DETECTION OF INTENSITY OF RAIN AND ACTUATION OF WIPER MOTOR USING RAIN SENSOR

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report

"**DETECTION OF INTENSITY OF RAIN AND ACTUATION OF WIPER MOTOR USING RAIN SENSOR**"

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ABSTRACT

A rain sensor or rain switch is a switching device activated by rainfall. There are two main applications for rain sensors. The first is a water conservation device connected to an automatic irrigation system that causes the system to shut down in the event of rainfall.

The second is a device used to protect the interior of an automobile from rain and to support the automatic mode of windscreen wipers. An additional application in professional satellite communications antennas is to trigger a rain blower on the aperture of the antenna feed, to remove water droplets from the mylar cover that keeps pressurized and dry air inside the wave-guides.

Needless to say, the rain sensor has quite a diversified field of applications, in which it can be used depending upon the mechanism of the systems. In this project, we tried to replace the already existing optical rain sensor with a potentiometer rain sensor (both are automatic) at effectively low cost.

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INTRODUCTION

- A windscreen wiper or windshield wiper is a device used to remove rain, snow, ice and debris from a windscreen or windshield. Almost all motor vehicles, including cars, trucks, train locomotives, watercraft with a cabin and some aircraft, are equipped with such wipers, which are usually a legal requirement.

- A wiper generally consists of a metal arm, pivoting at one end and with a long rubber blade attached to the other. The arm is powered by a motor, often an electric motor, although pneumatic power is also used in some vehicles. The blade is swung back and forth over the glass, pushing water or other precipitation from its surface.
- The speed is normally adjustable, with several continuous speeds and often one or more "intermittent" settings. Most automobiles use two synchronized radial type arms, while many commercial vehicles use one or more pantograph arms.
- Wipers may be powered by a variety of means, although most in use today are powered by an electric motor through a series of mechanical components, typically two 4-bar linkages in series or parallel.
- So here we propose an automatic rain sensor system that automatically switches ON and OFF. On detecting rain, it turns on and turn off when rain stops. Our project brings forward this system to automate the wiper system, having no need for manual intervention. For this purpose, we use a potentiometer (in the form of plate), a voltage comparator and a driver (servo motor).
- The rain sensor works on the principle of using water for completing its circuit, so when rain falls on potentiometer plate,

the voltage comparator measures the change in voltage and send the output to servo motor gets completed and sends out output, accordingly to servo motor.

- The systems become an even more appealing feature, as they work to minimize the time the driver must take his/her hands off the wheel. These systems detect droplets of rain on the windshield and automatically turn on and adjust the wiper system in accordance to the level of precipitation.
- Current rain-sensing systems use an optical sensor to detect the presence of water on the windshield, and relay wiper control data to the vehicle's body control module (BCM). Unfortunately, these optical rain sensors suffer from a small sensing area, are prone to false positives, need to eliminate noise, and are too expensive to be included as standard equipment in most vehicles.
- Over the past two decades, the automotive industry has aggressively researched ways to exploit modern computing and electronic advances in the development of safety, reliability, and entertainment technologies.
- Despite this, automatic rain-sensing wiper systems are relatively uncommon in modern vehicles for a number of reasons. They are often too expensive, too unsightly, or too unreliable to be desired in new automobiles. Many attempts have been made at constructing an effective, reliable, and cheap rain detection and wiper control system for vehicles speed and intermittent interval automatically according to the amount of rain.
- To measure the amount of water usually use optical sensor. In this type of sensors uses the fact that the reflection angle changes when the screen is wet. Even though optical sensors are used

widely they have some disadvantage. One of disadvantages is the sensitivity to external light.

- Another problem is occurring when car drive at night or gone through tunnel and even in underground parking. For this many systems still activate the wiper when the car comes out of tunnels or underground parking lot.
- Another shortfall, maybe a major one is that the sensing area is a relatively small portion of windshield. Hence the system operates only with limited area.

AUTOMOTIVE RAIN SESNORS:

- Vehicles are now available with driver-programmable intelligent (automatic) windscreen wipers that detect the presence and amount of rain using a rain sensor. The sensor automatically adjusts the speed of the blades according to the amount of rain detected.
- Rain sensing windscreen wipers appeared on various models in the late 20th century, one of the first being Nissan's 200SX/Silvia. As of early 2006, rain-sensing wipers are optional or standard on all Cadillac and most Volkswagen, and are available on many other mainstream manufacturers.

WHY AUTOMATIC RAIN DROP SENSOR?

In present automobiles the number of facilities is much higher. The driver has to concentrate on road while driving, and with increased traffic, things get frustrating. The features in the car like GPRS to trace the route, music system, air condition system, etc., may drive away the attention of the driver.

- ✓ Thus, an effort has been made to reduce the effort put by driver in controlling the speed of the wiper and put more concentration on his driving. Since this system is put into use in many higher end cars and has been successfully working, an effort was made to reduce the cost of the system so that this system can be implemented in common economic cars where a common man can also enjoy the benefits.
- ✓ It was found that the rain sensor is the expensive unit in the present system and an effort is done in making a sensor which is

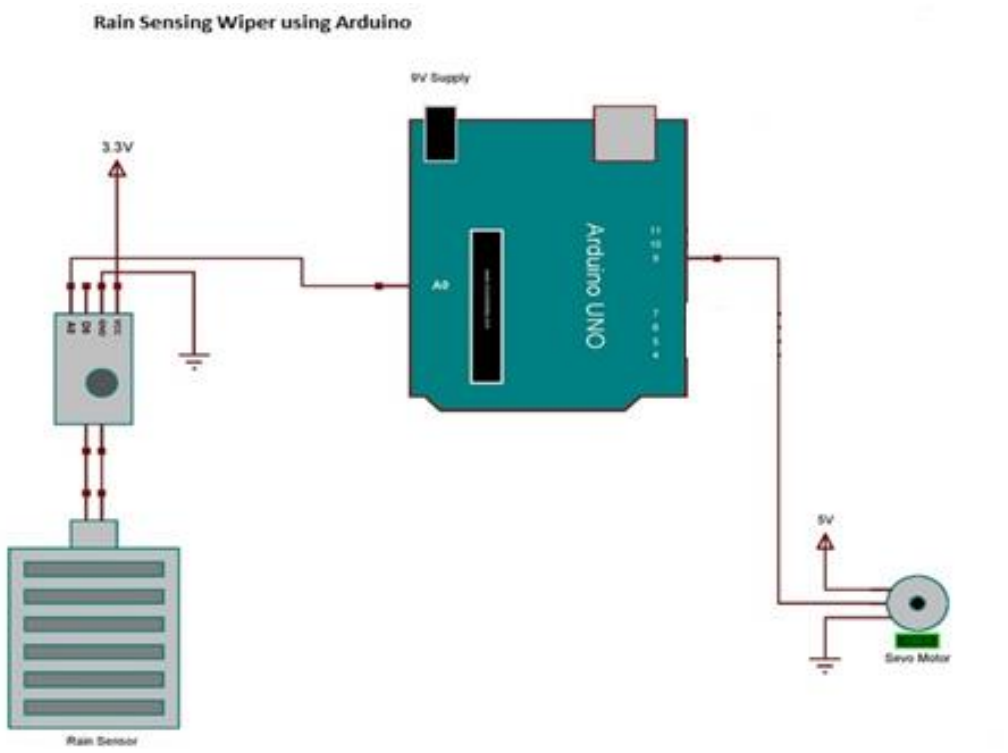
reasonable by price, the Cup Sensor. The sensing device used here is basically a conical shaped cup with a tray on the top of the cup to collect maximum possible amount of water.

- ✓ When the rain begins and the visibility to the driver is reducing, the system has to trigger the wiper to wipe the water on the screen. It can so happen that the driver feels the need of wiper but because the floater has not reached the level of the probe the system may not begin its function.

EXPERIMENT

CIRCUIT DIAGRAM:

Rain sensing wiper using Arduino Uno



POWER SUPPLY:

- The power supply unit is basically a 9V battery which was introduced for the early transistor radios. It has a rectangular prism shape with rounded edges and a polarized snap connector at the top. This type is commonly used in walkie talkies, clocks and smoke detectors.
- They are also used as backup power to keep the time in certain electronic clocks. This format is commonly available in primary carbon-zinc and alkaline chemistry, in primary lithium iron disulphide, and in rechargeable form in nickel-cadmium, nickel-metal hydride and lithium-ion.

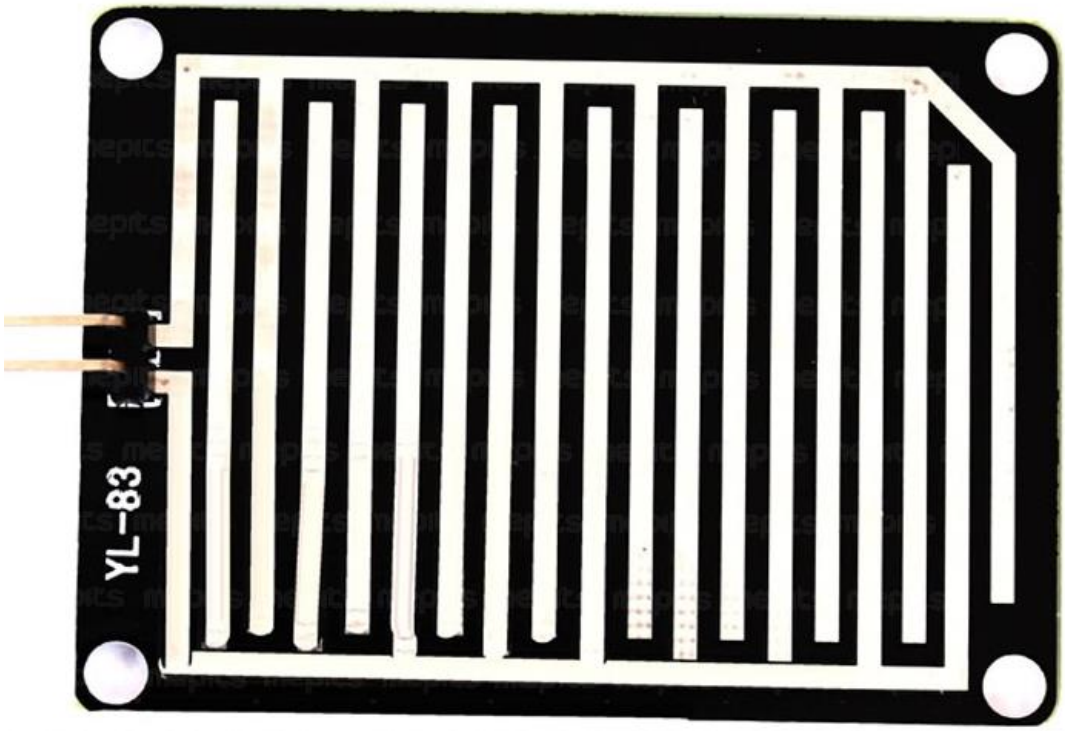
- ❖ Mercury oxide batteries in this form have not been manufactured in many years due to their mercury content.

ARDUINO UNO:

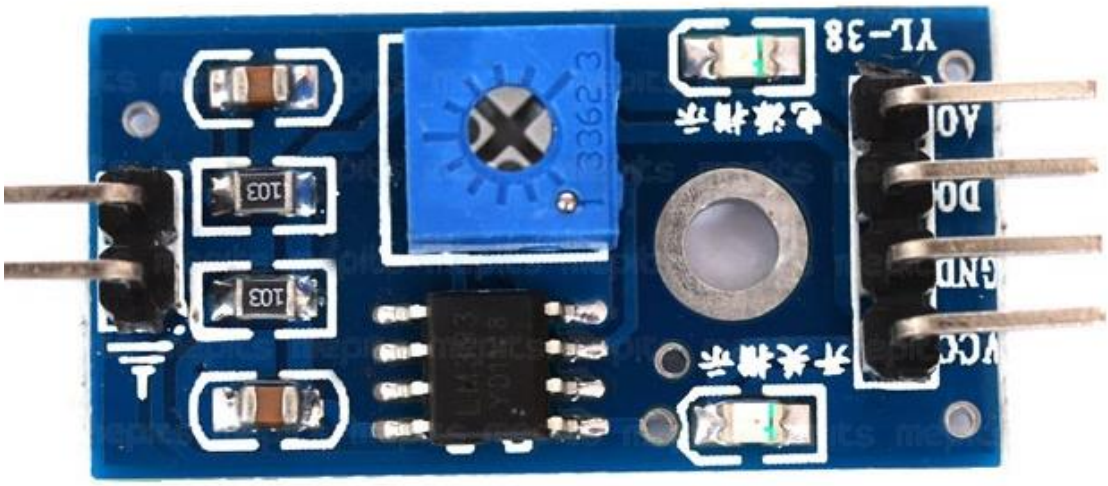
- ➢ The Arduino UNO is nothing but the microcontroller based on the ATmega328. 14 digital input/output pins, 6 analog inputs, 16 MHz ceramic resonator, a USB connection, a Power jack, an ICSP header and a reset button is contained by the Arduino Uno.
- ➢ It is fabricated with requirements to support the microcontroller. It can be connected with the computer with a USB or to the power with AC-to –DC adapter. A battery may be used for starting this.
- ➢ This is equipped with Atmega16U2 programmed as a USB to serial converters. This serial converter differs the Arduino from preceding boards which are equipped with FTDI USB-to-driver chip.

Arduino Uno

Potentiometer plate



LM393 voltage comparator



SERVO MOTOR:

- ✓ It is an electrical component which can be used to move or rotate an object with high precession and high accuracy. Servo motor is the best option to rotate an object at some required angles. It is simply created from a straight forward motor that runs through a servo mechanism.
- ✓ If the motor is employed is dc powered then it's referred to as a dc servo motor, and if it's an ac powered motor then it's referred to as an ac servo motor.
- ✓ We are able to get a really high force servo motor in little and light-weight weight packages. Due to these advantages several applications sort of a toy automobile, RC helicopters, and planes, robotics, machine etc. Servo motors are articulated in kg/cm (kilogram per centimetre) most hobby servo motors are articulated in 3kg/cm or 6kg/cm or 12kg/cm.

MG995 DC servo motor

OBJECTIVES:

- This project aims to develop an Automated Rain Operated System taking the following objectives:
- To dispense with troublesome wiper operation needed when rainfall condition change or driving condition change, including the car speed and entry to or exit from tunnels.
- To operate the wiper with response to changing rainfall or driving conditions, thus keeping the driver's windshield clear.
- To implement a control system this reduces human efforts. To increase automation in vehicle driving system.
- To achieve high safety by reducing the driver's work load.
- To minimize rates of accident caused by distraction in driving.
- To develop a cheaper automated system that can be integrated easily.

CONSTRUCTION:

- It works on the principal of resistance.
- Rain Sensor module allows to measure moisture via analog output pins and it provides a digital output when a threshold of moisture exceeds.
- The module is based on the LM393 op amp. It includes the electronics module and a printed circuit board that "collects" the rain drops.
- As rain drops are collected on the circuit board, they create paths of parallel resistance that are measured via the op amp.

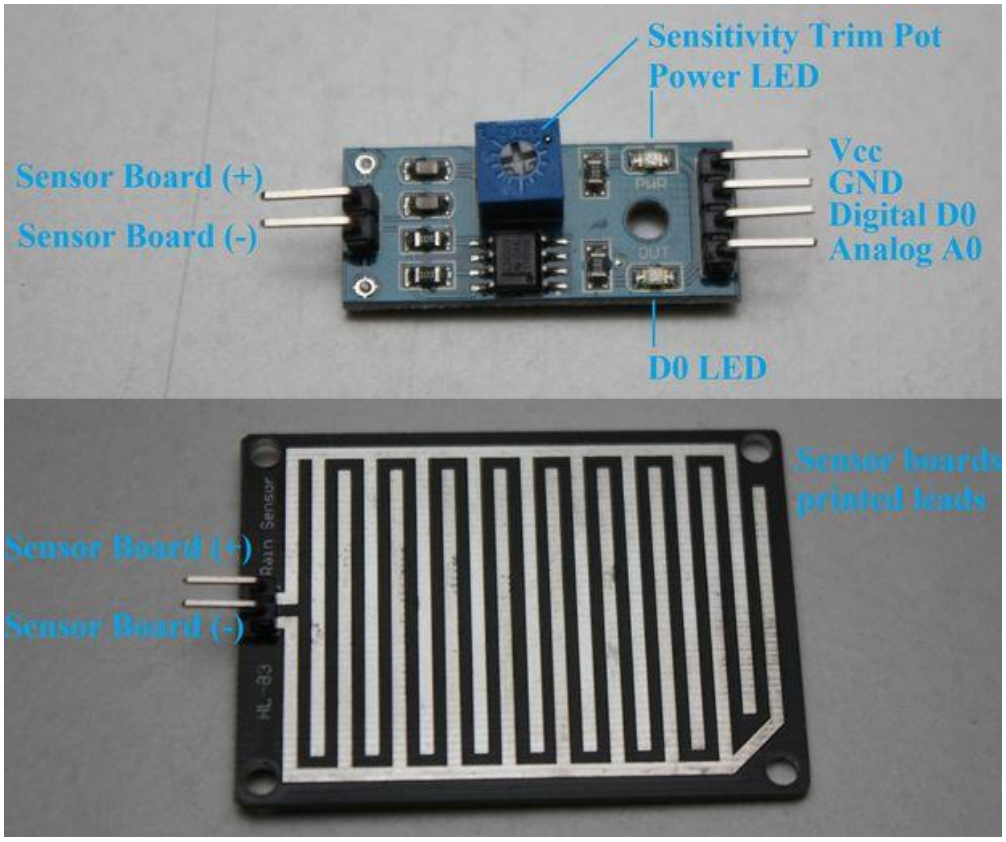
MATERIALS NEEDED:

- Rain drop sensor (lm393 and potentiometer)
- **3x** Male to Female jumper wires
- **2x** Female to Female jumper wires
- An Arduino Uno and Source of water

USAGE:

- Rain sensors are used in the detection of water beyond what a humidity sensor can detect.
- The rain sensor detects water that completes the circuits on its sensor boards' printed leads. The sensor board acts as a variable resistor that will change from 100k ohms when wet to 2M ohms when dry. In short, the wetter the board the more current that will be conducted.

Points



PINS:

A0..... Analog output

D0..... Digital output

GND..... Ground

VCC..... Positive voltage (input: 5v for analog 3.3v for Digital.)

LOOP PINS:

+ ..... Sensor board hook up A

- ..... Sensor board hook up B

Dimensions:

2.17 in x 1.57 in x 0.31 in (5.5 cm x 4.0 cm x 0.8 cm)

Weight:

0.28 oz (8 g)

Testing:

To test the Rain Sensor and ensure that it is working correctly connect the VCC to a 5v power source and GND. Try placing a few droplets of water on the Rain sensor detection board and the D0-LED should light up.

Troubleshooting:

If the D0-LED does not light up check the following:

Sometimes salinity is an issue with these units, this one worked fine with filtered, bottled water, but in some instances, you may have to add a bit of salt to increase the waters conduction.

This might be a bit trickier, but for some reason two different models by two different manufacturers have had defects in their soldering skills. Make sure all of the little SMD's and connectors have been soldered on properly.

If none of the previous makes the D0-LED light up, your sensor may be defective.

The following code maps and reads the analog values given by the Rain Sensor (0-1024). The Rain Sensor will have the following reaction with this code. If the Sensor Board is completely soaked; "case 0" will be activated and " Flood " will be sent to the serial monitor.

If the Sensor Board has water droplets on it; "case 1" will be activated and " Rain Warning " will be sent to the serial monitor.

If the Sensor Board is dry; "case 2" will be activated and " Not Raining " will be sent to the serial monitor.

** The output in "case 2", "Not Raining" is just for this demonstration. When I used this code in production, I omitted the output for this case and just had the alert for "Rain Warning" and "Flood".*

* This code is constantly updating in order to provide a real time feedback of the Rain Sensor at 9600byte/sec.

SOURCE CODE:

```
const int sensorMin = 0;

const int sensorMax = 1024;

void setup()

{

 Serial.begin(9600);
```

```
}

void loop()
{
 int sensorReading = analogRead(A0);
 int range = map(sensorReading, sensorMin, sensorMax, 0, 3);

 switch (range)
  {
   case 0:
    Serial.println("RAINING");
    break;
   case 1:
    Serial.println("RAIN WARNING");
    break;
   case 2:
    Serial.println("NOT RAINING");
    break;
  }
 delay(1000);
```

EXPLANATION OF PROGRAM:

Initialize the lowest and highest sensor readings with type as an integer and variable name.

```
const int sensorMin = 0; // sensor minimum

const int sensorMax = 1024; // sensor maximum
```

The setup() routine runs once when we reset it or power the board. Here we are initializing serial communication at 9600 Byte/sec.

```
Void setup()

{

 Serial.begin(9600);

}
```

The loop function runs over and over again forever. Firstly, this code reads the analog signal at A0 pin from Rain sensor and maps those measured value with initialized values.

```
Void loop()

{

 int sensorReading = analogRead(A0);

 int range = map(sensorReading, sensorMin, sensorMax, 0, 3);
```

Checks the measured value with pre-stored condition and displays the weather condition like RAINING, RAIN WARNING & NOT RAINING.

```
 Switch (range)

 {
```

```
 case 0: // Sensor getting completely wet
  Serial.println("RAINING");
  break;
 case 1: // Sensor getting partially wet
  Serial.println("RAIN WARNING");
  break;
 case 2: // Sensor dry
  Serial.println("NOT RAINING");
  break;
 }
delay(1000);
}
```

Pin and Description

Pin	Description
Vcc	+5 Volts Power Source
GND	Ground
D0	Digital Output. Goes low when moisture exceeds set threshold.
A0	Analog Output – Zero to five volts. The lower the voltage, the greater the moisture

POWER LED	Indicates that power is applied
OUTPUT LED	Illuminates when moisture has exceeded threshold set by sensitivity adjustment.
Sensitivity Adjustment	Clockwise is more sensitive. Counter clockwise is less sensitive.

COST OF PROJECT:

The individual cost of different parts used in this project is given below.

Part	Cost in Rupees
Potentiometer plate + LM393	150
Arduino Uno + auxiliary cable	450
Female to female and male to male jumper wires	50
Mg995 DC servo motor	410
TOTAL	1160

Thus, it is observed that the project's cost is only Rs.1160. But a manufacturing company, take this project serious, the overall cost of this module will go down significantly.

Hence, there is a great possibility of installing this module in cars and trucks.

A typical rain sensor installed in a car will cost around Rs.12500 (optional) depending upon the manufacturers. So, if anyone, seeing this report mass produced our project after doing several modifications, this project can be handy for the manufacturers to have a great profit. This can also be installed on any vehicle as an after-market device, depending upon user's needs.

ADVANTAGES AND LIMITATIONS

ADVANTAGES:

1. It can be easily and quickly installed in automobiles.

2. Low Power consumption.

3. Simple and Portable.

4. Cost Effective.

5. The source code can be easily changed depending upon user's needs and regional condition.

6. No ambient light sensor is needs, as required for a typical optical rain sensor

7. The wiper actuation angle can be changed depending upon the mechanism used in the wiper system. .

LIMITATIONS:

1. Sensitive to salinity

2. The rain sensor-based system functions when water falls on the sensor directly.

3. A separate heating coil is needed, as needed for a typical optical sensor, to heat the potentiometer up.

APPLICATIONS AND FUTURE SCOPE:

1.This small circuit finds numerous applications.

2. Useful in vehicles.

3. It can be implemented at house window for cleaning.

4. It can be used in houses as an alarm for housemates to alert about rain.

5. A slight modification in it leads to a better cleaning system.

6. Prevents glass shield or bars from getting corroded.

CONCLUSION

- As almost everything described already for this design, we would like to say there are still numerous kinds of enhancements one can implement on this project to make it even more convenient.
- The project we have made and presented is quite efficient and it is cost effective also.
- It has great advantage of over the optical sensor covering all the design specifications together with the requirements of common man.
- The speed controlling mechanism is added in this project which will make the motor to actuate according to the intensity of rain on the sensor.

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