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Automatic Wiper System using Rain Sensor, Arduino Nano and Servo Motor

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Abstract - *This paper details the design and implementation of an automatic wiper system using a servo motor, Arduino Nano, and a rain detection module. When raindrops are detected by the sensor, the sensor will trigger the wiper system to operate automatically, requiring no human activation. The circuit will operate the wipers with a servo motor, use an Arduino Nano as a CPU, and use a rain sensor module to detect water. The intention of this project is to work toward driver convenience, particularly in small instrumentation such as automation prototypes or model cars.*

Keywords: Rain Sensor, Arduino Nano, Servo Motor, Automation, Embedded Systems.

1. INTRODUCTION

Automatic wipers in modern cars are both convenient and safe in inclement weather. This is what this project aims to show. This project detects the presence of water from a raindrop sensor, processes data from that signal with an Arduino Nano, and wipes with the help of a servo motor. Therefore, this prototype is a prime example of how you can automate repetitive tasks with simple hardware.

1.1Motivation and Objective

Manually controlling the windshield wipers can be a nuisance. The project takes a simple embedded systems approach to automate the situation.

The objective is to have an automatic rain sensing system to operate a servo-controlled wiper system, eliminating the need for manual control.

1.2 Overview of Components:

The Arduino Nano, which is key to the system, acts as the microcontroller and responds to a Rain Sensor Module (MH-RD). The rain sensor uses a resistive grid to detect, or not detect, water on its surface. The wiper is triggered once the rain sensor detects rain. The Arduino activates a servo motor to control the wiper mechanism using the inputs from the rain sensor.

2. SYSTEM COMPONENTS AND CONNECTIONS

The hardware configuration includes a rain sensor plate, an Arduino Nano board, a servo motor, a breadboard/Jumper wires, and a signal conditioning module (comparator). The actual rain sensor module consists of the sensing plate which detects raindrops through its change of resistivity on its edge, as well as the signal processing module which changes these analogue resistance values into a digital signal that the Arduino can read. The connections are quite simple, connecting pin for the servo motor is into one of the PWM pin of the Arduino, and the AO/DO pins of the rain sensor module are then connected to the Arduino Nano. Finally, the Arduino Nano which powers the individual components (5V USB supply operated).

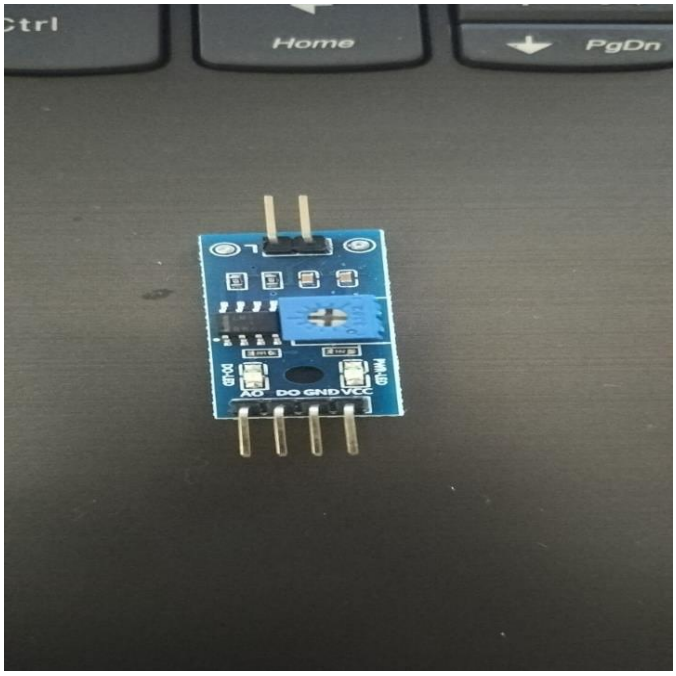

figure -1: Rain Sensor module

When rain droplets land upon the sensing plate, the resistance changes. The rain sensor module consists of a moisture detecting sensing plate and a signal processing module which consists of a comparator with analogue and digital outputs. The digital output alternates between HIGH and LOW depending upon a threshold set by the onboard

potentiometer; whereas the analogue output, gives a variable voltage proportional to the amount of water deposition on the sensing plate. This dual output capability enables accuracy of detection and control in multiple applications. Due to this capability, the rain sensor module is a reliable and simple module that is particularly useful in systems like smart irrigation, weather stations, and automated wiper systems.

Fig -2: Raindrop Sensing Pad

A flat PCB that has a grid of conductive tracks, the rain drop sensing pad is designed to sense the presence of water. When raindrops land on the pad, the water bridges the conductive tracks and this results in a change in resistance. The presence of rainfall and its intensity are then established by using this change as input to further signal processing.

Connections:
The Arduino Nano is connected to the AO/DO pins of the rain module.
The Arduino Nano's pin is linked to the servo signal pin.
Power is supplied via USB (5V).

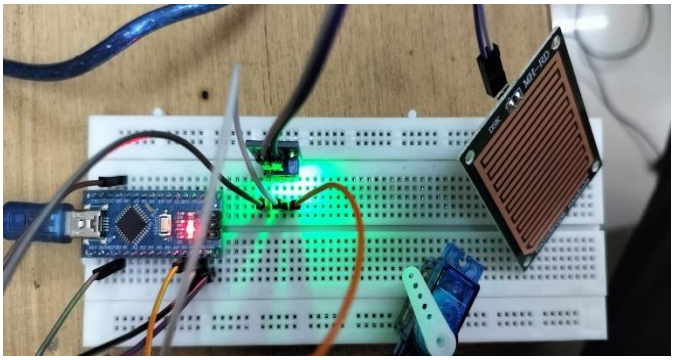

Fig -3: connections

3. SOFTWARE IMPLEMENTATION

The Arduino code tracks continuous output from the rain sensor module. The servo motor exhibits wiping action, swinging back-and-forth, every time it detects raindrops (digital output LOW). The servo will return to its original start location at the same time that water is not located.

Important capabilities:

Rain detection using analogRead() and digitalRead()

Controlling the servo with Servo.write().

Timing logic and debouncing to allow for smooth operation.

4. RESULTS AND ANALYSIS

When water came in contact with the sensor plate to test the prototype, the servo motor immediately began to wipe the surface as it recognized raindrops. Fast action was possible because of the short delay between detection and servo movement. While testing the prototype, the system reacted successfully to multiple rain events, indicating it works as intended. This idea could be used for solar panels, vehicles, and any other surface that needs automatic maintenance and cleaning.

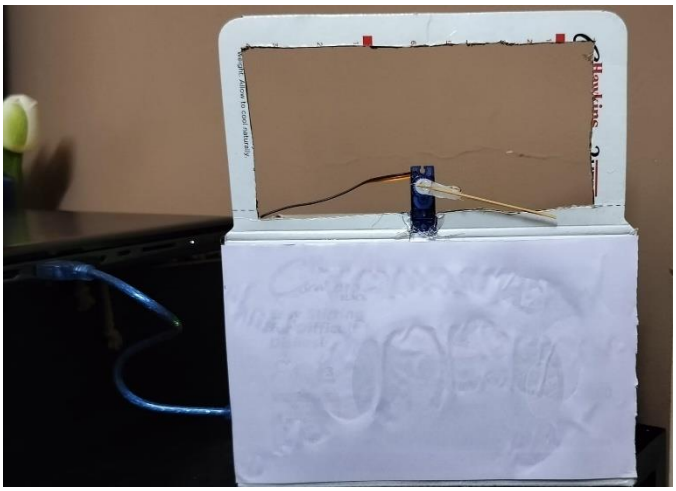

Fig -4: Result (created a wiper-screen prototype & a wooden stick is attached to the servo's arm acting as wiper)

5. CONCLUSION

The goal of the project is to present a way to connect the use of an Arduino Nano, servo motor, and rain sensor, to create a simple low cost and efficient process to activate wipers automatically. The prototype can be expanded and adapted for practical real-time use with automated machinery, vehicles, or windows.

REFERENCES

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