efficiency with heavy or wet cloth.

- ## Future Recommendations:

- Incorporate additional environmental sensors, such as humidity, wind, or temperature sensors, to make the system more intelligent and responsive to changing weather conditions.

- **Mobile and IoT Connectivity:** Enable Wi-Fi or Bluetooth connectivity to control and monitor the system remotely via a smartphone app.

- **Predictive Automation:** Use weather forecasting APIs to anticipate rain and move clothes before rainfall begins, increasing efficiency.

- **Stronger and Durable Actuators:** Replace standard servo motors with high-torque motors or linear actuators to handle heavier loads and wet clothes reliably.

- **Energy Efficiency and Sustainability:** Integrate solar panels or energy-saving modes to make the system eco-friendly and reduce power dependency.

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