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AUTOMATIC CAR WIPER USING RAIN SENSOR

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Abstract: Driver safety occupies a top priority in the automotive industry, where poor visibility during heavy rains often results in accidents. This article proposes an automated wiper system using a rain sensor such that it can detect rain and adjust the speed of the wipers automatically without requiring human intervention. The system comprises an Arduino, rain sensor, and a servomotor; it shall measure humidity and activate trigger signals for wiper operation when that value goes higher than the maximum set point. That is, the Arduino system can process sensor data to give commands to the servomotor that triggers wiper speed based on the intensity of rainfall. This rain sensor is mounted in the windshield, and all components will be operated through the car battery.

INTRODUCTION

A windshield wiper is an apparatus that wipes raindrops off a windshield. Nowadays, every vehicle is equipped with wipers so that no accidents occur and the human control of the wipers is minimized for luxury. A typical wiper is made of a metal arm and a long rubber blade. Some cars use pneumatic power. The metal arm is connected to an electric motor in this case. The blade moves clockwise and anti-clockwise over the glass pushing water off of the glass surface. Changes of velocity occur automatically according to the rate of rainfall. Two radial types are mostly used in cars.

The sync arm works with commercial vehicles the same way that pantograph arms do for trains. Most of the wipers also have their automated functionalities. An automobile is a combination of various mechanical parts, all automated by electric motors. The unmanned wiper is proposed here as a rain detection-and-action initiation system that stops automatically in the absence of rain. It would dispense with any human physical engagement in the speed control of the wiper. A rain sensor detects rain, and the signal processing of the detected signals is communicated to the Arduino for taking action. Over the last decade, the automotive industry has made progress to find latest technologies that can be used to develop the safety. The reasons behind the absence of automatic wipers in vehicles are overwhelming. For many reasons, windshield wipers seem out of reasonably economical cars and to too unreliable for a new car. Many companies have worked hard and spent resources trying to design better, cheap wipers for cars to make them affordable without losing efficiency. Presently, it is only luxury models that come equipped with automatic rain sensor car wipers. Our paper tends to demonstrate the necessity of using an automatic wiper system that starts instantly the moment it starts to rain. Wipers automatically vary in speed, depending on the rainfall intensity. Such projects ensure safety trips, it has general causes, but a great cause of accidents during the rainy season is poor visibility. The purpose is to design an auto-start wiper system that will start automatically when it rains.

The system detects rain and adjusts the wiper speed according to the amount of precipitation. This project will have an Arduino, a rain sensor, a servo motor, and an LCD module for indicating rainfall. The system commodifies precipitation, which makes the wipers more efficient and therefore improves safety.

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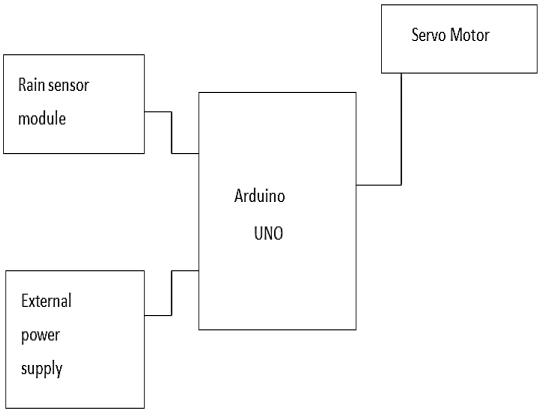

FIG.1 Block diagram

The setup comprises of an Arduino Uno board, a rain sensor, and a servomotor. It consists of a block diagram of the proposed system as shown in Figure 1. Also, this system is proposed to overcome the demerits of existing systems. A four-stage wiper system. A reading mode is the first stage where data is captured from the rain sensor module, then comes the processing stage which involves the processing of the information from the sensor, the analysis stage where the processed information is compared/ analyzed, and the last stage is control stage which controls the servo motor. It works on the Arduino Uno and the programming language is Arduino programming.

METHODOLOGY

Below is a detailed system architecture for the hardware components involved:

ARDUINO UNO R3

FIG 2. Arduino Uno R3

The ATmega328P microcontroller serves as the basis of the Arduino Uno board. It has 14 input/output digital pins (6 of which can serve as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, and a USB connection. Each of Uno's 14 digital pins can be employed as input or output using the pin Mode (), digital Write() and digital Read() functions. They all operate at 5 volts. Each pin is designed to provide or receive 20 mA under normal operating conditions with a built-in pull-up resistor (normally disconnected) of 20-50k ohm. However, it should be noted that the maximum rating of amperage should not exceed 40 mA for any of the I/O pins; otherwise, it will result to a permanent damage of the microcontroller.

RAIN SENSOR MODULE:

The sensing of rainfall can be done via a device called the Raindrop Sensor. There are two modules of which it consists. Rain board is the first one, and the control section, which compares the analog value and gives digital value, is the second one. Applications of a raindrop sensor are found in sectors like automobiles for automatic control of windshield wipers, agriculture, and also in house automation systems.

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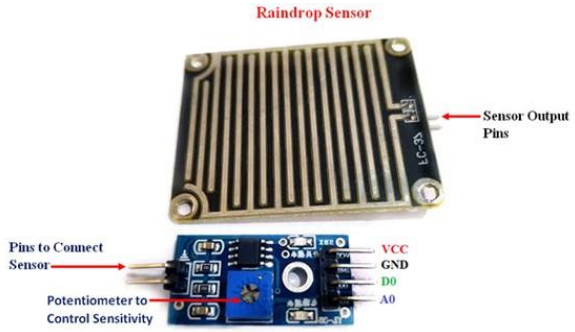

FIG 3. Rain Sensor Module

Pin Configuration of Rain Sensor:

Sl.No:	Name	Function
1	VCC	Connects supply voltage- 5V
2	GND	Connected to ground
3	D0	Digital pin to get digital output
4	A0	Analog pin to get analog output

SERVO MOTOR (MG995):

FIG 4. Servo motor

You get a 30 wire with a 3-pin 'S' type female header connector known to work with nearly most receivers including Futaba, JR, GWS, Cirrus, Blue Bird, Blue Arrow, Corona, Berg, Spektrum and Hitec! It is a pretty standard highspeed servo moving about 120 degrees (about 60 in each direction). Because you can utilize any servo code, hardware or library to control these servos, it is perfect for beginning builders who want to get things moving without building a motor controller with feedback & gear box, especially because it will fit in small spaces. The MG995 Metal Gear Servo includes different arms and hardware for a basic fast assembly!

The MG995 is a servo that operates on digital metal gears and works extremely well in applications involving very high

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torque planes, helicopters, RC cars of 10 to 6 stages truggy and monster, and many other RC models. This servo also comes in a 180-degree rotation model mainly for robotics applications.

LEAD ACID BATTERY

FIG 5. Lead Acid Battery

This document helps in getting the Arduino power supply with the aid of 6V 5Ah-lead-acid battery. The reason for its popularity is reliability because of their less initial cost and availability especially in PV systems. They have been having two categories: shallow cycle and deep cycle. Shallow cycle batteries give high bursts of current for very short periods and do not allow deep discharge and then the life is shortened. Deep cycle batteries are dischargeable upto 80% without serious damage, 50% is optimal for their lifetime, and they are advisable for PV systems. For example, a 6V 5Ah lead-acid battery can be kept fully recharged when included in proper charging because discharging too long without the battery being recharged leads to sulfation action doing permanent damage to the capacity. The unsealed wet types have comparatively shorter lives: maintenance-free sealed deep-cycle batteries provide their users with less hassle. Proper regulation of a charge is important to avoid overcharging and undercharging, which can harm batteries.

ARDUINO IDE SOFTWARE:

FIG. 6 Arduino IDE

The Arduino IDE (Integrated Development Environment) is a user-friendly, cross-platform tool designed for programming Arduino boards, offering a simple interface, built-in examples, and a simplified version of C/C++ that makes it accessible to both beginners and experienced developers, while supporting a wide range of tutorials and resources from its active online community, enhancing its versatility for various projects.

LITERATURE SURVEY

[1]. “Development of a Rain Sensor System for Automatic Windshield Wipers” (Jang, Kim, Lee, 2018): This paper outlines the development process for an automatic rain sensor system designed to improve windshield wiper functionality in vehicles. The authors describe the integration of optical sensors that detect the presence and intensity of rain by measuring changes in light reflection. The paper covers the design considerations, including sensor placement and calibration, and discusses how the system adjusts wiper speed in response to varying rain conditions. The study emphasizes the potential improvements in driver safety and convenience achieved through this technology.

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[2]. "Capacitive Rain Sensors for Automotive Applications: Design and Performance" (Das, Faruque, Khan, 2019): This paper explores the application of capacitive rain sensors in automotive systems. It provides a detailed examination of how capacitive sensors work, including their ability to detect water based on changes in electrical capacitance. The study presents a comprehensive analysis of the sensor's design, including material choices and configuration, and evaluates its performance through experimental testing. Key findings include the sensor's sensitivity to different levels of rainfall and its reliability in diverse weather conditions, offering insights into practical implementation challenges and benefits.

[3]."Optical Rain Sensor for Automotive Windshield Wipers: Analysis and Optimization" (Zhang, Liu, Wang, 2020): This research focuses on the use of optical rain sensors in automotive wiper systems. The authors analyze the principles behind optical rain detection, where infrared light is used to sense the presence of raindrops on the windshield. The paper details various optimization strategies to enhance sensor accuracy, such as adjusting light source intensity and sensor angles. Performance evaluations are presented, including the sensor's effectiveness in detecting different rain intensities and its adaptability to various environmental conditions. The study provides valuable insights into improving sensor design for better performance in real-world scenarios. SAE Mobilus

[4]."Integrated Rain Sensor Systems for Automotive Applications: Current Trends and Future Directions" (Patel, Xu, Goldsmith, 2021): This review paper discusses the integration of rain sensor systems within modern automotive environments. It covers current trends in sensor technology, such as the combination of rain sensors with other vehicle systems like automatic lighting and adaptive cruise control. The paper also highlights recent advancements, including the use of advanced algorithms and sensor fusion techniques to improve the accuracy and responsiveness of rain sensors. Looking ahead, the authors discuss potential future developments and innovations, such as integrating sensors with autonomous driving systems to enhance overall vehicle safety and functionality.

[5]."Performance Evaluation of Conductive Rain Sensors in Automotive Environments" (Nguyen, Williams, Sanchez, 2022): This paper evaluates the performance of conductive rain sensors used in automotive applications. Conductive sensors measure changes in electrical resistance caused by water presence, providing a method for detecting and quantifying rain. The study presents experimental results on sensor accuracy, durability, and reliability under various driving conditions, including heavy rain and road spray. The authors analyze factors that impact sensor performance, such as sensor placement and environmental factors, and offer recommendations for optimizing sensor design and integration to enhance system reliability.

CONCLUSION

In conclusion, automatic car wipers systems equipped with rain sensors improve driver safety and convenience immensely. The sensors detect rain and adjust the wipers in real-time. The automatic systems reduce driver distraction; improve visibility, and ensure road safety. The automatic response of the system to changing weather conditions will keep the windshield free, thus allowing drivers to concentrate on the road instead of manually adjusting wiper settings. Rain sensor with a servo motor and wiper system is a perfect example of how modern technology can affect the functionality of the vehicle and driver experience. The precise, efficient operations of the servo motor ensure that the wipers work the best speed to clear rain effectively for enhanced visibility.

REFERENCES

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[2]."Development of an Automatic Rain Sensor Wiper System" by R. K. Gupta, M. Sharma, and A. J. Verma, published in the *International Journal of Engineering and Technology*. It explores the development process of an automatic rain sensor wiper system, focusing on sensor integration and system performance.

[3]."Automatic Windshield Wiper System Using Rain Sensor" by N. S. Kumar, S. S. Reddy, and K. K. Prasad, published in the *International Journal of Advances in Engineering & Technology*. This paper presents an analysis of an automatic windshield wiper system using a rain sensor, including algorithm development and implementation.

[4]."Rain Detection and Control System for Automotive Wiper Applications" by C. L. Chen, H. L. Liu, and P. C. Chen, published in the *IEEE Transactions on Industrial Electronics*. It covers rain detection techniques and control systems for

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automotive wipers, highlighting sensor and control algorithm integration.

[5]."Automotive Wiper Control System Using Rain Sensor and Fuzzy Logic" by S. R. Kumar, A. K. Jain, and R. S. Yadav, published in the *International Journal of Fuzzy Systems*. This paper explores the use of fuzzy logic with rain sensors for automotive wiper control, offering insights into advanced control methods
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