Development of Electronic System for Safer and Reliable Transportation

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Abstract- In modern days, the accidents are most common in vehicles. Headlights of vehicles pose a great danger during night driving. The drivers of most vehicles use high, bright beam while driving at night. This causes a discomfort to the person travelling from the opposite direction. The driver experiences a sudden glare for a short period of time. This is caused due to the high intense headlight beam from the other vehicle coming towards him from the opposite direction. We are expected to dim the headlight to avoid this glare. This glare causes a temporary blindness to a person resulting in road accidents during the night. In rainy seasons for many vehicles, the wiper on the windshield has to be controlled manually by the driver. This causes distraction to the driver from the primary task they are doing that is ABC (accelerator, brake, clutch) while driving. 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. In order to overcome all these accidents due to two different reasons we develop the" Automatic wiper and dimmer for vehicles". Hence this system helps the driver to mitigate driving distractions and allow drivers to focus on their primary task of driving. Thus the prototype of Automatic wiper and dimmer can automatically switch high beam into low beam thus reducing the glare effect by sensing the approaching vehicle and the wind shield screen can also be wiped automatically on sensing of the rain without distracting the driver from the driving.

Keywords- *Automatic Wiper, Dimmer, Accidents, Vehicles, Road, Driver, Headlight, Transportation*

I. INTRODUCTION

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, an entertainment technology 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 must take his/her eyes off the road to attend to a device.

In recent days the whole concept of making cars has change the companies are shifting towards providing more and comfort to their customers. The requirement of headlight is very common during night travel. The same headlight which assists the driver for better vision during night travel is also responsible for many accidents that are being caused. The driver has the control of the headlight which can be switched from high beam (bright) to low beam (dim). The headlight has to be adjusted according to the light requirement by the driver. During pitch black conditions where there are no other sources of light, high beam is used to. On all other cases, low beam is preferred. But in a two-way traffic, there are vehicles playing on both sides of the road. So when the bright light from the headlight of a vehicle coming from the opposite direction falls on a person, it glares him for a certain amount of time. This causes disorientation to that driver. This discomfort will result in involuntary closing of the driver's eyes momentarily. This fraction of distraction is the prime cause of many road accidents. The prototype that is has been designed, reduces this problem by actually dimming down the bright headlight of our vehicle to low beam automatically when it senses a vehicle at close proximity approaching from the other direction. The entire working of the dimmer is a simple electronic circuitry arrangement which senses and switches the headlight according to the conditions required.

All the four wheelers are equipped with the wipers. These wipers are used to wipe the water on the windshield during rainy seasons so as to obtain clear vision. The wipers invented previously used to oscillate at a slow speed. Sometimes this lead to the distraction to the driver's visibility. This led to the invention of different speed wiper motors. But still the wiper actuation is controlled by the driver. To provide tension free driving, automatic wipers were implemented.

a. *Current Problems Faced By Motorists*

Motorists are facing a huge problem due to this high beam light which falls directly onto their eyes during driving. There are many medical facts and figures which support their problems of night driving. In the medical world, Troxler effect is used to describe a kind of temporary blindness. It is otherwise known as the 'fading effect'. A study shows that if our eyes are exposed to a very bright light source of around 10,000 lumens, we experience a glare. This glare is produced due to over exposure of the rods and cones inside our eye. Even after the source of glare is removed, an after-image remains in our eye that creates a blind spot. This phenomenon is called Troxler effect. This means that the driver's reaction time is increased by 1.4 seconds. For example, let us assume a

motorist travelling at 60 miles per hour takes 0.5 seconds to react to a hazard and will stop within 41 feet. Due to Troxler effect, the same person travelling under the same conditions will take 0.9 seconds longer to react and hence will come to a complete halt only at 123 feet. There is a huge difference of 82 feet. This is more than enough to cause a disaster on the road. This Troxler effect is across all ages. Any one exposed to sudden bright light experiences this Troxler effect. And also incase of wiper, when rain falls on the windshield screen then the driver doesn't have clear vision of the road. Controlling the wiper manually is difficult task to the driver because he gets distracted from the driving.

b. ***Accidents Due To Troxler Effect***

There are many accidents caused due to Troxler effect as shown in the fig.1.1. Many accident reports have been witnessed where a large vehicle, hitting a slow moving smaller vehicle while the latter is trying to over-take. Though it might be obvious to blame the driver, they claim to have not seen the smaller vehicle approaching. This is the most common example of illustrating the Troxler effect in our day-to-day life. Due to excessive brightness, the driver of the large vehicle is blinded. So he is unable to notice the smaller vehicle even though it is right in front of him. This can be avoided if the headlight is dipped to low beam mode.

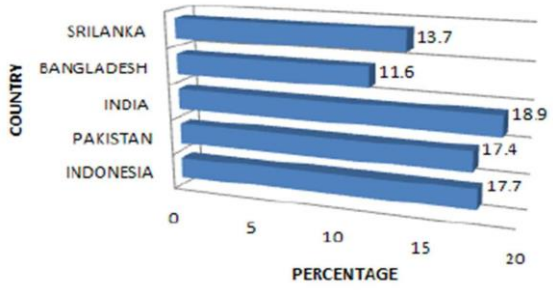

Fig.1: Accident report of Asia due to Troxler effect

Now a days these accidents statistics are given in the above figure. The most of the accidents are caused due to this Troxler effect and it has to be reduced greatly. This Troxler effect is main to cause accidents during night time which glare will form on eye and it lasts for few minutes, due to this many accidents occur.Many accident reports have been witnessed where a large vehicle, hitting a slow moving smaller vehicle while the latter is trying to over-take.

c. ***Problem Statement***

Manual Handling: The manual handling of the current wiper systems cause trouble to the driver while driving in tough situations like heavy rainfall or during foggy conditions. In these conditions it becomes uncomfortable or inconvenient for the driver to switch the wiper ON and OFF again and again. Manually handling is a difficult task and it has to be automated, handling both car and wiper, dimmer is tough so if we automate wiper and dimmer then driver will have complete concentration over driving.

Switching of Wiper: The switching of wiper can cause distraction while driving which can lead to accidents on highways or sharp turns if precautions are not taken. Current systems require the driver to switch the wiper according to need. Even speed control of the wiper should be done manually.

Speed Control: During rainfall with changing intensity or stormy conditions, there is need to change the speed of wiper according to the requirement. Current systems require manual speed control which can again cause trouble during driving.

Switching Of Dimmer: The switching of dimmer should also be done automatically based on the intensity of the light of the opposite vehicle if not accidents occur due to the Troxler effect. This switching can be done through the values which are read by the LDR sensor i.e., analog values generated by it.

d. ***Objectives***

This paper aims to develop an Electronic System for Safer and Reliable Transportation taking the following objectives:

To dispense with troublesome wiper operation needed when rainfall condition change or driving condition change, including the car speed and entry to or exit from tunnels. To operate the wiper with response to changing rainfall or driving conditions, thus keeping the driver's windshield clear.

- To dim the light or brighten the light based on the intensity of the light from the opposite vehicle.
- To implement a control system this reduces human efforts.
- To increase automation in vehicle driving system.
- To achieve high safety by reducing the driver's work load.
- To minimize rates of accident caused by distraction in driving.
- To make the system easy to install.
- To develop a cheaper automated system that can be integrated easily.

Hence, this becomes the major concern to think of a new innovative solution that is useful and also cost effective. This had led to the development of the automatic headlight dimmer prototype and also wiper.

II. DEVELOPMENT OF THE MODEL

A. *Block Diagram:*

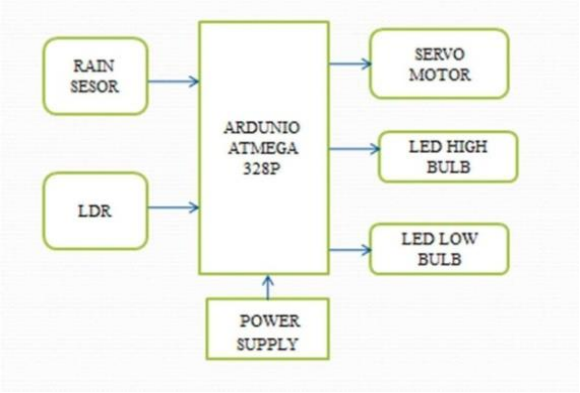

Fig.2.1: Proposed model

The working of automatic rain operated wiper is based on conductive method. This method uses a conductive sensor, which consists of two sets of contacts separated by an insulating material or an insulator. When water falls on the sensor i.e., in between two lines then the resistance of the two lines becomes parallel and hence resistance decreases and rain sensor conducts the signal based on the analog values which ranges from (0-1023). Thus it completes the circuit. If the water doesn't fall on the sensor then the resistance of the circuit doesn't change i.e., 1023. The signal is then send to the wiper motor and based on the value generated speed of the motor also varies. When the value generated is low then the speed of the motor is high and when the value generated is high then the speed of the motor is low. Pure water has a very high resistivity approximately, $\rho = 18.2M\Omega cm$, hence it does not conduct electricity. However, rain water is not completely pure due to presence of salts and has ρ in the range of $0.2M\Omega cm$ to $0.02M\Omega cm$. Thus conductivity of rain water is better than that of pure water.

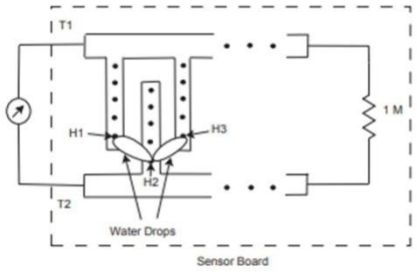

Fig.2.2: Two Water Drops Accumulated Over Sensor

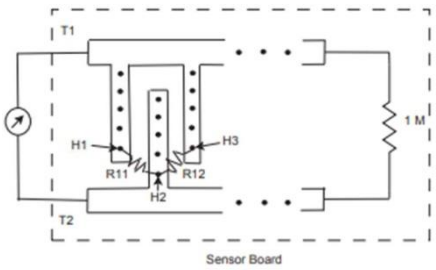

Fig. 2.3: Equivalent Electrical Model

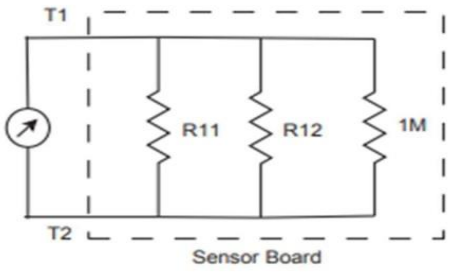

Fig. 2.4: Equivalent circuit

Fig.2.3 and 2.4 give the equivalent electrical circuit model for the condition shown in fi 3.2. The two water drops are represented as two resistances R11 and R12. R11 and R12 can be obtained from equation 1. As can be seen the resistances are arranged in parallel. Hence for every new resistance or water drop added the equivalent resistance of the circuit will reduce. The rain sensor board is designed in such a way that this resistance change with increase in water level is optimized. The resistance of a water drop would be given by $R = \rho l/A$.

The working of dimmer is similar to the comparator circuit. Two LEDs are used in this circuit. The LED 1 represents the high beam bulb and LED 2 represents the low beam bulb of the vehicle .Whenever a high-intense light falls on the LDR, its resistance drops thus creating an unbalance in the potential divider and R1 and R2. We will set the limit of the intensity of the vehicle and based on those values it switches from the low beam to high beam or high beam to low beam. Thus according to the light intensity of the opposite vehicle the dipper is either switched ON or OFF. Initially 12v voltage is given by the power supply to ARDUINO and as well as voltage regulator. As ARDUINO can it self converts 12 volts to 5v we don't connect ARDUINO with external voltage regulator.

Generally this voltage regulator is used to convert 12v to 5v which is given as an input to remaining block. This 5v will be driven to LDR and as well as to rain sensor module. All the components are connected to ARDUINO using jumper wires to different ports. Rain sensor module is connected to A1 port of ARDUINO i.e., the analog port 1 of the ARDUINO. When the water drops on to the rain sensor, then the rain sensor detects the water droplets and sends information to rain sensor module, as this rain sensor module is connected to Arduino then it generates the equivalent analog value and digital values, it is our wish to use analog or digital values.

In our analysis we use analog values because in order to vary the speed of wiper. Analog values vary from 1023-0 and digital values vary from 1-0. Initially the value generated by rain sensor when no rain detected is 1023 and when it detects rain this analog value decreases accordingly and this value will be given to ARDUINO. The servo motor rotates with that particular speed i.e., based on the analog value. The speed of the motor varies as the amount of water on the sensor varies. Servo motor usually contains 3 wires which are connected to port 9 of ARDUINO and remaining 2 wires are connected to 5v and ground of ARDUINO.

If the analog value generated is less then the water droplets on the sensor is more and motor rotates with high speed. If the value generated is high then the water droplets on the sensor is less and motor rotates with less speed. LDR sensor is connected to 5v power supply and also to A0 port of the ARDUINO, i.e., the analog port of ARDUINO. This sensor will produces different analog values whenever light falls over it and this values vary from 1023-0. If the intensity of the light fallen is more then it produces less analog value and if the intensity of light fallen is less then it produces more analog value. This all values will be given to ARDUINO. LED's are

connected to 4,5 ports of ARDUINO. Initially LED which is connected to port4 will be in ON state and whenever light is detected by LDR sensor and if the value generated by that is less then the LED connected to port5 will go to ON state.

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III. IMPLEMENTATION

In our experiment we use analog values because in order to vary the speed of wiper. Analog values vary from 1023-0 and digital values vary from 1-0. Initially the value generated by rain sensor when no rain detected is 1023 and when it detects rain this analog value decreases accordingly and this value will be given to ARDUINO. The servo motor rotates with that particular speed i.e., based on the analog value. The speed of the motor varies as the amount of water on the sensor varies. Servo motor usually contains 3 wires which are connected to port 9 of ARDUINO and remaining 2 wires are connected to 5v and ground of ARDUINO. If the analog value generated is less then the water droplets on the sensor is more and motor rotates with high speed.

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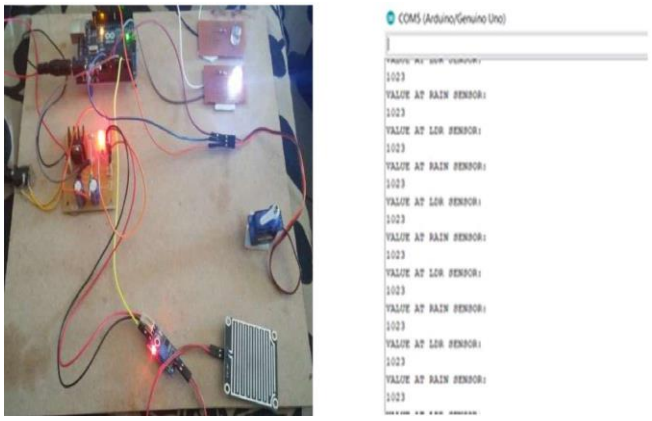
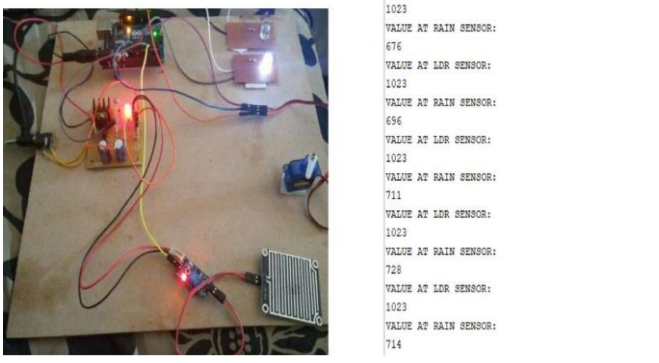
IV. RESULTS & DISCUSSIONS

Case 1: Fig 4.1(a) represents the values of the initial stages of rain sensor and light dependent resistor.



Initially when the system is in ON state .At the starting condition there is no water droplets on the sensor, so that there will be no change in the resistance of the rain sensor and it generates the higher analog value which is equal to 1023. The servo motor is kept constant at this stage i.e., servo motor does not make any rotations. In the same way at the initial stage there is no light falling on the LDR sensor and the resistance of light dependent resistor doesn't change .Therefore it generates the analog value of 1023.

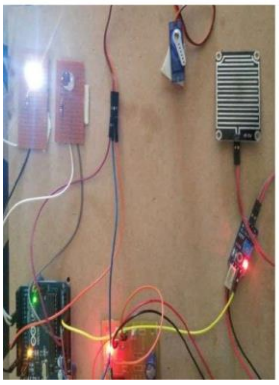
Case(2): The following Fig 4.1(b) are the values generated by the rain sensor .The value of LDR sensor will be at 1023 itself.

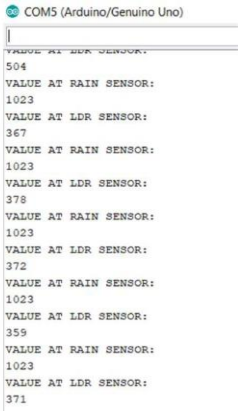


Here in case (2) the Sensor and wiper is turned ON. When the water droplets are present on the rain sensor then the

resistance of the rain sensor board gets changed. That is the place where the rain droplets are present on the rain sensor board , the resistance is shorted. So that the resistance of the board decreases gradually. If the water droplets are more then the more no of resistance lines are shorted so that resistance value decreases and the analog value generated will be less than 1023. So that the servo motor speed will be varied according to the analog values generated. Here in this case we only dealt with the changes in the rain sensor and the LDR circuit is kept constant , that is it is in its initial stage itself. LDR here we will not incident any external light on it, so it will remain constant as it is in initial state.

Case (3): Fig 4.1(c). gives the values at LDR sensor when the light is detected by the sensor.





Dimmer is turned ON by detection of light Values generated by LDR

At this stage LDR sensor will detect the light and it will change its resistance value based on the intensity of the light fell on it the resistance changes, the different values will be generated which varies from (1023-0).The values generated will be less than 1023 as its resistance is decreased. As the intensity of the light of light is more then then resistance will be decreased and if the intensity of light is a bit low then Light Dependent Resistor will generate more value. However the value of LDR i.e., the analog values will vary from 1023 to 0. Here in this case rain sensor is kept at the initial stage i.e., no water is present on the rain sensor so that analog value generated is equal to 1023. The rain sensor module will be remained constant.

When the both LDR and Rain sensor are simultaneously in ON state. That is when the resistance of rain sensor and the resistance of LDR will get changed because of water droplets on the rain sensor and due to the intensity of the light falling on the LDR sensor.

V. CONCLUSION

The concept of the Automatic wiper and dimmer has been implemented successfully. After the experimental setup the wiper was tested for the following conditions drizzling, heavy rain. The wiper will wipe off rain automatically when detected. By the use of this automatic wiper one can drive the commercial vehicles without any distractions to operate the wiper. Use of this automatic wiper and dimmer will reduce in turn prevents the accidents. The circuit consists of simple and economical components which can easily installed. The working and implementation of the prototype are discussed in detail. Thus the implementation of this device in every vehicle on future will not only avoid accidents but also provide a safe and comfortable driving.

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