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AUTOMATIC RAIN SENSING WIPER

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Abstract- Working of a windshield wiper is a manual procedure which requires to be switched on to remove rainfall and debris from the screen. This does not only require driver's attention, but also, causes a certain level of discomfort to the driver and serves as a source of distraction which increases the risk of accidents. To offer comfort to the driver and essentially reduce the risk of accidents, an automatic rain sensing device has become a necessity. While such a device is available in the market, its high cost and other such limitations have made it less popular in the automobile industry. Aim of this work was to propose another such model in market that limits the cost while maintaining the efficacy. A rain sensor, a microcontroller and a driver integrated circuit (IC) are the major components used in the construction and seamless working of the proposed device. Falling water is quickly and precisely detected by the rain sensor which then transmits the signal to the second component i.e. microcontroller which in turn energizes the driver IC to switch the required motion of the wipers on using servo motor. This device converts a cumbersome manual operation to a smooth automatic one.

Keywords- *Automatic rain sensing wiper, rain sensing wiper, automatic windscreen wiper.*

Introduction- A windscreen wiper is an essential device that comes pre installed in almost all motor vehicles including trains, cars, buses, some aircrafts, watercrafts etc. Operation of these wipers in the existing models is yet manual. The physical model of the operation includes two arms twirling at one end back and forth over the glass. The arms have long rubber blade attached. While one end of the arms is attached, the other end pivots. The blade when swung back and forth over the glass pushes water from its surface providing good visibility to driver. The speed of the central shaft is adjustable. A range of several speeds and at least one or more settings that let you set the speed in between are provided. These settings are commonly labelled as "intermittent" settings. To generate the force to accelerate the wiper blades a worm gear is used. The implementation of new technology in the current scenario can help to tackle the issue at hand. Using automation and IOT technologies to automate the working of the wipers using specific sensing devices can help reduce the risk of accidents and offer comfort to the people. These implementations that we aim to offer through this project has high flexibility, is quite reliable and accurate.

The main theme in this project is to develop an automatic rain sensing car wiper to automatically detect perciperation. The system has been designed in a way which ignites the wiper blades to push off the water falling over the glass in the event of rainfall. This system aims to give better visualization to driver without involving the efforts of driver. Thus limiting the distraction Arduino UNO board, a rain sensing module, a servo motor and a LCD are the main set of requirements used in the construction of the said system. In this setup, the microcontroller adjusts the speed of the servo motor according to the signal given by the rain sensing module.

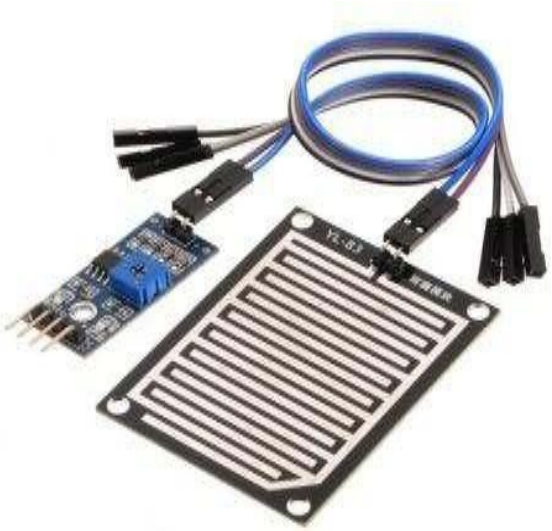
The data is transmitted through signals, the intensity of the rain or snowfall serves as the input. Pulse width modulation (PWM) controls the servo motor at its signal line. PWM is the representation of intensity of rain. The subsequent paper is divided into 5 sections. Section 1 deals with the problem definition. Section 2 proceeds towards the review of existing systems. The next section describes the system design (section 3) and results (Section 4) and conclusion (section5).

1. **Problem definition**- Modern cars come equipped with a variety of facilities. While these facilities are incorporated in the four wheelers for entertainment and recreational purposes and aim to enhance the overall travelling experience, these features also serve as a means of intrusion and causes confusion and hysteria. In monsoon, rainfall adds to the list of distractions and makes driving a tedious task. As mentioned earlier, these distractions often become a source and cause of severe accidents that are sometimes unfortunately catastrophic. Various services are being actively included in the automobiles to ensure safety along with comfort of the driver. Several automobile companies have looked at the prospect of making the working of wipers automatic. Even today, only luxury cars come equipped with automatic rain sensing wipers, major reason being the cost. To make economical and reliable automatic rain sensing wipers and their installation has been a challenge that the automobile sector hasn't been able to tackle.
2. **Review of existing systems-** Many attempts have been made to tackle the defined problem. These models have their own set of limitations. A few of these systems are mentioned below.
   A. **Automatic wiper controlling using optical sensor-** This system makes use of optical sensors to detect the rain drops and thus switches on the blades. Integration of existing wiper system with custom designed sensors and controllers were done to implement this system. The detection of rain drops by the installed rain sensor is based on the fact that the shift or change in light intensity serves as an input for the sensor. This shift in light intensity is caused when the near infrared sensing beam between the elements of the rain sensor that emit light and are sensitive to it are crossed over or interfered with by the falling rain drops *(Hideki Kajioka, et al.; FUJITSU TEN Tech J. No. 2; 1989; Page No. 69).*
   B. **Detection of rain based on its effect on the resistance and capacitance-** Another model of rain detection is based on the rain's effect on resistance and capacitance in the electrodes that are installed on the wind-shield. These rain sensors are found to be beneficial as they are less expensive. The large dielectric constant of water is the core feature on which the detection is majorly based**.** *(Mukul Joshi, et al.; IEEE; 2013, Page No. 40).*
3. **System Design-** The proposed system aims to provide a low cost, efficient and reliable solution to the defined problem. The model is practically cheeked against deformities and malfunctioning due to presence of non-essential elements- natural or artificial in nature. Hindrance due to the presence of dust particles, stones etc. is a bare minimum. In subsequent sections, we will be presenting a list of all the required tools and also provide an in-depth description of each of the tools in the list. We will be discussing the modelling and working of rain sensors along with the other components of the device to explain the overall working of the automated rain sensing wiper model.

3.1 Hardware design tools- A multitude of tools are used in the building of this model. The major hardware components used to build this model are mentioned below.

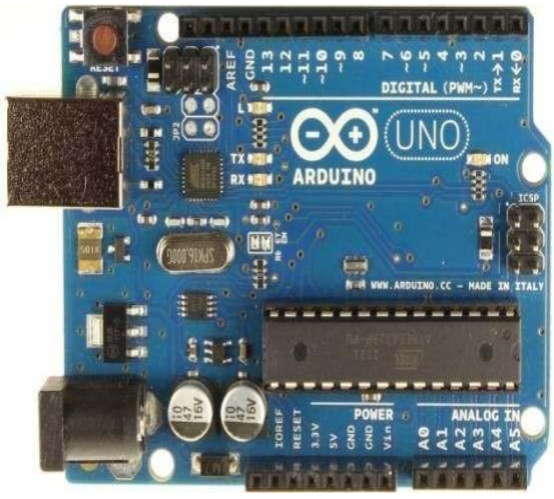
- **Rain sensor-** Rain sensors are devices that are used to detect raindrops. These are electrically isolated and are available as printed circuit boards. The working of a rain sensor can be adequately compared to the working of a switch. When rain falls, the switch turns to off mode. Whenever rain falls, the circuit gets completed and thus the resistance varies. They usually have a zigzag pattern of conductive path for conducting the rain fall or water fall. This rain sensor module can be used as switch for detecting the rain fall and the usage is quite simple. This rain sensor unit contains of a rain board and control board. Rain falls on the rain board which is equipped with two LED lights. In which one is for indicating the power supply and another one is for indicating the rain fall. The second LED light on the control board will blink only when the rain drops collided with the rain board. Rain board is adjusted to make fall the rain drops on it. Whenever the rain drops fall on

the rain board, the LED indicator will blink and sends the signal to the microcontroller regarding the intensity of the rain fall.



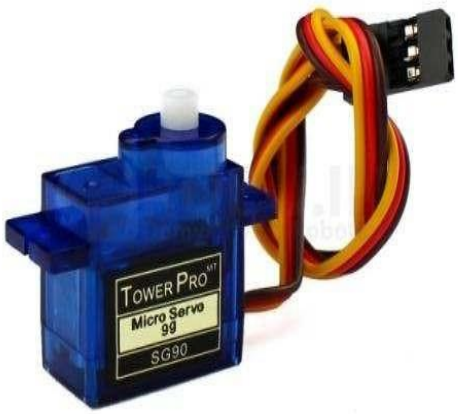
- **Arduino Uno Microcontroller-** The Arduino UNO is nothing but the microcontroller based on the ATmega328. Arduino Uno contains 14 digital input/output pins, 6 analogy inputs along with 16MHz ceramic resonator, a connection for USB, a Power jack, an ICSP header and a reset button. It is designed in such a way that it supports the microcontroller. The connection can be set in two ways viz.,
  - With a computer by a USB
  - With 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 is the point of major difference between the Arduino and other FTDI USB-to-drive chip boards.



- **Servo Motor-** Servo Motor is an electrical component that moves or rotates an object with the help of electricity. It is an electrical component that has high precession and high accuracy. It has high rotation capacity and is preferred where he object has to be rotated at necessary angles. This is a kind of motor that run through a servo mechanism. Based on the source of power, the servo motor are of two types:
  - DC powered servo motor
  - AC powered servo motor

  The servo motor used for the purpose of this project is highly efficient, light- weight and offers high force. These features are advantageous and hence these kinds of servo motors find application in development of toy cars, RC helicopters and planes etc. Servo motors are most commonly developed in kg/cm. The servo motors that are installed in automobiles for recreational purposes for kids are articulated in three models viz., 3kg/cm or 6kg/cm or 12kg/cm. This essentially means that the servo motor can be used in a device that weighs 6kg and the height of suspension of the weight is 1cm far from the shaft of the motor. Also, the bigger the gap the lesser the burden carrying capability becomes. An electric pulse determines the position of the servo motor and is placed beside the motor.



3.2 Working Principle- The rain sensor is placed on the vehicle front glass. The rain sensor, servo motor and other required components get power from the battery. When the rain droplets fall on the rain board, the control board of the rain sensing unit sends the signal to the Arduino Uno module. The Arduino module estimates the intensity of rain fall by manipulating the signal given by the rain sensor

module and then gives signal to the servo motor according to the rain fall. The servo motor takes the signal in the form of pulse width modulation, which is the representation of the intensity of the rain drops. The servo motor then rotates the wiper in accordance with the signal given by the Arduino module. The wiper rotates in accordance with the intensity of the rain fall. For instance, if the rain fall intensity is very high the pulse width modulation will be high and hence the servo motor will drive the wiper speedily and if the rain fall intensity is low then wiper will rotate slowly by the mechanism explained above. This system avoids the interaction of the vehicle operator to operate the wiper. So, operator will concentrate on the driving.

3.3 Detailed system design and working- In the event of rainfall, the rain sensors have a water column or a flow column which results into the change in resistance. Thus, the sensor acts as a variable resistance board. The relationship between rain intensity and resistance has been determined to be inversely proportional to each other. The increase in number of raindrops results into decrease in the resistance of the sensor. The sensor then transmits the signal, the signal is received using microcontroller which determines the intensity and transmits the signal to servo motor in the form of pulse width modulation and the mode of action of wipers is then switched on in accordance with the intensity of the rain falling.

The sensor is designed in such a way that its size does not impair the driver's view. The sensor is entirely immune to environmental particles and elements that may come in contact with the sensor. Thus, the sensor does not send false alarms if such an event were to take place.

Through a working example, we hereby attempt to explain the working of the rain sensor. Say, the resistance in resting senor is 1000 KΩ. In a mild rainfall, the height of the water column inside the rain sensor is little as the intensity of the rain is low. The resistance of the sensor drops down and now gets into the range of, say, 900-400 KΩ. When rainfall increases, the build-up and accumulation of rain drops in the sensor increases, and thus the resistance falls down to 300-100 KΩ.

As the rainfall's intensity increases, the resistance decreases. The decrease in resistance is taken in as a signal through which the Arduino Uno microcontroller determines the intensity of the rain. The signal is transmitted to the servo motor which then operates the working and movement of the wiper blades. As the intensity increases, the speed of the wipers increases.

3.4 Complete Overview- The rain sensor is placed over the windshield and the servo motor powers the wiper blades, which are directly connected to the motor. When the signal is received, the arduino Uno microcontroller is attached to all of the three components, namely, the rain sensor, the servo motor and the LCD. The microcontroller unit is placed inside the car and is attached to a dc source; The LCD is also in the car near the driver's seat. It displays the speed of the wiper blades along with the intensity of the falling rain.

4. Results- The LCD model displays the rain intensity which is gathered through the signalling pathway from rain sensor to arduino Uno to servo motor. Intensities of the rainfall are classified into four major classes, viz., NIL, high, medium and low.

5. Conclusion- An automatic wiper control system will be the modified version of the intermittent wiper system. This system will improve the driver's level of comfort. Its need is more especially for the drivers who have to work night shifts and drive in the areas prone to traffic where drivers have to give maximum concentration on the brakes and clutches. The wiper controlling task during the rainfall is eliminated with this implementation. This system contains high precision, high accuracy. This system will also be useful in home applications like cleaning the window glasses and it intimates the rainfall and also notifies people in the house. So that people can take care of things like clothes, food grains and products. The following points explain the requirement of additional implementations; these points will act as future scope.

- Use of micro controller enables the wiper rotate through 180 degree rather than 360 degree.

The usage of better speed control mechanisms will guide wiper more effectively and reduce the consumption of battery power.

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