



Design of Rain Detection System for Power Windows

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Abstract- *In this paper, the rain detection system used to detect rainfall and activate automatic closing of glass, is presented. The system was developed to reduce driving distractions and allow drivers to focus on main task of driving. The system contains a microcontroller that takes in the input signals from the sensors and controls the operation of the glass based on these input signals. The proposed model automatically turns up the glass upwards when rainfall is detected and the glass goes down when no rain is detected. This system can further be used to detect the percentage efficiency of the rain which is falling on the windscreen.*

Keywords: *rainfall detection, rain sensor, buzzer and alarm system.*

I. INTRODUCTION

In automotive vehicles, windows can move up and down. But when rain occurs the driver may take time to close the window. In some cases, however, the vehicle may be left unattended with one or more windows opened. The windows can also be left opened when the car is parked. Sometimes the weather may change for the worse. As a result, rain may enter the vehicle through the open windows. In some cases, the rain may cause damage to the vehicle interior and/or the contents within the vehicle.

When rain occurs the driver can take time to close the windows and it might lead to distraction which sometimes may lead to accidents also. The National Highway Traffic Safety Administration (NHTSA) 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 [1]. Similar systems are currently installed in some luxury vehicles, but such systems have not reached the massive economy vehicle market. Therefore, a rain detection system which automatically rolls up the windows during rain has been designed. The purpose of this rain detection system for power windows is to create a device that will allow car windows to roll up automatically when it rains, to prevent interior destruction and to make device safe for costumers. It is centred on developing a reliable automatic rain detection system that is commercially available to a large market of automobile owners. Car manufacturers will be the primary customers for system integration into their future automobile lines and the secondary customers will be individual automobile owners, using the system as an after-market product. The low-cost solution proposed by the design will most importantly satisfy the safety and performance requirements needed for the driver at a more reasonable price. There are products similar to the systems that are currently in the market. The improvement of existing rain detection system is still an area of interest for researchers. In 2001, researchers presented a report at an IEEE conference that concentrated on the design and implementation of a rain sensing system [2].

The features of this rain detection system are:

- Rolls up windows in unattended vehicle when it begins to rain.
- Only activated when car ignition is off.
- Window stops if obstruction in path of window.
- Easily interfaced with power windows in vehicles.

The product goals are:

- Detect rainfall on windshield.
- Close glass automatically once rainfall is detected.
- Meet or exceed the response time of the driver.
- Make adaptable to all vehicles.
- Develop high reliability.
- Create with ease of installation.
- Low cost.

The main goal of the rain detection system is to grant the driver the convenience of having his or her car windows automatically close in the event of rain. The system protects the inside of the vehicle from water damage caused by the rain. It provides safety to the driver and passengers by eliminating the distraction of having to close windows manually by pressing switches.

In Section II existing work has been discussed. Proposed Methodology has been discussed in Section III. Section IV tells about the result. In Section V conclusion and future scope has been discussed.

II. EXISTING WORK

The related work has been done in past as S. Dharmadhikari et al. They have presented automatic wiper system during rain. Figure 1 shows the block diagram of rain detection system proposed by them [1]. The rain detection box contains a series of rain sensors. The data processing unit contains the microcontroller. The motor control module is composed of the motor and its control circuit. The rain detection unit uses two types of sensors whose outputs are normalized by an input signal module. The data processing is performed by a microcontroller and its results are fed into an output signal module which is the input to the motor control box. The two signal modules were needed for interfacing between all the units. Some work has been done as I.A. Khan et al. They have presented zone wise vehicle parameter control. There are various parameters which have been discussed in this paper like speed, horn, wipers and window pane [3].

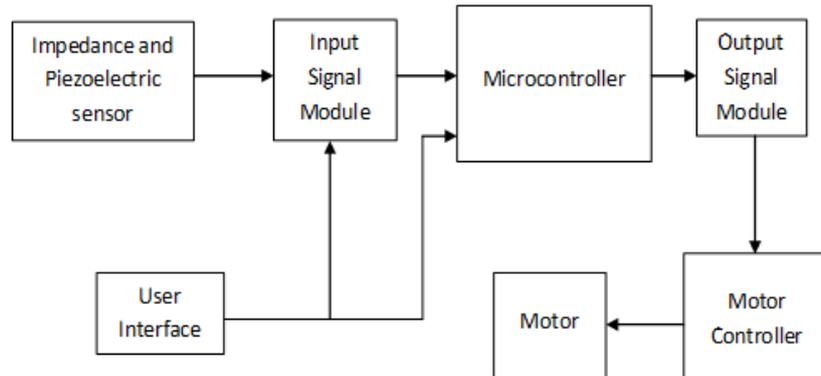


Fig 1. Block diagram of rain detection system

In 1958, the Cadillac Motor Car Division of General Motors experimented with a water sensitive switch that triggered various electric motors to close the convertible top and raise the open windows of a specially-built Eldorado model, in case of rain [2].

The Earlier Technology is based on the Automatic Rain Detection System which automatically starts window wipers whenever rain is detected. The device is fitted on the windshield which senses rain and starts the wipers. Figure 2 shows the automatic wiper activation system. It consists of sensor modules, wires, wiper module and controller module. When rain falls on the car, the signal is sent to the moisture impedance sensor which is located at the top. It sends the signal to the controller module and then the signal is sent to the wiper motor which closes the glass.

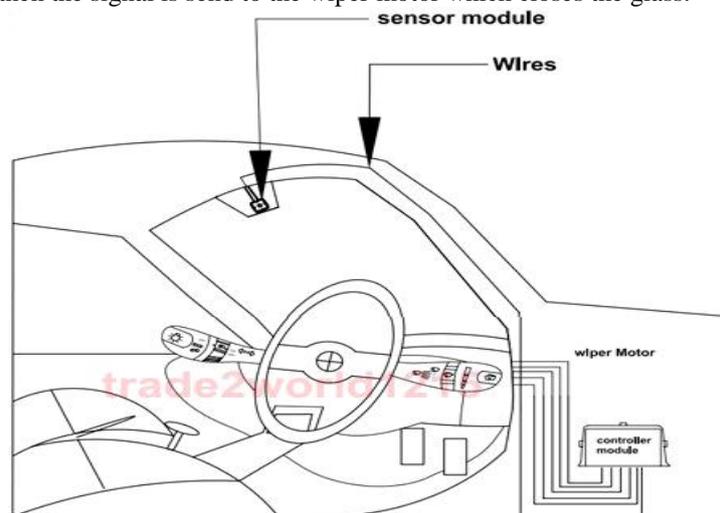


Fig 2. Automatic wiper activation system

III. PROPOSED METHODOLOGY

Rain detection system for power windows by using various components integrated on the PCB is implemented. The ULN2003 is interfaced through microcontroller AT89C51. The Relay and pre programmed microcontroller sends the signals to the motor which closes the glass. The glass which is mounted on the steel channel moves up when it senses the rain. This work is analogues to Automatic wiper system where wipers are used to remove the droplets of rain. But wipers are not used here. In this system glass goes upwards when it detects rain and downwards when no rain is detected. This is helpful for the driver to concentrate on driving to avoid accidents and it also helps in preventing the interior destruction of the car.

This operation allows this design to be used as a rain sensor detection system and also it allows the system to automatically close windows whenever it senses rainfall thereby without disturbing the driver of the vehicle. The glass used here is Plexi glass. Plexi glass is poly (methyl methacrylate). It is a chemical compound. It is stronger than any normal glass. Its width is more than other glass. It can easily fit in any channel [4]. Flow chart for the proposed methodology is shown below in figure 3.

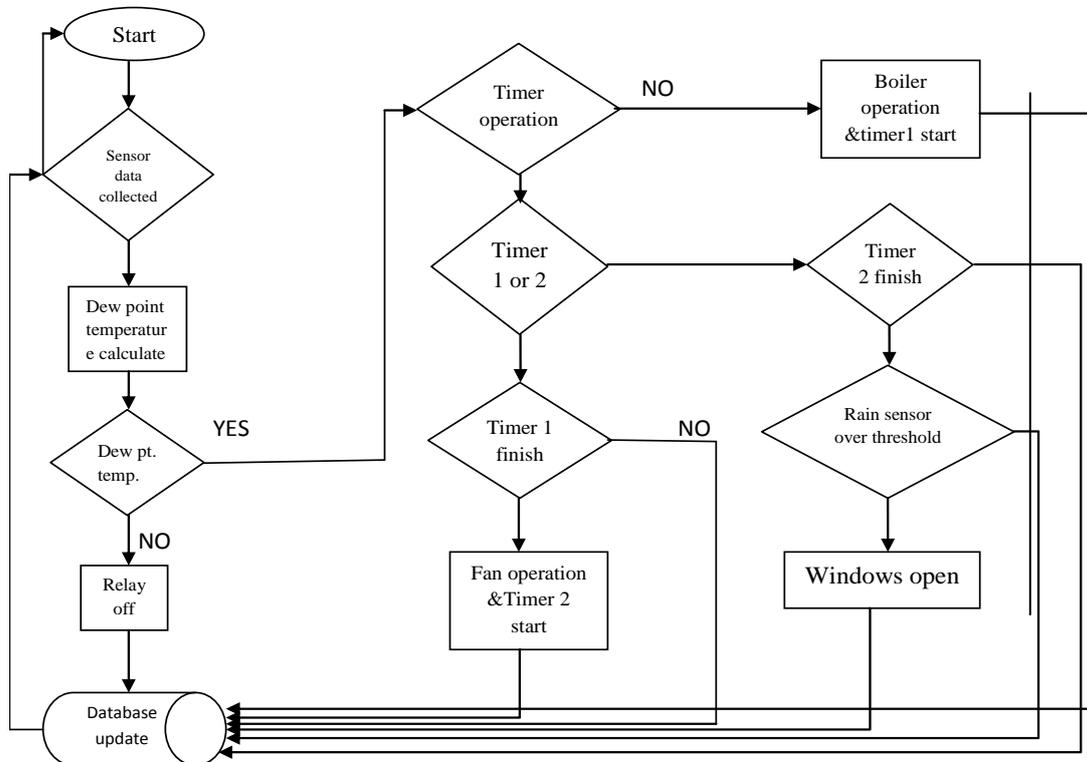


Fig 3. Flow chart of proposed methodology

A. Components

The rain detection system consists of the following components:

- Microcontroller
- Darlington Transistor Array
- Voltage Regulator
- Electrolytic Capacitor
- Resistors
- Crystal Oscillator
- Motor with Relay Drivers
- Plexi Glass
- Rectifiers

B. Circuit Explanation

Rain detection system for automobiles using a microcontroller and a signal conditioning circuitry is presented. The entire components like microcontroller 8051, resistor, capacitor, ULN2003, voltage regulator, relay driver and motor are mounted on a perforated PCB. Figure 4 shows the circuit diagram of the proposed work. The sensors send an input signal to the microcontroller that controls the motor through interfacing with the automobile control circuitry. A microcontroller along with ULN2003 is used. The crystal oscillator is used for the clock. ULN2003 is a high voltage and high current Darlington array IC. A Darlington pair is an arrangement of two bipolar transistors. It is used for interfacing and to drive the relays. ULN ICs are connected with the relay drivers. Relay Drivers provide power to external devices. It sends signals to motor to rotate either in clockwise or in anticlockwise direction. They are connected with the motors. Here the motors are running in clockwise direction. A voltage regulator is used with the capacitor. It maintains a constant voltage level. The purpose of a voltage regulator is to keep the voltage in a circuit relatively close to a desired value (5V). The Electrolytic capacitor of 1 μ F and resistor of 1K Ω is used. They are connected to the reset pins of the microcontroller for resetting it. The supply of 230V, 50Hz is given to the rectifier and it converts the AC into DC with the help of transformer mechanism. The battery is connected to the socket and the two wires are short in the water. The LED mounted on the PCB glows which show that the circuit is correctly installed. The glass automatically goes up with the help of motor which moves in clockwise direction. The relay switches send the signal to the motor which activates it. This work can also be operated manually by pressing the two switches which are mounted in opposite direction. The whole system is mounted on a wood cardboard platform.

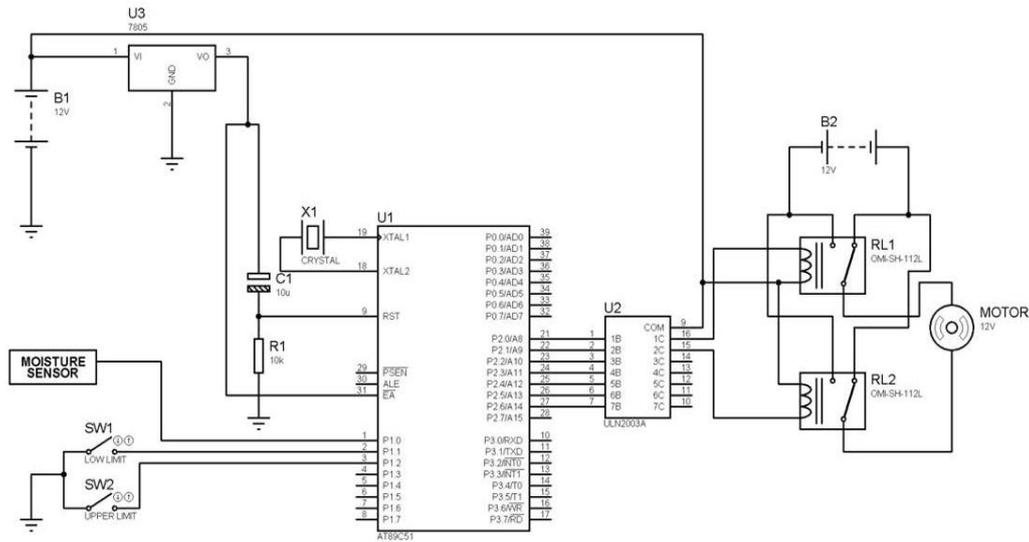


Fig 4. Circuit diagram of proposed work



Fig 5. PCB of the proposed work

Figure 5 shows the proposed work done on the Printed Circuit Board (PCB). A microcontroller along with the voltage regulator, Darlington Transistor Array, Voltage Regulator, Electrolytic Capacitor, Resistors, Crystal Oscillator and Motor with Relay Drivers have been soldered on PCB.

IV. RESULT

The rain detection system using power windows is implemented through microcontroller and relay drivers which detect the rain on the glass shield. The system detects the rain and rolls up the windows automatically in automobiles. The objective is to bring convenience to the drivers and close the car windows automatically. The distraction to the driver and the passengers is eliminated by providing safety. This system also provides convenience to drivers by allowing them to keep windows open while they are away from their vehicle and not have to rush out to close them if it begins to rain suddenly. This system protects the inside of the vehicle from water damage caused by rain.

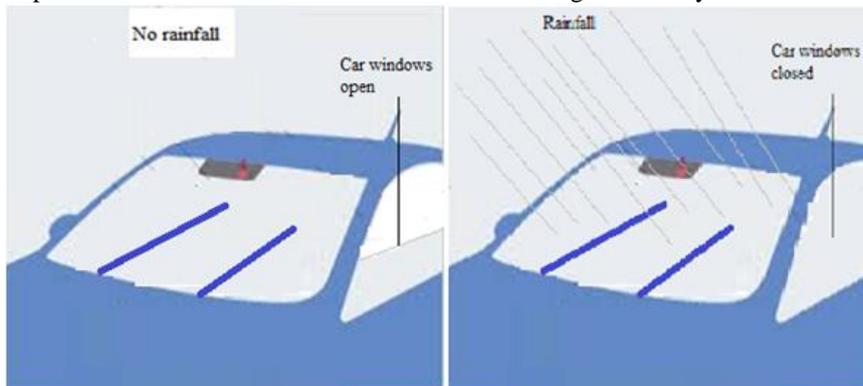


Fig. 6 Car with windows opened

Fig.7 Car with windows closed when rainfall detected

Figure 6 shows that the car windows are opened when no rainfall is occurring. When rainfall starts car windows will be automatically closed. Figure 7 shows the car windows are closed when rainfall occurs.

V. CONCLUSION AND FUTURE SCOPE

This system protects the inside of the vehicle from water damage caused by rain. The distraction to the driver and passengers is eliminated by providing safety. The rain detection system automatically rolls up the windows when rain occurs. The system prevents interior destruction and makes the device safe for customers.

The further development according to the innovation is the buzzer and alarming system. In automobiles, when the rainfall occurs, rain detector detects the rain and it will immediately activate the wipers and inform to the driver. Rain detector will give a heads-up the instant it starts to rain, giving time to close windows and bring in possessions. Further, amount of rainfall in terms of percentage can also be calculated.

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