Computer Organization and Assembly Language Lab

Project Proposal – Auto Shade

Session: 2023 – 2027

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Project Title:

Smart Rain-Sensing System – *Auto Shade*

Objective:

The goal of this project is to create a smart system that detects rain drops and activates a servo motor to move a shade. This project helps us understand how sensors, microcontrollers, and motors work together in real-life applications like automatic car wipers or smart windows. The system will be implemented in two parts:

- **AVR Module (Low-Level Programming in Assembly using ATmega328P)**
- **IoT Module (High-Level Embedded C using ESP32 on Arduino IDE)**

Components Required:

Component	Quantity	Description
Arduino UNO Board (ATmega328P)	1	Microcontroller board for AVR module
SG90 Servo Motor	1	To simulate wiper movement
Raindrop Sensor Module	1	Analog sensor to detect rain via water drops
Jumper Wires	~10-20	For all circuit connections (Male-to-Male)
Breadboard	1	For connecting and prototyping the circuit without soldering
USB Cable or Battery Pack	2	Powers the Arduino board (via USB or external power)

Explanation of Each Component:

Component	Purpose
Arduino UNO Board (ATmega328P)	Acts as the central controller. In the AVR module, custom Assembly code will be used to read sensor input and control output.
SG90 Servo Motor	Detects water presence. Sends analog voltage depending on moisture level. This input will be processed by ADC in Assembly.

Raindrop Sensor Module	Used to simulate wiper movement. Controlled by generating PWM signals from Timer1 (in Assembly).
Jumper Wires	Connect sensor output to analog pin, servo signal to PWM pin, power, and ground lines.
Breadboard	Allows quick prototyping without soldering. All connections are built here.
USB Cable or Battery Pack	Supplies power to the Arduino during operation. Can be a portable or PC-connected option.

Working Principle:

- The **raindrop sensor** detects water on its surface and sends an analog voltage signal to the Arduino UNO.
- The Arduino UNO reads this analog signal using its built-in ADC (Analog-to-Digital Converter).
- If the detected signal crosses a **threshold (indicating rain)**, the Arduino sends a signal to the servo motor.
- The servo motor rotates to pull a lightweight plastic sheet (shade) over the window using a **stick** or arm with clips.
- When no rain is detected, the **motor** returns the stick to its original position, uncovering the window.
- If it's not raining, the system remains idle, constantly monitoring the sensor input.

Modules Covered:

1. AVR Module (ATmega328P with Assembly Language):

We will write custom libraries in Assembly to control:

- ADC for reading the rain sensor.
- PWM for controlling the servo motor.

This helps us understand how the microcontroller hardware works at the low level.

All code will be written using Microchip Studio in AVR Assembly Language.

2. IoT Module (ESP32 with Arduino IDE):

In this module, we will re-create the same system using the ESP32 board.

- Code will be written in C (Arduino language) using Arduino IDE.

- ESP32 will read the sensor and control the motor using built-in analog and PWM pins.
- Optional future expansion: Send rain alerts over Wi-Fi.

Conclusion:

This project helps us understand how to use small electronic systems to solve real-life problems. We learn how to use both low-level Assembly language (for AVR) and high-level C language (for IoT) to control sensors and motors. It gives us practical experience in working with hardware and software to build smart and automatic systems.