Design And Implementation of Automatic Rain Sensing Car Wiper

*OTCHERE. P. K,OWUSU. D. K,OTCHERE. A. A
Takoradi Technical University, Ghana
*Corresponding Author Email:peter.otchere@tpoly.edu.gh

Abstract:*The automated rain wiper system is used to detect rainfall and activate automobile automatic rain wiper without driver interaction. The system is developed to mitigate driving distractions and allow drivers to focus on their primary task of driving. The distraction eliminated with the development of this product is the manual adjustment of windshield wipers when driving in precipitation. The few seconds that a driver takes their attention off the road to adjust a knob while driving in poor weather conditions could potentially lead to car accidents.The system uses a combination of impedance and rain sensor to detect rain and its intensity. The system contains a controller that takes in the input signals from the sensors and controls the operation of the windshield wipers based on those input signals The aim of this project is to help reduce accidents that happen as a result of the driver intending to clean the windscreen when rain is falling thereby taking the attention of the driver off the road when he or she is switching on and off the wiper. In rainy days we suffer from act of sprinkling of water on front glass of our wheeler. While driving car, driver cannot see on road vehicles. So he tries operating wiper on glass, for that he should often switch on for operating wiper and because of this it might cause vehicle accident. If we apply any kind of sensor on glass which senses the act of sprinkling water, by automation the wiper will be operating automatically. When the water hit the sensor, it will send signal to the system thus moving the wiper motor. Once the sensor did not detect any water, the wiper will stop. This will reduce the weaknesses which have been stated at beginning. Additional plan to this invention is to make the wiper automatically push up from the windscreen when the engine shut off.*
*Keywords:*Precipitation, Impedance, Sensor, Body Control Module (BCM), Wiper, Multivibrator*

1. INTRODUCTION

In recent years researchers are trying to develop automobile industry more and more for safety, reliability, flexibility and entertainment by modern computing and electronics. Consumers are expecting their car to be voice controlled, auto driven and GPS assisted visual directions for driving. Almost all consumers first go for checking electronic gadgetry before selecting a car. Bluetooth hands free, mp3 player, video/ TV players are even common phenomena for a car. These interactions with gadgetry could be very dangerous distraction for the driver [1]. Distraction or taking drivers eye off the road may cause devastating accidents. Southern part of Asian countries as well as Bangladesh has placed within 100 top accident happening countries in the world (WHO 2011) [2]. The National Highway and Transportation Safety Association reports that twenty six percent of all car accidents are caused by distractions due to talking on cell phones, eating while driving, and other similar distractions that take a driver's focus off the road. The distraction considered in this project is the adjustment of wiper speed based on the intensity of precipitation falling. The number of accidents caused by distraction can be slightly reduced by eliminating the need for drivers to adjust wiper speed. The traditional wiper system requires driver constant attention in adjusting the wiper speed using manual switch. And sometimes dust particles floating in the air are covered in the windscreen during moving vehicle which could be another cause of accident. The manual adjustment of the wiper and windscreen washing spray distracts driver's attention, which

may be a direct cause of accident. This project is up to minimize the drivers work by setting up automatic control system for windshield mountings which are wiper, and rain sensor. With drivers exposed to an ever increasing number of accidents, automatic rain- sensing wiper system, dust cleaning system and automatic sun visor system could be an even more appealing feature, as they work to minimize the time the driver must take his/her hands off the wheel. By using rain sensing device the wiper can be automated and light sensor can be useful to regulate the sun visor without even touching it. The pivotal concern is to render more attention of the driver on the road [2].The automated rain wiper system is used to detect rainfall and activate automobile automatic rain wiper without driver interaction. The system was developed to mitigate driving distractions and allow drivers to focus on their primary task of driving. The distraction eliminated with the development of this product is the manual adjustment of windshield wipers when driving in precipitation. The few seconds that a driver takes their attention off the road to adjust a knob while driving in poor weather conditions could potentially lead to car accidents. The system uses a combination of impedance andImpedance sensor to detect rain and its intensity. The system contains a controller that takes in the input signals from the sensors and controls the operation of the windshield wipers based on those input signals [3].Nowadays, a new type of wiper system is starting to appear on cars that actually do a good job of detecting the amount of water on the windshield and controlling the wipers. The system uses a sensor that uses optical sensors to detect the moisture. The sensor is mounted in contact with the inside of the windshield, near the rearview mirror.The sensor works by projecting infrared light into the windshield at a 45- degree angle. If the glass is dry, most of this light is reflected back into the sensor by the front of the windshield. If water droplets are on the glass, they reflect the light in different directions. The wetter the glass, the less light makes it back into the sensor [3].

PROBLEM STATEMENT

In rainy days we suffer from act of sprinkling of water on front glass of our wheeler. While driving car, driver cannot see on road vehicles. So he tries operating wiper on glass, for that he should often switch on for operating wiper and because of this it causes vehicle accident. If we apply any kind of sensor on glass which sense the act of sprinkling water and by automation the wiper will be operating automatically. The concept of this proposed wiper system is just the same with other conventional wiper, in spite of removing water from windscreen, this system also will be upgraded to an automatic control system by using a controller [4].When the water hit the sensor, it will send signal to the system thus moving the wiper motor. Once sensor did not detect any water, the wiper will stop. This will reduce the weaknesses which have been stated at beginning. Additional plan to this invention is to make the wiper automatically push up from the windscreen when the engine shut off.

OVERVIEW OF CAR WIPERS

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 for vehicles. Previously remarkable and uncommon features such as auto dimming mirrors and rear-view cameras have become standard in the modern era. Today consumers expect their automobiles to be able to connect to their MP3 players, provide GPS-assisted visual directions, and allow hands-free phone calls via Bluetooth technology. While these features have improved the driving experience for many, they also imply the increasingly common interaction between driver and electronic gadgetry during vehicle operation. These interactions can be a dangerous distraction for the driver, who musttake his/her eyes off the road to attend to a device [4].Wiper is an essential component that is used to wipe the raindrops or any water from the windscreen. Wipers are designed and made to clear the water from a windscreen. The wiper parts visible from outside the car are the rubber blade, the wiper arm holding the blade, a spring linkage, and parts of the wiper pivots. The wiper itself has about six parts called pressure points or claws that are small arms under the wiper [5].With drivers exposed to an ever increasing number of distractions, automatic rain-sensing wiper 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, and are too expensive to be included as standard equipment in most vehicles [4].Many attempts have been made at constructing an effective, reliable, and cheap rain detection and wiper control system for vehicles. A perfect system could subtract one more task from the driver's workload, and allow them to better keep their eyes on the road and hands on the wheel during foul weather. Despite this, automatic rain- sensing wiper systems are relatively uncommon in modern vehicles for a number of reasons. They are often too expensive to be desired in new automobiles. While a number of different design approaches have been made to improve upon these issues, none have been successful enough for the technology to become widely adapted in new vehicles [5].By far the most common rain detection method, and the one currently employed by Hyundai vehicles, is the use of an optical sensor. These optical sensors function by transmitting an infrared beam at an angle through the windshield and measuring the reflection to determine the presence of water. This is a relatively difficult task, requiring complex circuitry and precision manufacturing. Optical sensors are thus somewhat expensive and can produce false readings when dirt or other particles on the windshield cause a reflection mimicking that of rain. Because it relies on an infrared beam for detection, the optical sensor also suffers from a very small sensing area on the windshield, limiting its effectiveness in rapidly responding to light rain. In addition, the sensor housing is physically bulky, reducing its appeal in luxury vehicles [5].The automated rain wiper system is used to detect rainfall and activate automobile automatic rain wipers without driver interaction. The system was developed to mitigate driving distractions and allow drivers to focus on their primary task of driving. The distraction eliminated with the development of this product is the manual adjustment ofwindshield wipers when driving in precipitation. The few seconds that a driver takes the attention off the road to adjust a knob while driving in poor weather conditions could potentially lead to car accidents. The system uses a combination of impedance and Impedance sensor to detect rain and its intensity. The system contains a controller that takes in the input signals from the sensors and controls the operation of the windshield wipers based on those input signals [6].When we are driving on the road, it is very important for us to fully concentrate. It will be dangerous if we are distracted while we are driving, especially when it is raining heavily. It is dangerous to drive when we have a lot of things to think about. It is better to fully concentrate on driving rather than to think about when to turn on the wiper especially when the weather is really bad which needs our full concentration. It is better to lose some of our budget rather than losing our lives in accident [6].In rainy days we suffer from act of sprinkling of water on front glass of our wheeler. While driving car driver cannot see on road vehicles. So he tries operating wiper on glass, for that he should often switch on for operating wiper. And because of this it can cause vehicle accident. If we apply any kind of sensor on glass which sense the act of sprinkling water, by automation, the wiper will operate automatically [6].When the water hit the sensor, it will send signal to the system thus moving the wiper motor. Once sensor did not detect any water, the wiper will stop. This will reduce the weaknesses which have been stated at beginning. Additional plan to this invention is to make the wiper automatically push up from the windscreen when the engine shut off [7].

Why Anyone Would Want Rain Sensor

The most obvious reason anyone would want rain-sensing wipers is safety: rain sensors reduce driver distraction. The amount of rainfall hitting the windshield is constantly changing. The weather itself fluctuates, and the speed and traffic conditions change. As a consequence, the driver has to constantly adjust the wipers because they are wiping too often and smearing, or not often enough, and the driver cannot see properly. Adjusting the wiper control is a constant source of distraction, and distraction kills. NSTSA (The National Highway Traffic Safety Administration) has implicated driver distraction in at least 26% of fatal accidents in a one-year period, so rain sensing wipers offer the driver additional safety [9].The next reason is convenience. We would like to put a quote from the National Post's Drivers Edge column supplement on May 25, 2001: "Adjusting your windshield wipers takes a split second -- after split second after split second... Automatic windshield wipers are easy to use and convenient. Drivers like them because it means no more fiddling with buttons toget the wiper speed just right" [9].Drivers with special mobility or vehicle control needs have particular need of rain sensing wipers. If a driver requires hand-operated brake or throttle controls, then the constant adjustment required by conventional wiper systems is downright dangerous. For these and other

reasons, almost everyone that drives a car with rain sensing wipers likes the feature and does not want to go back to plain old intermittent wipers. Rain sensors are available in most new luxury cars, as well as the automotive aftermarket [8][9].

Types of Rain Sensing Wipers

Varieties of rain sensing wipers have been constructed over the years. The various types are discussed in brief below.

Rain Detector Using 555-Timer

Rain Detector using 555 Timer is a simple alarm that can be used to find out if it was raining. In principle, Rain Detector using 555 Timer is a stable multi vibrator which is prepared by IC555 with installed sensor that can detect water. A stable multi vibrator with the 555 timer is set in the audio frequency with a frequency of 1 KHz. The series of using Rain Detector 555 Timer can be supplied with a voltage source that is free enough from 5-15V DC. In application, Rain Detector using this 555 Timer can be mounted in a motor, car or other object that we want to protect from rain [14].
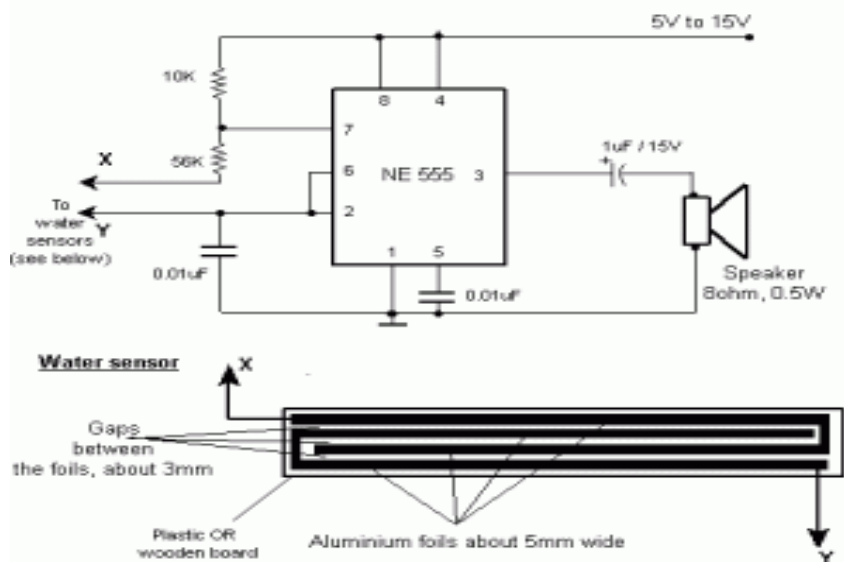

FIGURE 1. Rain Detector Using 555-Timer [14].

Water sensors that are used in circuit 555 Rain Detector using this can be designed with a PCB that one can make the path as shown in the image above or as disclosed from the imageabove is by using aluminum foil taped to a board or boards that are plastic insulator . The important principle of the sensor is to conduct electrical current very well when the surface is exposed to water even a little [14].

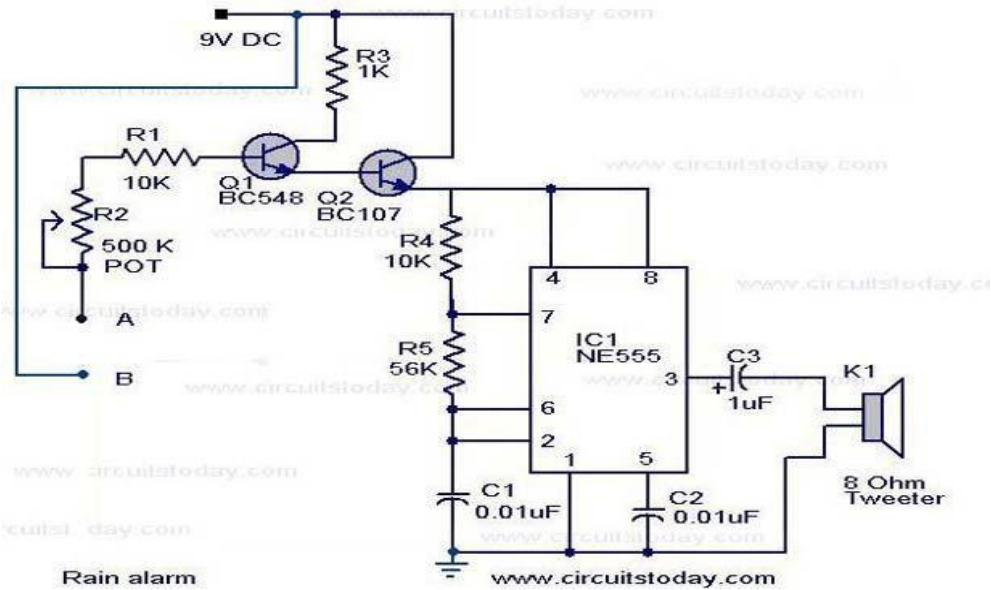**Rain Detector Using the Combination of 555-Timer and Darlington-Pair**

Figure 2 Rain Detector Using the Combination of 555-Timer and Darlington-Pair [15].

Here is a simple rain alarm circuit that produces an audible alarm whenever rain falls. The rain detector circuit is based on two transistors (Q1 & Q2) and a NE555IC (IC1). The two transistors are wired as a switch which goes on when the base of Q1 is shorted to the positive of the supply by the rainwater falling on the sensor. When the transistors are ON power supply is available to the IC1 which is wired as a stable multi vibrator. The output of IC1 drives the speaker to produce an alarm.It uses a 9V battery or a 9V regulated DC supply for powering the circuit and hence has a stable power supply. However, connecting any speaker less than 8 ohms impedance as load can damage the IC.Comparatively, most of the rain detectors as shown above are not easy to design and are expensive to construct, but the two- transistor rain detector is very easy to design and requires less components for its construction. Its sensing element can be locally constructed instead of importing, and it can be made from two separate transistors connected in parallel. This makes it less expensive and affordable [15].
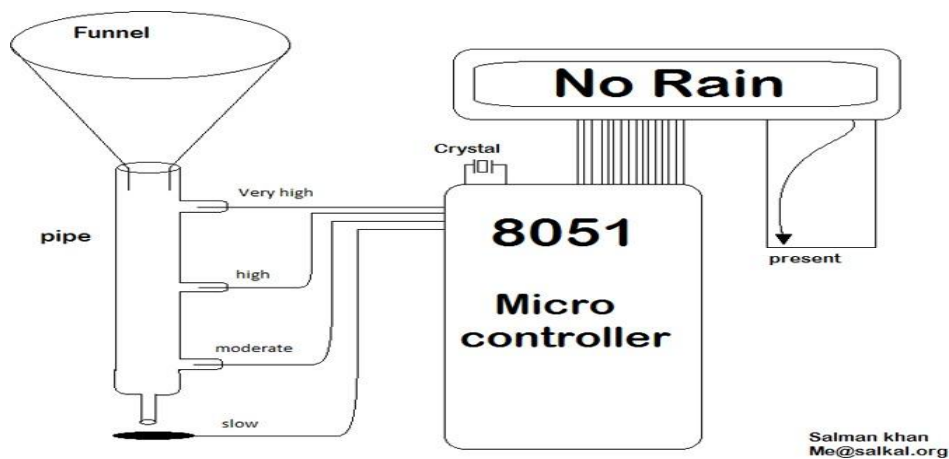
Rain Detector Using 8051 Microcontroller

FIGURE 3. Rain Detector Using 8051 Microcontroller[15].

It works in the principle of water conducting electricity.This rain detector is working in very simple process of water conducting electricity. The wire which is connected to Vcc and the other four wires are made to be inside

the pipe whose image is given below. It has different levels namely slow, moderate, high, and very high via BC547 transistor. Port P2 is connected to data pins of LCD and P1.0, P1.1, P1.2, are connected to RS, RW, and EN pins of LCD respectively.When there is no rain it will show No Rain. As the rain starts the pipe gets filled slowly wire at different levels get some positive voltage, due to conducting nature of the water. Due to this voltage is sent to their respective pins on controller. When first drop fall in that pipe, LCD displays the message slow. When the speed of rain increases the water get touched the wire and show different message like slow, moderate, high, very high [15].

Advantages:
- You can make your own.
- Work with a basic principle.
- Very easy to make
- Easy to handle.

Disadvantages:
- Alert will be start when rain is there, sometimes it disturbs human.
- It has to be in few heights so that something could not enter

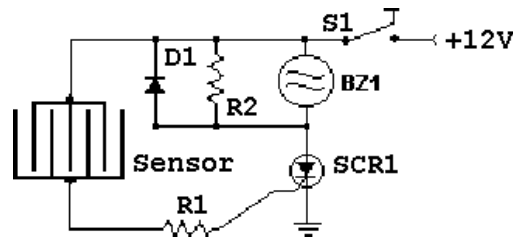**Rain Detector Using Silicon Controlled Rectifier (SCR)**

FIGURE 4. Rain Detector Using Silicon Controlled Rectifier (SCR) [15].

This circuit uses a sensor made of a small piece of etched PC board and a simple SCR circuit to detect rain and sound a buzzer. The SCR could also be used to activate a relay, turn on a lamp, or send a signal to a security system. Also, because the SCR power controller is a solid- state device, it provides virtually limitless, trouble free operation with a minimum of maintenance and so it is highly reliable. One limitation of using the SCR is that there will be high current surge (di/dt) and high voltages (dv/dt) effect which can damage the device. There is a need to protect the device against damages by using snubber circuits [15].

Rain Detector Using NE555 and UM66

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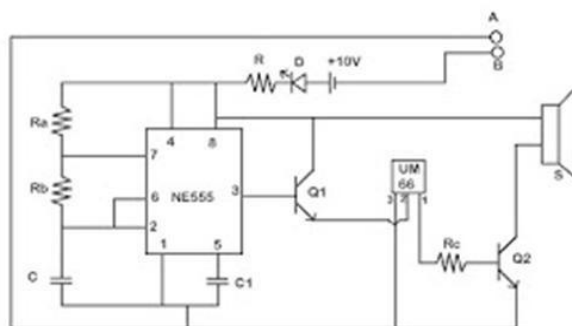
FIGURE 5. Rain Detector Using NE555 and UM66[15].

This rain detector has two parts, astable using NE555 and simple continuity tester. The input to the astable is given through a continuity circuit. It has two wires A and B which are placed just near each other. But both have no connection. The continuity circuit is closed when it

begins to rain and as water particles fall on the two wires A and B. Thus the circuit is closed and the 10V is fed into the astable multi-vibrator. The astable multi-vibrator can produce square waves when input is given to it. In this circuit we use a melody sound generator IC UM66. It is used to produce sound when rainfall occurs. It has 3 pins used as input, output ground. The output from the astable multi-vibrator is given to the input of the IC UM66. First the output is given to the BC548 transistor to amplify it. After it is given to the input to UM66, the output from the UM66 is again given to the BC548 for amplification and then given to the speaker, and the speaker produce the sound. If the rain continues, the sound is also continuously produced. Fix the circuit except wires A and B and speaker. Place the speaker at the place where it can be heard, and place the wires A and B in the open and close to each other for rainfall to occur.The IC UM66 helps to prolong the sound of the buzzer as long as the rain continues but consumes more power during this period [15].

Automatic Rain Sensor Using PIC18F2580 with CAN Facilities

In this project PIC18F2580 is used with CAN facilities. The Controller Area Network (CAN) is a serial bus communications protocol. It defines a standard for efficient and reliable communication between sensor, actuator, controller, and other nodes in real-time applications. CAN is the de facto standard in a large variety of networked embedded control systems. The early CAN development was mainly supported by the vehicle industry: CAN is found in a variety of passenger cars, trucks, boats, spacecraft, and other types of vehicles. The protocol is also widely used today in industrial automation and other areas of networked embedded control, with applications in diverse products such as production machinery, medical equipment, building automation, weaving machines, and wheelchairs. In the automotive industry, embedded control has grown from stand-alone systems to highly integrated and networked control systems .By networking electro- technical subsystems, it becomes possible to modularize functionalities and hardware, which facilitates reuse and adds capabilities [16].

Synthesis of Knew Knowledge from the Existing Work

Existing system manually used control stalk to activate wiper and the process of pulling up wiper is difficult to be handled. The driver needs to switch on and off the control stalk and it will reduce the driver's concentration during the driving. Thus, this system is proposed to solve all these problems.The concept of this wiper system is similar with other conventional

wiper, yet this system is upgraded to an automatic control system by using a rain sensor [22]. Whenever the water hit a dedicated sensor that is located on windscreen, it will send a signal to move on the wiper motor. Once water is not detected by sensor, the wiper will automatically stop. This will help the driver to give more concentration and reduce the car accident probability.So in this approach we will concentrate much on the modification of this type of automatic rain sensor to be applicable in saloon cars. This idea was developed when it was found out that in case of trucks, the actuation of wipers during rainy season is based on the switch which is being operated by the driver. On plane roads or four lane roads, this may not be big problem. But in the congested or hilly areas during heavy rain driving is a bit difficult because of operating the wiper continuously along with the driving. Few years ago, there were some accidents reported in north India. These accidents claimed precious lives due to hinder in the visibility of the driver during heavy rain.The working principle of automatic rain sensing car wipers is to wipe the mist formed on the windscreen vehicles just as it senses rain on the windscreen, which is based on the concept which makes use of a combination of a rain sensor and the wiper motor. The rain sensor and the wiper motor are already connected to a DC source so therefore if the sensor senses the presence of raindrops, by the principle of conductance; it actuates the wiper motor to start working. This is actually less cost expensive due to the few components been used also very reliable, efficient and simple in construction.

Brief Introduction of Proposed Work

With drivers exposed to an ever increasing number of distractions, automatic rain-sensing wiper systems has 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. A rain sensing wiper consists of a sensor circuit incorporated with mechanical system for automatic wiping of raindrops during rainfall, thus providing complete degree of automation. Both rain-sensor and intermittent wipers are significant milestones that incorporate the windshield wiper as part of an overall design system. Efficiency of rain sensing wiper system depends on the different factors.The innovation showcases simple and economical technology for automatic rain sensor car wiper motor using rain sensor operations. The main objective of the research work is to provide a low cost solution for automatic rain sensor car wiper depending on the intensity of rain. It is effective for both low rainfalls as well as during extreme heavy downpour. It can easily be adapted in saloon cars; this proves its effectiveness and applicability. Also the extraneous and

environmental factors such as impurities, presence of foreign bodies in the rainwater, dirt on the windshield and smog do not affect the system performance.

Factors Affecting the Rain Sensing Wiper System

The factors that could possibly affect automatic rain sensing car wiper system are:

Comfort: To operate the wiper with response to changing rainfall and driving conditions, thus keeping the driver's windshield clear.

Installation: The system is easy to install. In the installation process we add one sensor system on the front glass. When sensor detect water droplet then wiper system is operating. If the installation is not done properly it may not work accurately as its designed purpose [19].

Failsafe Function: It is assured that the wiper operates at 6-second intervals when the drop detection function is disabled because the sensor is completely blocked by dust, snow, or other matter stuck to the sensor [20].

DESIGN CALCULATION

For wiper top motor $speed = 2400 rpm$

The worm gear in wiper mechanism reduces the speed 50 times and increase torque 50 times.
$So\ the\ wiper\ top\ speed\ will\ be = \frac{2400}{50} = 48 rpm.$

Using this we can vary speed of motor using various voltage level of sensor at 1800 rpm and 1200 rpm which will give the wiper speed 36 rpm and 24 rpm . This variation of wiper speed is satisfactory for our requirement.

Given, servo motor rotational $time = \frac{0.12 sec}{60\ degree}$

for requirement at an angle of 110 −

125 $degree$,

$Timerequired = 110 \times 0.1260 \qquad to 125 \times 0.1260 \quad = .22 \sec to .25sec.$

We want to have a required angle servo motor have to rotate for .22sec or .25 sec

4.1 Components Specifications

TABLE 1. Components Specifications

Components	Model type	Quantity
Integrated circuit	NE555	1
Transistor(NPN)	BC548	1
Diode	IN4007	5
Resistor	1MΩ,10KΩ,1KΩ	3
Relay	12V	1
Transformer	230V-12V	1
Wiper motor	12V DC	1
Rain sensor	Sensor pad	10
Capacitor (ceramic)	0.1μf	1
PC board	Small size	4
Wind screen	30 ×20 inches	1
Windscreen frame(wood)	10× 80inches	1
Wiper blade	Small pieces	10
Cable	1.5mm^2	60 inches
Power Switch	DC type	1
Electrolytic capacitor	50V 220μf	1

METHODOLOGY

Block Diagram of Automatic Rain Sensor Wiper

The construction is made up of two circuits: the automatic rain sensor circuit and the power supply system.
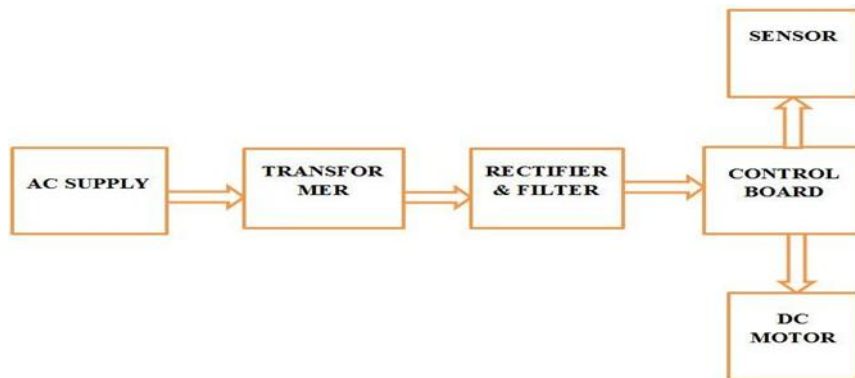

FIGURE 6.Block Diagram of an Automatic Wiper [25].

Detailed Explanation of the Block Diagram of the Automatic Rain Sensing Car Wiper

The automatic rain sensor block diagram can be broken down into a series of blocks namely the AC supply block which consist of a 230V AC, transformer block which steps down the 230V AC to 12V AC, rectifier and

filter block which converts the 12V AC to 12V DC and then smoothens the pulsating DC voltage, control board block which receives signal from the rain sensor and back to the DC motor, sensor block which senses the rain drops and then actuates the automatic wiper system to wipe windscreen and finally the DC motor block which receives signal from the control board in order to operate the wiper, moreover it controls the direction and speed of the wiper.

AC Supply: The AC supply feeds the system with 230V AC which is further stepped down to 12V AC by the transformer.

Transformer: It is an electrical device which transfers the power from one winding to the other winding with isolation. All the electronic gadgets work for less voltages. So a step down transformer is used, whose function is to step down the AC voltage from 230V to require 12 V. The output of the transformer is 12V AC which is connected to the diodes for rectification.
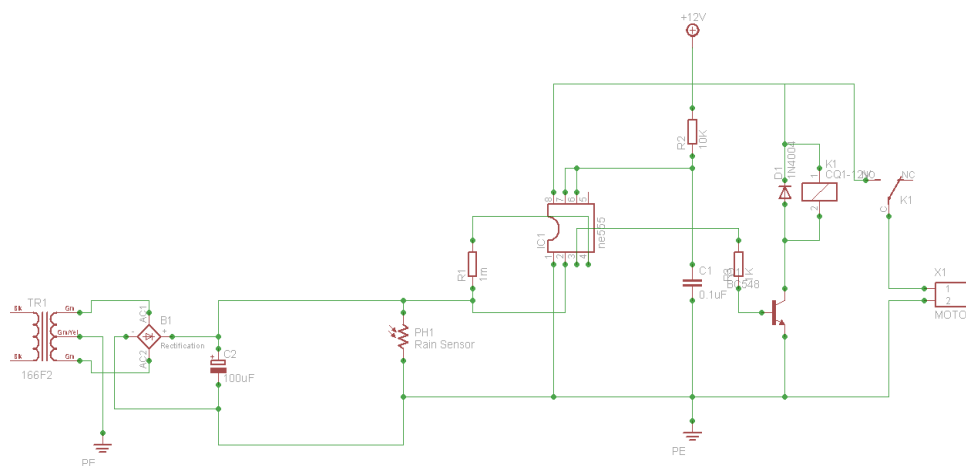
Rectifier and Filter: It employs diodes, which convert AC into DC. The output of the rectifier circuit is not a DC. It also consists of some AC components, which are called as ripples. In order to remove these ripples, filter circuits are employed. So the output of the rectifier circuit is input to the filter circuit.Filter circuit employs electrolytic capacitors in order to remove the AC components. The capacitor does not allow AC components to pass through it, because it offers high reactance to the AC components, so all DC components will be bypassing the capacitors. Hence the output from the filter circuit will be DC only.

Control Board: This is the heart of the system which controls the whole system. It receives signal from the rain sensor and back to the motor. When there is the presence of rain, the sensor sends signal to the control circuit and the circuit actuates to start the wiper.

Rain Sensor: The most common modern rain sensors are based on the principle of total internal reflection: an infrared light is beamed at a 45-degree angle into the windshield from
the interior if the glass is wet, less light makes it back to the sensor, and the wipers turn on.

DC Motor: This is used for controlling the direction and the speed of the wiper. It actuates whenever it receives signal from the control circuit to operate the wiper.

Circuit Diagram of Automatic Rain Sensor

FIGURE 7 Circuit Diagram of an Automatic Rain Sensing Car Wiper [25].

Simulation of the Circuit Diagram

Before practical implementation of the automatic rain sensor wiper, a software simulation was carried out using PCB software. Below is the screen shot of the circuit during simulation.
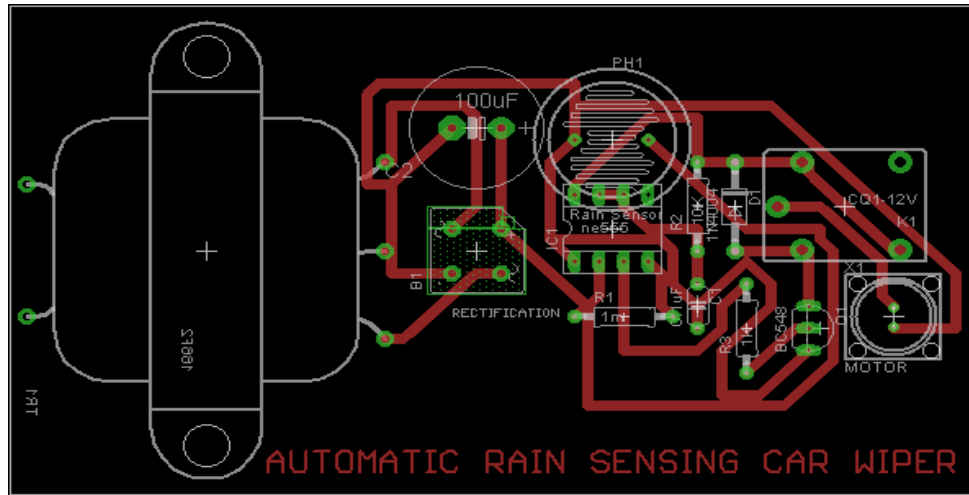

FIGURE 8. Simulation of the Circuit Diagram [27].

Procedure for Construction of the Automatic Rain Sensor Circuit

An AC current of 220V is supplied to the primary turns of the transformer and it's been step down to 12V AC. This 12volts is fed to a four diode rectifier which changes the 12V AC to 12V DC. This is fed to the smoothing capacitor to filter the DC output voltage.A 555 timer is used in construction of the automatic rain sensing circuit. A 1MΩ resistor is connected between pin 4 and pin 2. This is connected to the positive terminal of the DC output voltage from the rectifier and triggers the system to operate. Pin 8 is connected to the DC supply since it is a +VCC terminal. Pin 7 and pin 6 are connected together and fed to the connection between 10kΩ resistor and capacitor 0.1uf where the capacitor is connected to the ground connection and the 10kΩ resistor is in line with positive of the source. Resistor 1kΩ is connected to pin 3 which biases the transistor BC548. The collector of the transistor is connected to the diode and to the relay. One terminal of the relay is connected to the wiper motor and the other wiper motor terminal is connected to the ground. The rain sensor has two terminals where one is connected to the pin 2 of the 555 timer and one is connected to pin 1 which is the ground.

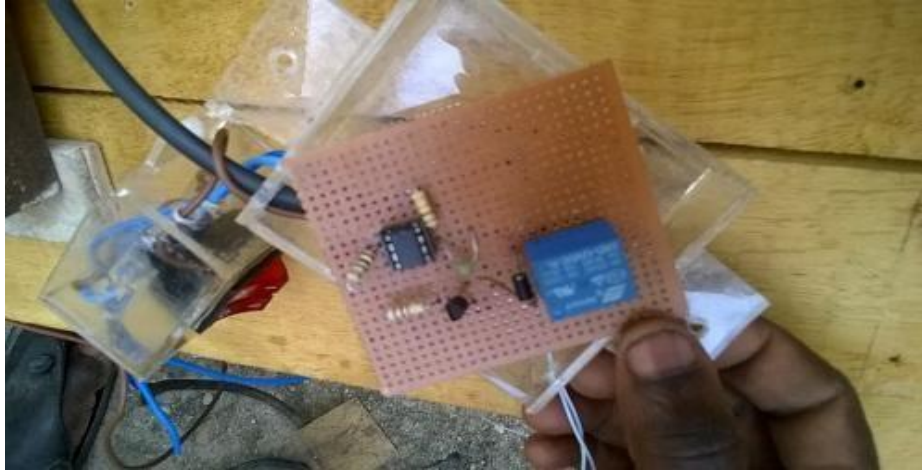**Pictorial view of the construction of the automatic rain sensor wiper circuit**

FIGURE 9. Image of Automatic Rain Sensor Constructed Circuit [25].

Working Principle of the Automatic Rain Sensing Wiper Circuit

Working of this circuit is same as the working principle of monostable multivibrator. Here the trigger to the second pin is given by rain sensors. A small water drop on the rain sensor will connect the negative voltage to the trigger pin of 555 IC which in turn will turn the output pin of 555 high. 555 Output is connected to the base of transistor through a 1K resistor which forward biases the transistor. Thus relay gets negative and it switches ON the wiper motor.The 12V DC supplies the power to the sensor as well as rain operated motor. Wiper motor is automatically ON during the time of rainfall. The senor is fixed in the vehicle glass. The rain (Touch) sensor is used in this project. It senses the rainfall and gives control signal to the control unit. The wiper sweeps the windshield with the help of a 4-bar linkage using a simple inversion. The motion of wiper is based on double crank mechanism whose working is quite similar to coupling rod of locomotive. The control unit activates the wiper motor automatically. This operation is called ―Automatic rain operated wiper‖.

System Implementation

The following measures must be taken into consideration when using the automatic rain sensor car wiper:When the wiper switch is in the AUTO position, the wiper will operate for 1 cycle if the initial engine start is made. This may cause the wiper blades to wear prematurely. Therefore, other than rainy days, set the switch to the OFF position. Especially during the winter time, check if the wiper blades are not frozen to the windshield.Operating the wiper with the blades frozen can damage the wiper motor. If you operate the wipers when the windshield is dry without spraying washer fluid, the windshield can be scratched and the wiper blades can wear prematurely. Use the wiper with the washer fluid when the windshield is dry.When it does not rain, turn the wiper switch to the OFF position.Turn the wiper switch to the OFF position before any car wash to avoid unwanted operation of the wipers.

Image of the artifact after construction

FIGURE 10. Image of the Artifact after Construction [25].

Testing/ Validation of the Automatic Rain Sensor wiper Performance

The 12V DC supplies the power to the sensor as well as rain operated motor. Wiper motor is automatically on during the time of rainfall. The senor is fixed on the vehicle glass. The rain (Touch) sensor is used in this project. It senses the rainfall and gives control signal to the control unit. The wiper sweeps the windshield with the help of a 4-bar linkage using a simple inversion. The motion of wiper is based on double crank mechanism whose working is quite similar to coupling rod of locomotive. The control unit activates the wiper motor automatically. This operation is called Automatic rain operated wiper‖.•As the raindrop falls on touch sensor, it activates a timer which is supplied power through a battery.It then activates the relay circuit which gets on or off during falling of raindrops.Control circuit then activates DC motor which is connected to a linkage mechanism which is further connected to the wipers.

RESULTS AND DISCUSSIONS

Existing systems have some practical limitations this particular working model has dealt with. The existing types detects rain drops using 555-timer, using the combination of 555- timer and Darlington-pair etc. but these methods have a limited sensing area, are relatively expensive, and are only suitable for sensing moisture on the outer surface of the wind-shield. Also sudden change in intensity of light may result in malfunctioning.Comparing all the above types of rain sensors, the automatic rain sensor using PIC18F2580 with CAN facilities is actually preferable among the other types of rain detectors. This is because the Controller Area Network (CAN) is a serial bus communications protocol. It defines a standard for efficient and reliable communication between sensor, actuator, controller, and other nodes in real-time applications. And this is widely used in passenger cars, trucks, boats, spacecraft, and other types of vehicles.With the Rain Detector using 8051 Microcontroller, it has several disadvantages such as Alert will start when rain is there, sometimes it disturbs human. Also it has to be in few heights so that something could not enter but with Automatic rain sensor using PIC18F2580 with CAN facilities it isn't like that. It is very efficient and reliable and widely used.Automatic rain sensor using PIC18F2580 with CAN facilities showcases simple and economical technology and an upgrade for automatic rain sensor car wiper using rain sensor operations. The main objective of the research work is to provide a low cost solution for automatic rain sensor car wiper depending on the intensity of rain. It is effective for both low rainfalls as well as during extreme heavy downpour. It can easily be adapted to any segment of cars; this proves its effectiveness and applicability as compared to other types. Also the extraneous and environmental factors such as impurities, presence of foreign bodies in the rainwater, dirt on the windshield and smog do not affect the system performance.To overcome the challenges drivers face during

rainfalls when driving, the automatic rain sensor car wiper was incorporated to mitigate driving distractions and allow drivers to focus on their primary task of driving. Some advantages of automatic rain sensor wiper are as follows.

•   Low cost automation project.

•   Free from wear adjustment.

•   Less power consumption.

•   Operating principle is very easy and Installation is simple.

•   It is possible to operate manually/automatically by providing On/Off switch

•   Sensor cost is very low due to the use of automatic rain sensor.

           Performance Curves/ Graphs of the Automatic Rain Sensor Circuit

In testing the performance of the automatic rain sensor wiper indicating its graphical curves, COMSOL Multi-physics software was used. COMSOL Multi-physics is an interactive engineering and physics tool that performs equation basedmodeling in a visual interface. This software allows the modeling and simulation of any physical phenomena in a way that's easy to implement. It comes pre-installed with different model libraries that can be readily used. Some of the libraries include modules such as Chemical Engineering Modules, MEMS Modules, RF Modules and Structural Mechanics Module.

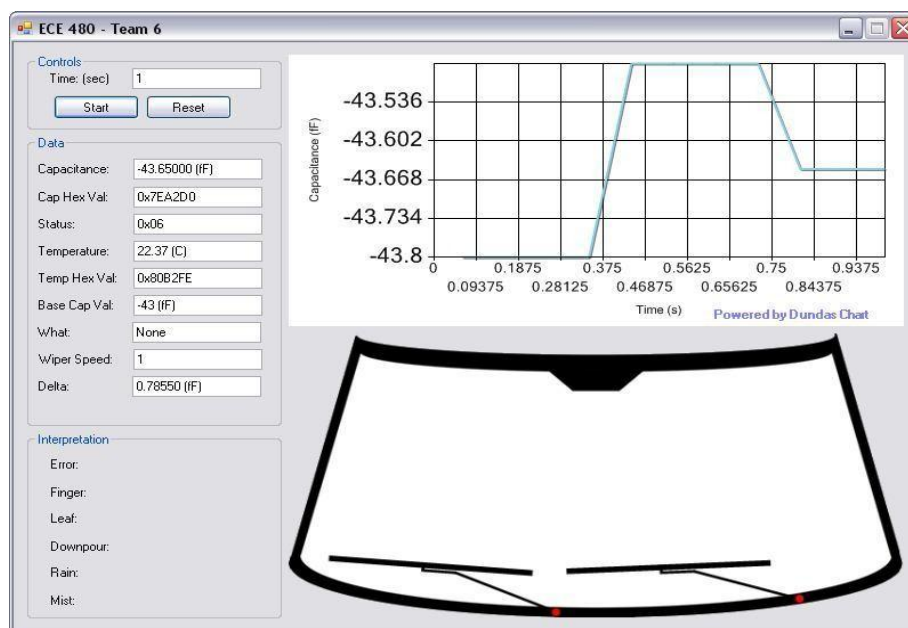**Testing the Automatic Rain Sensor Car Wiper at Startup Stage**

FIGURE 11. Startup Display of Visual Basic Program [28].

The above figure shows the display of the rain sensing car wiper. This indicates the startup process when the software timing is set to one second. The wiper remains at OFF position until the start bottom is pressed.

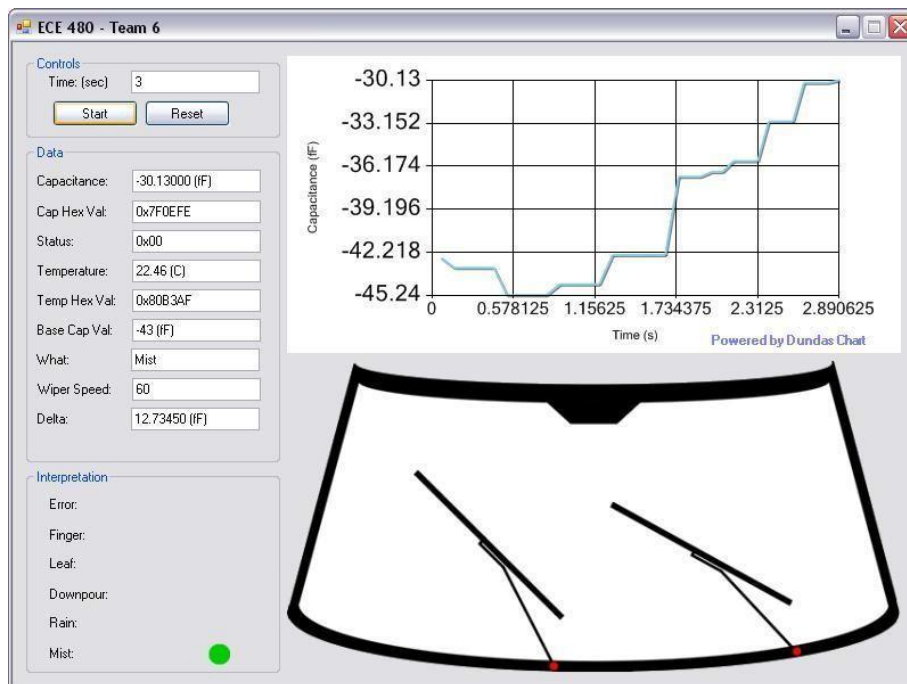**Testing the Performance of the Rain Sensor with the Presence of Mist**

FIGURE 12.Test with Mist [28].

The above figure shows the display of the presence of mist on the windscreen, the wiper begins to move as soon as the sensor senses the mist. Hence the waveform in the graph begins to rise up slowly indicating the movement of the wiper speed

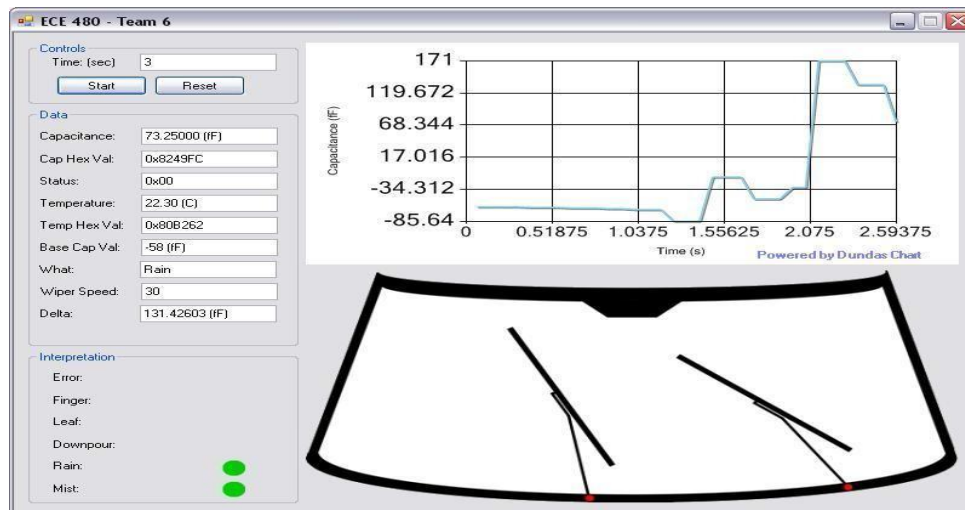**Testing the Performance of the Automatic Rain Sensor at Rain Level Detection**

FIGURE 13.Test with Rain Level [28].

The above figure shows the display of the wiper movement on the windscreen when the sensor senses rainfall. The wiper begins to move a little faster than when it was at the mist stage. In the graph it is realized that, initially the waveform started at a low stage and increased very fast due to the rainfall.

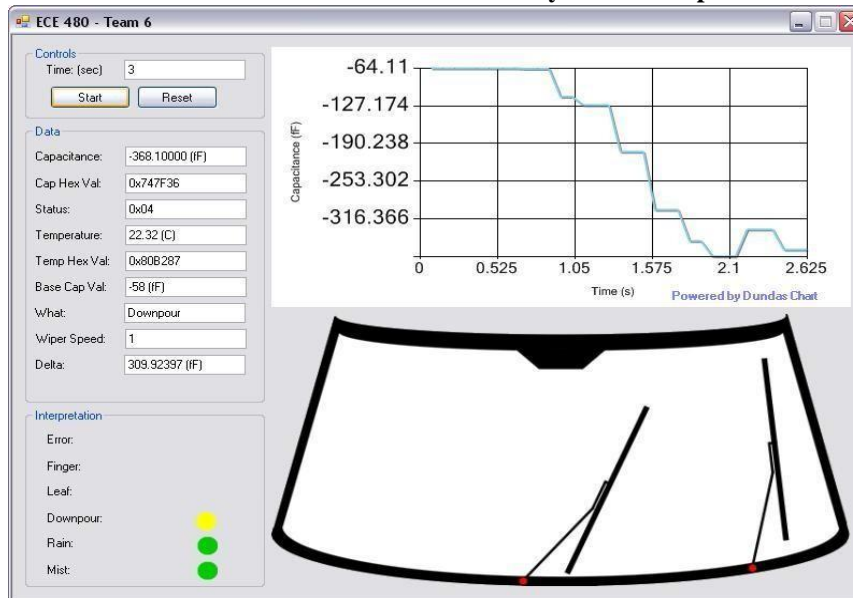**Testing the Performance of the Automatic Rain Sensor at Heavy Rain Downpour Level**

FIGURE 14. Test with Downpour [28].

The figure above shows the display of the wiper when subjected heavy rain downpour. The wiper begins to move faster than before and due to the interaction that occurs during the changing from the rainfall state to heavy rain downpour stage, the waveform descends and begins to ascend gradually.

Testing the Performance of the Automatic Rain Sensor when a Leaf was on the Screen
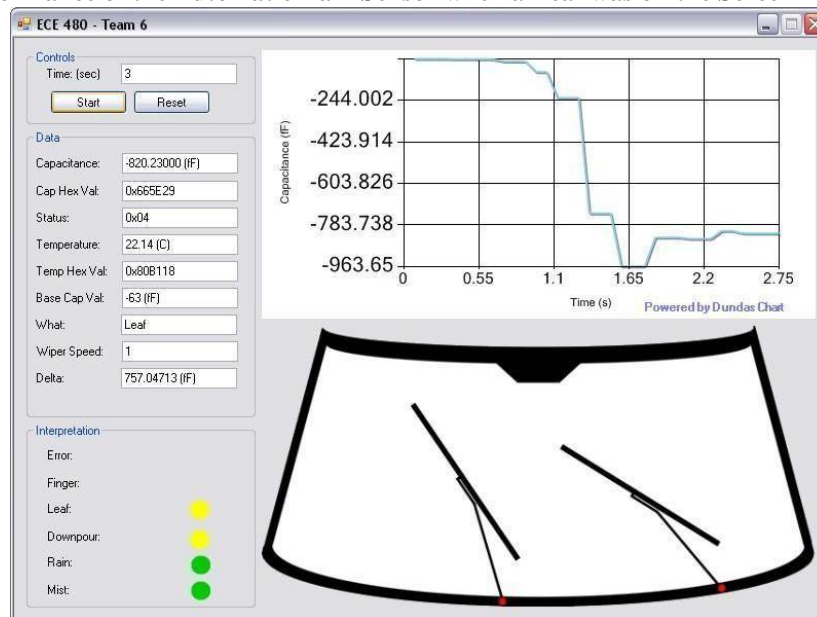

FIGURE 15.Test with Leaf on the Windscreen [28].

The above display shows the display of the wiper when a leaf or an obstacle is on the windscreen. This reduces the speed of the wiper movement and turns the waveform to zero level instantly and in a limited time the waveform begins to rise gradually.

Testing the Performance of the Automatic Rain Sensor by Touching the Windscreen with a Finger
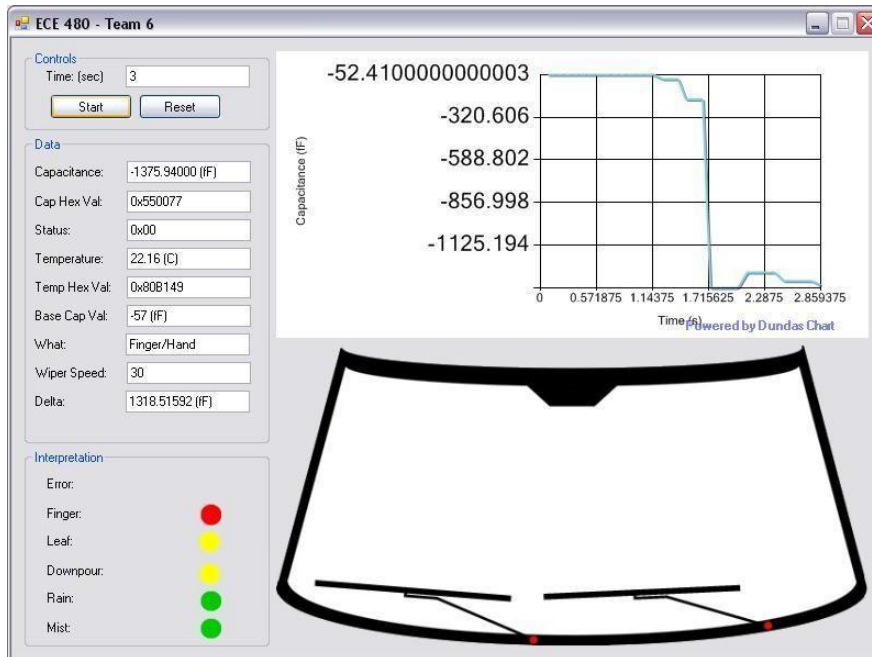

FIGURE 16. Test with the Finger on the Windscreen [28].

The above figure shows the display of the wiper when a finger touches the windscreen. In this situation, the wiper cease to move just because the rain sensor only senses raindrops thereby causing the waveform down to zero level.

CONCLUSIONS

Our Automatic rain operated wiper system works well with rain sensor. As future extraction work the same can be carried out by different types of sensor. As far as accuracy of the system is concerned it is more accurate than conductive, optical sensor etc. But the reason for not using those named sensors is because of their higher cost. The sensor unit mounts discretely to the interior of the windshield while providing increased detection area, improved accuracy, and a lower cost than the pre-existing optical unit. This sensor has been designed to be able to easily replace optical units, as it mounts in the samelocation of the vehicle, on the interior of the windshield, and relays the same control signals to the BCM of the automobile. Its less power consumption, been free from wear and tear as well as it been possible to operate manually/automatically by providing on/off switch all make this design a very useful and advantageous working model.Thus the advantage of this project, which is the automatic rain sensor wiper, is cost effective, sustainable, and user- friendly. This design brings about a result from either one of two paths, costing down the current automatic rain sensor wiper and creating an innovative new design. Both of these paths required a more broad knowledge of appropriate materials that could be utilized in creative ways in automatic rain sensor wiper construction.

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