Recent Trends in Sensor Research & Technology (RTSRT)

ISSN: 2393-8765
VOLUME-11
ISSUE-1
YEAR-2024

RESEARCH ARTICLE

Date OF Receive -05th-May-2024

Date of Acceptance- 15th-May-2024

Date of Publication- 28th-May-2024

Embedded System for Rain Sensing Car Wiper

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ABSTRACT

The automatic rain wiper system aims to detect rainfall and activate windshield wipers automatically, eliminating the need for manual intervention by the driver. For over a century, the driver has been the one operating the windshield wiper. The wiper should be turned on when the driver feels that driving the vehicle is difficult and that better vision is necessary. On the other hand, since the driver must concentrate solely on operating the pedals and steering wheel, assistance with wiper function is an essential ADAS feature. Developed to enhance driver focus and minimize distractions, the system employs an Arduino and rain drop sensor combination to identify rain presence and intensity. By receiving input signals from the rain drop sensor, a controller manages wiper operation accordingly. This innovation seeks to mitigate accidents caused by drivers diverting attention to adjust manual wipers while driving in rainy conditions. During inclement weather, drivers often struggle with visibility due to water droplets on the windshield, prompting them to intermittently engage manual wipers, potentially leading to accidents. Implementing a sensor-based system on the windshield detects water droplets and triggers wiper activation automatically upon detection. When the sensor no longer detects water droplets, the wipers cease operation, eliminating the need for human intervention.

Keywords- Sensors, automatic rain, weather, ADAS, arduino.

INTRODUTION

Advanced sensing aid is crucial and useful in the context of the Advanced Driver aid System (ADAS), since operating a vehicle requires complicated judgment and control from a human driver that involves many different kinds and levels of sensing. It is true that the most important piece of information that drivers should always have access to in high quality is the visual representation of the state of the road ahead. If there is poor visibility due to rain, snow, fog, dust, or inadequate lighting, driving safety is seriously jeopardized, and the motorist should either slow down or stop right away[1-10]. Windshield wipers have been the principal tool for preserving driver visibility of the perceived state of the road since its inception in the early 1900s. The driver has operated the windshield wiper for more than a century. When the driver determines that operating the car is uncomfortable and that there is a need to improve sight, that is when the wiper should be activated. However, the help with the wiper functioning is a crucial ADAS function as the driver needs to focus entirely on using the pedals and the steering wheel. Additionally, it was discovered that rain on the windshield impairs the deep learning-based visual detectors' ability to detect objects [11-25].

In order to detect the humidity of the windshield, several marketed automotive models have incorporated rain-sensing wiper systems [2], [3], which use infrared emitters and receivers. Nevertheless, the electronic sensor is limited in its ability to sample a tiny area of the windshield, and the detection is based more on humidity than on visibility. A few computer vision-based visual techniques were put out to identify and tally the quantity of raindrops. Apart from the requirement of enhancing the precision of detection, there is also a need for a system that can reliably identify various types of water formations, such as streaks and downpours, apart from raindrops. Faster modes of mobility have been made possible by the rapid advancements in the car industry and transportation infrastructure. Drivers can no longer afford to focus on manually operating multiple independent systems because to the increased speed of traffic. One example of such a system is the windshield wiper system, which helps drivers see better by clearing the windshield in the event of rain or snow [26-50] . In certain circumstances, manually operating a wiper system might present significant challenges. For example, drivers of heavy-duty vehicles must manually operate their vehicle's transmission. Controlling the windshield wiper system as well as the ABC (Acceleration, Brake, and Clutch) in bad weather can be difficult and dangerous [1]. Automatic windshield wiper systems can significantly improve driving conditions and driver safety in such situations. The use of automatic windshield wiper systems is especially evident in motorsport, where drivers must give their entire attention to the road because even a small amount of distraction can result in serious accidents and competition failure. In the realm of automotive engineering, wiper systems have undergone various automated advancements, predominantly through the integration of electric motors or servo motors to mechanize mechanical components. Our proposal introduces an automatic wiper system that senses rainfall, initiating wiper action upon detection by the rain drop sensor, and ceasing operation automatically when the rain subsides. This obviates the need for manual intervention in controlling wiper speed. Employing a rain drop sensor to detect precipitation, the signal is processed by an Arduino UNO to enact the requisite actions. The automotive industry continually strives to adopt cutting-edge technologies to enhance safety standards. Despite the ongoing progress, several factors impede the widespread adoption of automatic wiper systems in vehicles. Primarily, cost constraints and concerns regarding reliability deter their integration into new vehicles. Many manufacturers endeavor to produce cost-effective yet efficient wiper designs. Currently, automatic rain sensor wipers are predominantly found in high-end vehicles, underscoring the necessity for an automated wiper system accessible across various vehicle models. Our research aims to underscore the imperative of an automated wiper system that activates upon the onset of rainfall, with automatic speed adjustment corresponding to rain intensity. This system ensures driver and vehicle safety by mitigating accidents attributed to reduced visibility during inclement weather. Central to our project is the utilization of an Arduino UNO, a rain drop sensor, and a servomotor. The dynamic adjustment of wiper speed according to precipitation intensity significantly enhances safety parameters[51-68].

PROBLEM STATEMENT:

The project seeks to tackle the following primary challenges:

1. During rainy seasons, vehicles often contend with obscured visibility due to water accumulation on the windshield. This diminished visibility poses a distraction to drivers, hindering their ability to observe other vehicles on the road.
2. By implementing a rain drop sensor on the windshield, the system can detect water droplets

and automatically activate the wipers through automation.

OBJECTIVES OF PROJECT:

1. Minimize the likelihood of accidents stemming from manual wiper operation.
2. Automate manual wiper functionality within the automotive sector.
3. Enhance driver focus by mitigating distractions associated with manual wiper adjustments.
4. Alleviate the manual workload of wiper operation.

BLOCK DIAGRAM:

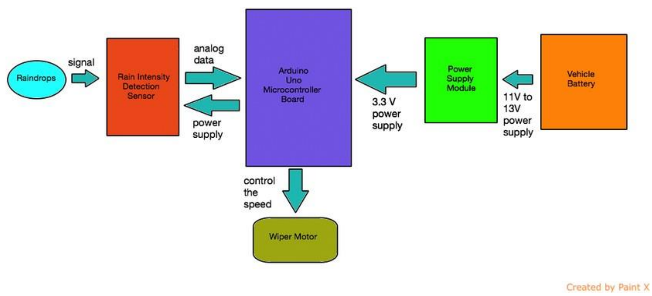

Fig. 1. Block Diagram for Model

The car wiper system comprises several sequential stages. Initially, in the reading stage, input data is acquired from the rain drop sensor module. Subsequently, in the processing stage, the received information from the rain drop sensor is processed[69]. Following this, in the analysis stage, the processed data undergoes analysis. Finally, in the controlling stage, output control for the servo motor is executed. The system is implemented using an Arduino UNO, utilizing the Arduino programming language[70]. Block Diagram for Model is shown in Figure 1.

DETAILS OF COMPONENTS:

ARDUINO UNO:

Fig.2 Arduino Uno

Arduino as shown in Figure 2 is user-friendly software that facilitates the coding for the control of hardware and electronic components. Arduino UNO boards possess the capability to detect various inputs, such as sensing water droplets on a sensor or controlling light patterns. For instance, when a raindrop is detected by the sensor, the wiper initiates operation, and upon removal of the drop, the wiper halts. The Arduino Uno microcontroller board is programmable, allowing users to upload code onto it. The programming language utilized in this context is tailored for Arduino UNO. Processing is conducted using Arduino Software[70].

RAIN SENSOR:

Fig. 3. Rain Sensor

Rain drop sensors as shown in Figure 3 are commonly utilized for detecting precipitation. Each rain drop sensor is configured with a predefined threshold limit. Upon reaching this threshold, the sensor triggers the specified action. Utilizing digital analog pins, the rain drop sensor measures the humidity present on its surface. If the sensed humidity exceeds the established threshold, the predetermined action is executed. When the rain sensor becomes wet, its resistance changes, typically ranging from 100000 to 2M ohms, effectively acting as a variable resistor. Consequently, when water is present on the sensor, there is a greater conduction of current. The rain sensor typically includes analog output (A0), digital output (D0), Ground (GND), and positive voltage (VCC) pins. Additionally, rain sensors feature two loop pins, one positive and one negative[71].

SERVO MOTOR:

Fig. 4. Servo Motor

A servo motor as shown in Figure 4. facilitates shaft positioning to a specified angle by interpreting a coded signal. Widely integrated into various everyday appliances, servo motors offer notable utility. They are both cost-effective and efficient, boasting compact dimensions suitable for diverse applications, enhancing operational efficiency. Notably, servo motors are renowned for their effectiveness and low energy consumption. These motors are regulated via Pulse Width Modulation (PWM), utilizing control wires to transmit electric pulses. With a total movement capability of 180°, servo motors typically rotate 90° in either direction, enabling both clockwise and anti-clockwise movement.

LITERATURE SURVEY:

In this study, the authors propose an automated wiper management system that is cost-effective, efficient, and yields superior performance. Utilizing a resistive rain sensor, they develop a system that is practically demonstrated with the placement of a sensor. Typically, rain sensors possess predetermined rotational geometries; however, when rainfall droplets accumulate on the sensor, they form a layer on its surface, causing nonlinearity in its resistance[24]. To enhance system efficiency and reduce distractions, the sensor's response needs to be linearized. This is achieved through the implementation of a linearized circuit and connections with the rain drop sensor's equivalent electrical model. To mitigate speed fluctuations based on the output provided by the rain drop sensor, a custom controller is employed. Fuzzy logic is utilized to process the collected analog data from the rain drop sensor. The decision to employ fuzzy logic is primarily driven by its adaptability and ease of reconfiguration, which enhances system performance. Fuzzy logic is well-suited for system enhancement and optimization[39]. The wiper motor is controlled and operated by a microcontroller utilizing pulse width modulation. This choice is motivated by fuzzy logic's ability to facilitate easy rearrangement and enhancement of systems, thereby contributing to improved performance[47].

RESULTS:

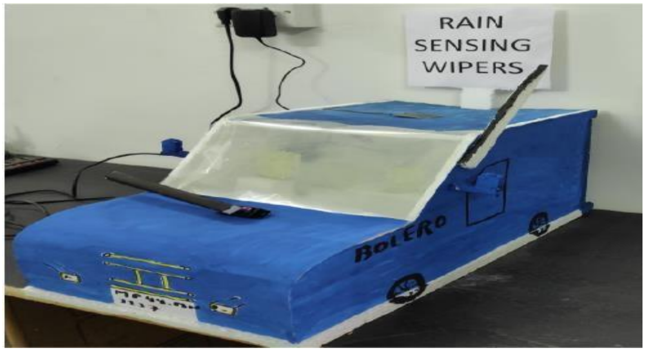

Fig. 5. Actual model of the rain sensing wipers

During rainfall, the rain sensor experiences a change in resistance due to the presence of water droplets. Acting as a variable resistance component, the sensor's resistance diminishes as the intensity of rainfall rises, following an inversely proportional relationship. Upon detecting this change, the sensor transmits a signal to the Arduino, which is received by the microcontroller. Subsequently, the microcontroller assesses the intensity of rainfall and transmits a signal to the servomotor using pulse width modulation at the output end. Consequently, the automatic wiper mode is activated based on the detected rain intensity. The design of the sensor ensures it does not obstruct the driver's view, and it is resistant to small environmental particles or elements that may come into contact with it, thus preventing false alarms. In instances of light rainfall, the water column height in the rain sensor remains low due to the weak intensity of rain, resulting in decreased resistance. This decrease in resistance signifies to the Arduino Uno microcontroller the presence of rainfall and its intensity. The microcontroller then relays this signal to the servo motor, which adjusts the wiper blades accordingly. The wiper speed increases as the rainfall intensity rises. Actual model of the rain sensing wipers is shown in Figure 5.

CONCLUSION:

The automatic wiper system is engineered to detect raindrops and initiate the movement of the wiper to clear water from the windows automatically. This system effectively automates the task of wiper control, eliminating the need for manual intervention by the driver. It has been observed that the rain drop sensor's response to rainfall, triggering the windshield wiper movement, occurs in less than 400 milliseconds. While the initial development of the automatic car wiper system involved the utilization of a rain drop sensor, Arduino UNO, and servo motor, there is potential for expansion by substituting the rain drop sensor with an IR sensor for enhanced accuracy in rain detection. When seeking an efficient car wiper system, opting for a rain drop sensor is advisable. As the system progresses and evolves, various sensor options can be considered to better cater to specific requirements and improve overall performance.

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