

Design & Fabrication of Rain Operated Wiper Mechanism using Conductive Sensor Circuit

K. V. Viswanadh Ch. Siva Sankara Babu J. Leela Krishna A. Lala Bahadur
 Assistant Professor, Department of Mechanical Engineering
 Lakireddy Bali Reddy College of Engineering
 Mylavaram, Andhra Pradesh, India

Abstract- This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation. Now a day's almost all the automobile vehicles are being atomized in order to reduce human efforts. The AUTOMATIC RAIN OPERATED WIPER system is a fully automation project. This is a genuine project which is designed for automobile vehicles and is fully equipped by sensor circuit and wiper motor. This project work includes design and development of a control system based on electronically controlled automotive rain operated motor called AUTOMATIC RAIN OPERATED WIPER.

Keywords — Wind shield wiper, 4-bar mechanism, conductive sensor

INTRODUCTION

A Windscreen or windshield wiper is a device used to remove rain and debris from a windscreen or windshield. Almost all motor vehicles motor, including trains, aircraft and watercraft, are equipped with such wipers, which are usually a legal requirement. The first windshield wipers were brushes. Inventor J. H. Apjohn came up with a method of moving two brushes reciprocate on a vertical plate glass windshield in 1903. In the same year, Mary Anderson devised a swinging arm that swept rain off the windshield when the driver moved a lever located inside the car. Anderson patented her invention of the mechanical windshield wiper in 1905, and it became standard equipment by 1913. Electric motors were not used yet to power automobile essentials or accessories. Without another power source, a driver had to use one hand to move the lever. Rubber strips replaced brushes as the cleaning tools on wipers in 1905. Unfortunately, the hazardous need for drivers to wipe windshields while driving was not eliminated until 1917. The solution was to use an electric motor to move a single wiper with a long rubber blade back and forth. Hawaiian dentist Dr. Ormand Wall invented the automatic wiper by placing an electric motor in the top center of the windshield so the wiper arced down over the hood of the car in a semi-circular or rainbow shape. Wipers were one of the first electrical devices in automobiles after the electric starter was developed in 1912. Most wipers on cars before 1930 were paired and hung down from the top of the windshield. They were moved to the base of the windshield as electrical systems became more complicated. In 1989 Hideki Kajioka, et al. [1] in their paper an automatic wiper which detects rain drops with an optical rain sensor was developed. This automatic wiper is implemented by combining an existing wiper system with a sensor and controller. In 1992, G.K. Ananthasuresh, et al. [2] developed a general procedure for synthesizing the rack and pinion

mechanism up to seven precision conditions. In 2011, Hong Ching Wah[3] invented an operating the car wiper automatically when raindrop is sensed. A fluid sensor is comprised and mounted on the outer part of the car windshield to detect raindrop. Renault Safety Manual [4] gives Automatic activation of the windscreen wipers is controlled by an infrared sensor which detects the presence of water droplets on the wind screen by the modifications in reflection that they induce.

EXPERIMENTAL SETUP

The major components of the "Automatic rain operated wiper" are Conductive Sensor, Glass frame, Battery, Wiper, Motor and its arrangement & Relay. The glass frame is the main part of this paper, because the wipers in the automobiles are mainly used for remove the rain and debris from a glass. Glass, Conductive sensor is fixed on the wood stand. A wiper generally consists of an arm, pivoting at one end with a long rubber blade attached to the other. The blade is swung back and forth over the glass, pushing water 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. The wiper & motor is fixed behind this glass frame. The Conductivity sensors or conductivity guard are designed for detection of electrically conductive liquids. This is fixed to the glass frame. In this circuit are having two leads which are fixed to the glass frame. The distance between these two leads is 3 mm. The wiper motor fixed to the glass frame so that it clean the glass whenever rain occurs. Here the lead acid battery for storing the electrical energy from the solar panel.

WORKING OF RAIN OPERATED WIPER

The battery supplies the power to the sensor as well as rain operated motor. Wiper motor is automatically ON during the time of rainfall. The sensor is fixed in the vehicle glass. The conductive (Touch) sensor is used in this project. It senses the rainfall and giving control signal to the control unit. The control unit activates the wiper motor automatically as shown in Fig.1.

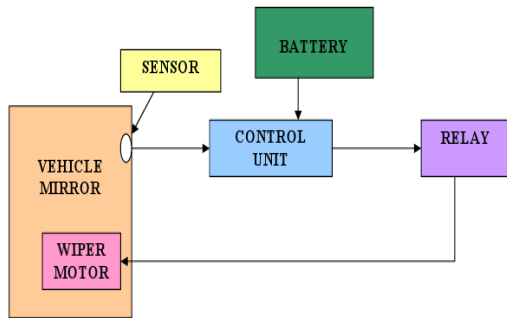


Fig.1. Working of automatic rain operated wiper

DESIGN PROCEDURE

a) Design of Wiper Mechanism

Several mechanisms are used for operating the wiper. In automobiles most widely used mechanisms for operating wiper are rack and pinion and four bar mechanism. And in our project 4-bar mechanism is used for operating wiper. It converts the rotary motion into oscillating motion. The reason behind choosing the 4-bar mechanism is it is simple mechanism. In this paper stainless steel bars are used for links of 4-bar mechanism, Aluminum is used for the blade frame & rubber is for blades. The dimensions of the 4-bar mechanism reduced so that it occupies less space. The dimensions of links calculated from Grasshoff's rule. Wiper should convert rotary motion of motor into oscillatory motion (i.e. crank & Lever mechanism). Case 2 in the table is useful for wiper mechanism as shown in Table.1.

Case	(L+S) Vs (P+Q)	Fixed link	Type of Mechanism
1	(L+S) < (P+Q)	Shortest link (S)	Double crank
2	(L+S) < (P+Q)	Link adjacent to Shortest	Crank & Lever
3	(L+S) < (P+Q)	Link opposite to Shortest	Double Lever
4	(L+S) > (P+Q)	Any link	Double Lever
5	(L+S) = (P+Q)	Any link	Change point

Table.1. Grasshoff's Rule

Where S is shortest link, L is longest link; P&Q are other to links.

And another important thing to select the dimensions is transmission angle. It chooses according to the requirement that means the position of the wiper based on the transmission angle. For different dimensions the transmission angle will be different. The minimum and Maximum value of the Transmission angle for the four bar mechanism will be

Given by

$$\cos \mu_{\min}^{\max} = \frac{a_4^2 + a_3^2 - a_1^2 - a_2^2}{2a_3a_4} \pm \frac{a_1a_2}{a_3a_4}$$

For the purpose of weight reduction the holes were made on the cross-section of bars results in less power consumption. The links of the mechanism are connected by the rivets after making holes. The following fig shows the model of 4-bar mechanism.



Fig.2. Assembly of holed Wiperlinks

b) Selection of Motor, Sensor & battery

According to the requirement of the wiper speed motor with these particular specifications are selected,

Voltage: The standard voltage requirement for the wiper motor is 12 volts DC.

Current: The minimum required current for the motor is 1.6 amps at 70 rpm, 0.9 amps at 41 rpm and 4 amps at 106 rpm. The following fig shows the wiper motor,



Fig.3. Wiper motor

In this paper sensor is required to sense the water which falls on the glass frame. The Conductivity sensors or conductivity guard are designed for detection of electrically conductive liquids is used here. Sensor used is astable multi vibrator using IC 555.

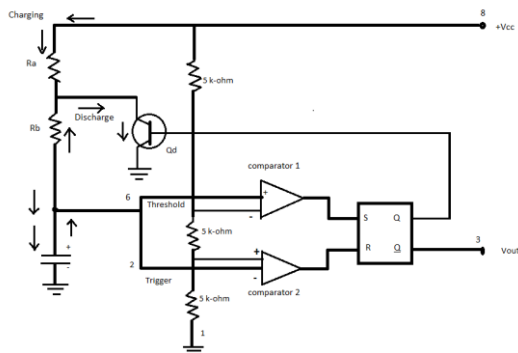
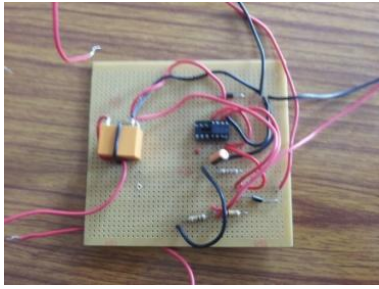


Fig.4. Astable multi vibrator using IC 555

According to the motor specification the battery had chosen. The specification of battery is 12V and 7amps selected to run the motor. Relay is used here as on-off switch.

c) Making the Supporting Frame for Whole Arrangement

In this project the glass is fixed on the wood stand. The wiper motor and whole mechanism is fixed behind this glass frame. Wiper is arranged on the glass frame to remove the debris and rain on the glass frame.



Fig.5. overall Setup

CONCLUSION AND FUTURE SCOPE

And finally we conclude that, the wind screen wiper which we had fabricated with the main theme of maintaining automation by using conductive sensor to the required extent is a modification to the existing wind screen wiper which were been using in the four wheelers.

And therefore, implementation of this modified wind screen wiper helps in reducing human effort, free from wear adjustment and operating principle is very easy which were the problems being faced with the existing wind screen wiper.

Presently the mode of power source used in our project is a battery which is a replaceable power source. Here we have used the battery which is a non-conventional source of power, keeping the scope of resources in mind this can be easily replaced by the conventional power sources like solar panels etc.,

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