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Automatic Headlight Beam Shifter for Controlling High Beam to Low Beam of Vehicles

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ABSTRACT: Today, one of the biggest problems Vehicle drivers in India are facing during night is the temporary loss of vision due to the Upper beam (high beam) coming from the Vehicle in the opposite direction. Moreover, the victims of this problem are mostly the students who are the backbone of their families. We have decided to undertake this project especially because this problem has become more dominant in recent years. Over five lakh accidents take place in the country annually, out of which, 41% (Approx. 2 Lakh) are due to road mishaps during night, and 18% (Approx. 90,000) are due to the vehicle headlight glare. In the current scenario, most of the automobile manufacturers in India have zeroed in on the Mass Production of their cars in order to fulfill their economic and financial goals without considering the accidental factors arising from the situation mentioned above. Automobile manufacturers like BMW, Skoda, Audi, Mercedes (and more) have provided facilities like intelligent headlight technology in their car models, which act as a remedy to this problem by reducing accidents by 60-70%. But these are only limited to their high end models (> 20 lakh □ and so on) due to which there arises a question for the middle class buyers about road safety. This project is targeted to facilitate such buyers so that they also can follow the protocol of Road Safety. Currently there is no provision for switching the headlight beam of the vehicle, automatically in mid-range vehicles. The Central Motor Vehicles Rules 1989 and Central Motor Vehicles Act, 1988, have chalked out certain Protocols related to the situation mentioned above. Operated by the Synergy of a Microcontroller and a Sensor, this device is capable of automatically shifting the Upper beam of the vehicle coming from the opposite direction, to the dipper beam, thus eradicating the problem of vision loss and avoiding accidents due to it. In the following sections we define the principle and design of the "Automatic Headlight Beam Shifter" device.

KEYWORDS: Temporary Loss of Vision, Headlight, Troxler effects, glare luminance, Light sensor, RF Communication, Protocol of Road Safety.

I. INTRODUCTION

The number of vehicles on our roads is burgeoning day by day. This, in turn forced almost all the vehicle manufactures to think about the extra safety instruments and electronic controls to provide with their products for giving the users a safety, derived in all road conditions through a mass flow traffic. If asked, one will always mention that the right driving is very cumbersome due to the dazzling light problems and the frequent dipping of headlights by manual means that often causes fatigue to the driver particularly at the time of peak traffic. There are only a few Indian cities like Dispur (capital of Assam) where the State Government has made it mandatory for the drivers to use low beam at night. But apart from this, the Protocol is being ignored by almost every driver and the situation has become intolerable now. In order to solve this problem, there arises a necessity of switching the upper beam to dipper beam of the vehicles during night automatically.

For keeping an Automobile under perfect control and reins of the driver, different types of controls and accessories are provided in an automobile, around the driver's seat, on the dashboard and at the footboard. There are controls in an automobile like clutch, brake pedal, and accelerator pedal which share the equal importance in terms of their operation. Similarly, when the situation of night driving arises, the importance of the dipper switch (manual), which is changed with time and road situations accordingly, to ensure safe and sound driving, is also one of the utmost Priority. So naturally to get rid of this perennial problem, an automatic mechanism has to come up to dip the headlamp automatically whenever required. This gives rise to an Automatic Headlight Beam Shifter. In Simple Words, an automatic Headlight beam shifter is a unit, which can automatically judge when the headlight beam needs to be

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lowered, and where accordingly. As this unit is well connected to the lighting system of the vehicle, we have to look short into the type and construction of a head light before discussing the wiring diagram or the construction of Automatic Headlight beam shifter.

II. RELATED WORK

2.1 Headlamps

The modern lighting system consists of switches, lamps, wiring harness, and fuses or circuit breakers. It may be mentioned that the primary purpose of the headlight design is to produce illumination over considerable distance ahead of the vehicle and enable the driver to drive at reasonable speeds at night with safety. But the provision should also be made that the drivers of other vehicles coming from the opposite direction not to experience a glare. For this purpose a dipped or meeting beam is also provided for maintaining the reasonable speed with safety without dazzling the coming driver. To prevent dazzle to the oncoming driver during particularly misty or hazy conditions the light about the horizontal should be cut off. This is called dipping of the head light beam. In an average car, the lighting system consumes about 70 - 75% of electrical energy when driven at night. In terms of amperage the consumption may be from 24 - 40 A at night for al purposes including the radio, heater, and transmission controls.

Light Source: There are two kinds of light sources, namely, the one that emits light and the other that reflects light. The filament of the electric lamp is the primary source, while the reflector is referred to as the secondary source. The intensity, color and distribution are the important characteristics of any light source. The headlight is composed of three elements:

1. The light filament that gives off light when a current flows through it.
2. The parabolic reflector that reflect the light in front: and
3. The lens that refracts of distorts the light beam into an illuminating Pattern.

The present day headlights are the outcome of a lot of research and development. Earlier a single electric bulb of the carbon filament type was employed. The bulb was placed at the focus of a parabolic silvered reflector in order to give a parallel beam of light. The following figure shows a parabolic reflector with bulb, the lines showing light rays emitted from the filament of the bulb in all directions. This type of headlight given a parallel light beam, that saves greater illumination nearer the axis. It may be mentioned that the bulb itself and the intensity of light fall off towards the outer portion of the beam block a small amount of light. From figure it may be seen that if the bulb filament is moved from position 'd', the focus of reflector, to a position 'a', the light beam 'abc' will no longer be a parallel one but will become divergent. On the contrary, if the filament is moved to position 'f' the beam will take the course a shown by 'fog' and will meet at a point on the axis of the bulb. It may be mentioned that by a single adjustment of the bulb, the beam cane be concentrated at a ore- determined distance ahead of the vehicle in order to give a spot light effect. On the contrary, if the filament is moved to position 'f' the beam will take the course a shown by 'fog' and will meet at a point on the axis of the bulb.

Formerly the headlight was provided with certain means of adjusting the bulb holder with respect to the reflector along with the bulb axis in order to focus it. It had to be done up every time the bulb was changed. This was essential, otherwise it would cause increased dazzle to other motorists. The filament is encased in an airtight bulb in order to prevent burning up of the white-hot filament because of oxygen in the air. The reflector is generally of polished metal and it throws all the light rays into a cylindrical beam.The lens is made up of a number of glass prisms molded together and they bend the beam of light into an oval pattern which is aimed ahead of the vehicle and somewhat in the downward direction. A part of the light is spread out in front of the vehicle for providing local illumination, whereas the rest of it is focused into a hot spot that provides distant illumination. The first major advancement in headlight Design took place with the introduction of pre- focused bulbs. It has two filaments, one for normal driving and the other for city driving or for overtaking. These days even two sets of headlights are used for the above said purposes. Generally a foot selector switch is provided, which enables the driver to select either the normal driving or the passing beam.A part of the light is spread out in front of the vehicle for providing local illumination, whereas the rest of it is focused into a hot spot that provides distant illumination.

2.2 TROXLER'S EFFECT

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

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experience 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 60miles 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 [1].

Accidents Due to Troxler Effect:

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 RREP. This can be avoided if the headlight is dipped to low beam mode. According to Forbes, the statistics shown in Figure below gives the details of the accidents that had occurred in the year 2013 in Asia due to over-bright light [1]. It shows clearly that India tops the list. 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 beam shifter prototype.

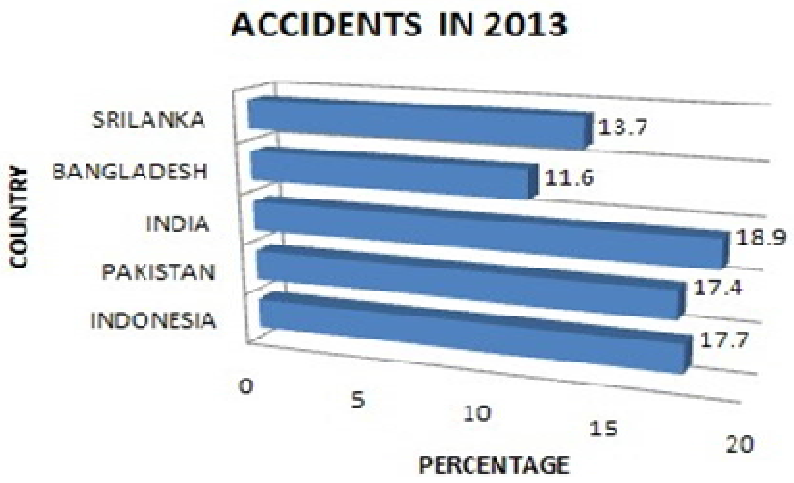

Fig.2.1 Accident report of Asia due to Troxler effect in 2013

III. SYSTEM DEVELOPMENT

An automatic headlight beam shifter could play a crucial role in shifting the headlights from driving beam to meeting beam and vice versa. This will improve visibility by minimizing glare, a major cause of momentary loss of vision.

3.1 CONSTRUCTION

The figure 3.1 below shows the block diagram of automatic headlight beam shifter. The incident light coming from other vehicle is captured by the photo sensitive element (LDR). Further it is connected to compiler. The microcontroller is connected to all other sensors and relay driver. The output of compiler is connected to microcontroller. The relay driver is further connected to relay which drives the headlight lamps. RF transmitter (434 MHz RF Module) is connected to microcontroller. Power distribution board is connected to all the blocks to provide the power. The voltage regulator is also used for regulation purpose.

3.2 WORKING:

3.2.1 Voltage Regulation using 7805:

The first capacitor, the 100nF ceramic capacitor, is hooked up after the voltage source, in this case the 12-volt car battery, and before the input of the LM7805 regulator. This capacitor is there to filter out any noise coming from the

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voltage source (the battery). The voltage regulator works best and will be most efficient when a clean DC signal is fed into it. We don't want any ac noise (ripple) imposed on the DC line voltage. The capacitor, in essence, acts as a bypass capacitor. It shorts the AC signal of the voltage signal (which is noise on the voltage signal) to ground and only the DC portion of the signal goes into the regulator. **Virtual Output of Power Supply using Proteus:**

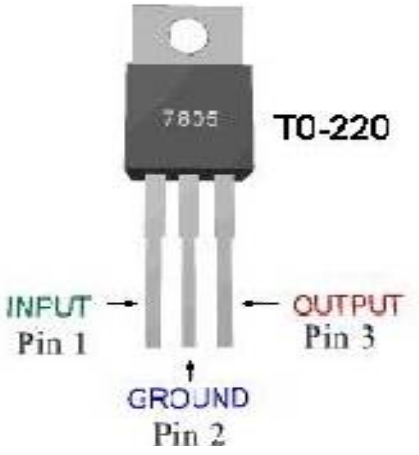

Fig 3.1 Block Diagra

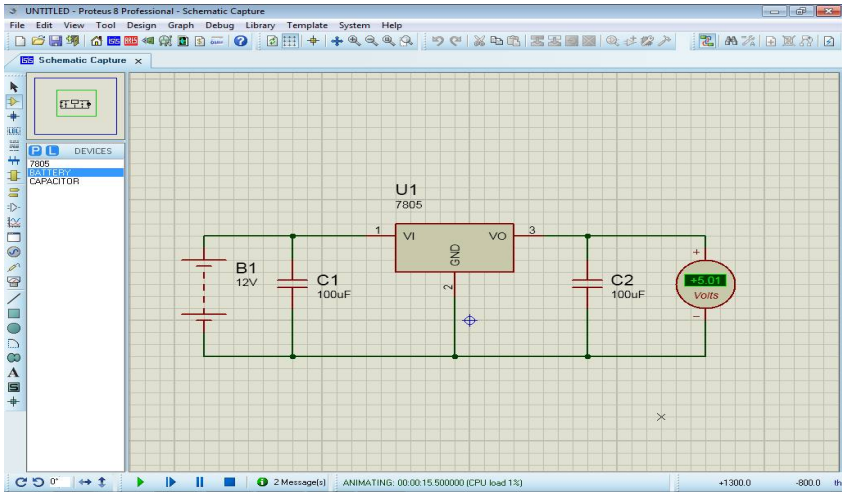

Fig 3.2 Virtual Output

The second capacitor, the 100nF ceramic capacitor, is hooked up after the voltage regulator. This capacitor is there again to filter out any noise or high-frequency (ac) signals that may be on the DC voltage line. The circuit begins at the 12-volt battery. This produces a voltage of 12 volts. The first capacitor, the ceramic 100nF, cleans up the signal if any (ac) noise is present on this. It shorts this noise to ground and allows the pure DC signal into the regulator. The regulator regulates this voltage down to 5 volts. After it comes out of the regulator, the other capacitor, the 100nF ceramic, cleans up any high-frequency or ac noise that may come out, again to produce a clean DC signal. Now this DC voltage, clean and crisp, is ready to power other elements in circuit like LM358, RF modules, encoder and decoder ICs etc.

3.2.2 LDR (Light Dependent Resistor) and resistor biasing For Comparator:

LDR changes its resistance according to the light which falls on it from opposite vehicle or car. Relation between intensity of light and resistance of LDR is: $\boldsymbol{RL}=\mathbf{500}/\boldsymbol{LUX}$ Now light intensity of 1000 LUX causes temporary blindness in eyes. Hence we substitute LUX=1000 in above equation.

On solving we get, $\boldsymbol{RL}=\mathbf{0.5}\boldsymbol{K}$Ohm

Now consider following voltage divider bias which is used in circuit:

3.2.3 COMPARATOR ACTION:

In electronics, a comparator is a device that compares two voltages or currents and outputs a digital signal indicating which is larger. It has two analog input terminals and and one binary digital output. The output is ideally

So in this case when light intensity greater than 1000 LUX falls on LDR then the voltage Vx increases hence crosses the 4.76 Volts which is threshold voltage for comparator IC and thus the output of comparator is high that is logic 1. But the output of comparator IC LM358 is sink and not source type hence cannot drive load. For this we designed another circuitry in which we have used optoisolator PC817.

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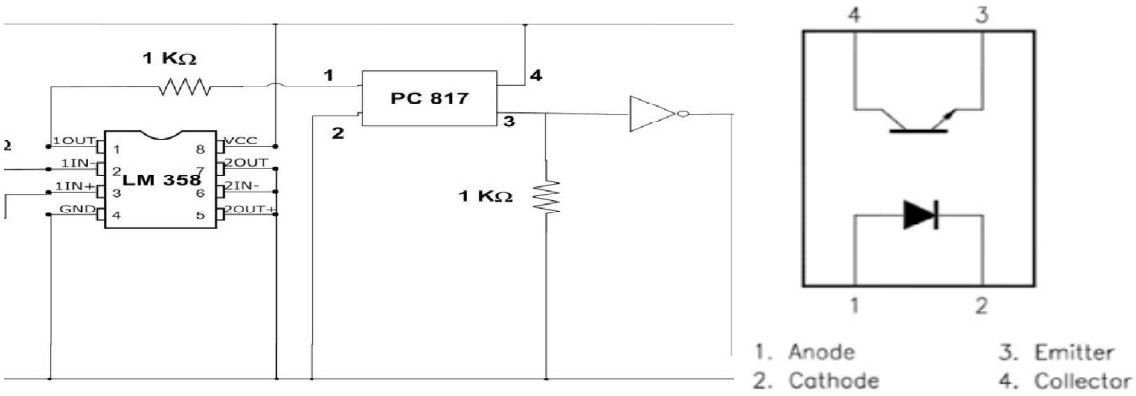

$$V_X = \frac{R_2}{R_1+R_2} . (5\ Volts)$$

$$= \frac{10K}{10K+0.5K} . (5\ Volts)$$

$$= \frac{10K}{10.5K} . (5\ Volts)$$

$$V_X = 4.76\ Volts$$

Using potentiometer (10KΩ) 4.76 volts is set and is given to comparator IC LM358 (pin no. 2) and Vx is applied to Pin no 3 of LM358 IC.

3.2.4 OPTOISOLATOR CIRCUIT:

PC817 requires normally 1V to turn on, that is pin 3 and pin 4 are made in contact with each other so that the collector emitter resistance decreases. When comparator output is high then it can easily drive PC817. Pin 4 is connected to logic 1 hence when comparator produces high output then pin 3 also gets logic 1. That's working of this stage. We have used a pull downresistor not to take input of NOT gate into tristate by letting it unconnected when input of PC817 is logic 0.

3.2.5 Wiring Harness

Wire harness, cable assembly, wiring assembly or wiring loom, is an assembly of cables or wires which transmit signals or electrical power. The cables are bound together by straps, cable ties, cable lacing, sleeves, electrical tape, conduit, a weave of extruded string. Cable harnesses provide several advantages over loose wires and cables. For example, many aircraft, automobiles and spacecraft contain many masses of wires which would stretch over several kilometers if fully extended. By binding the many wires and cables into a cable harness, the wires and cables can be better secured against the adverse effects of vibrations, abrasions, and moisture.

$$V_o = \begin{cases} 1, & \text{if } V_+ > V_- \\ 0, & \text{if } V_+ < V_- \end{cases}$$

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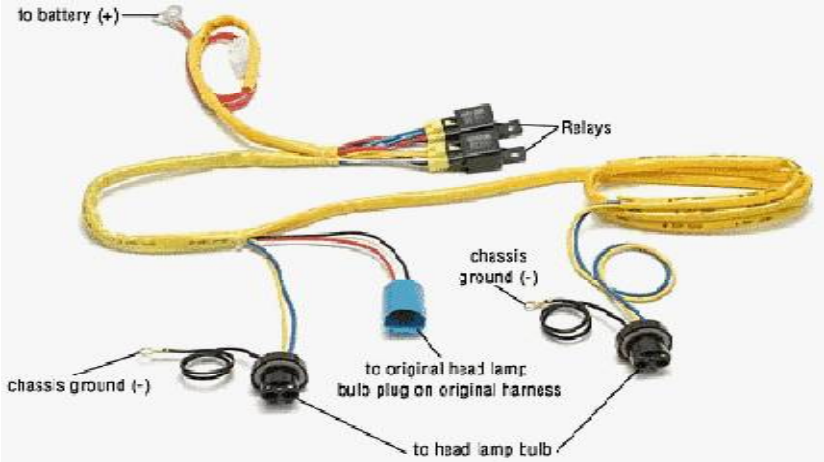
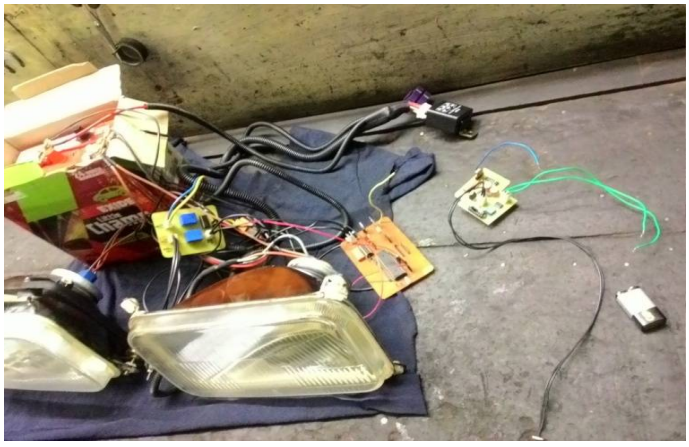


Fig.3.4 Wiring Harness

By constricting the wires into a non-flexing bundle, usage of space is optimized, and the risk of a short is decreased. Since the installer has only one harness to install (as opposed to multiple wires), installation time is decreased and the process can be easily standardized. Binding the wires into a flame-retardant sleeve also lowers the risk of electrical fires.

3.2.6 Assembly Pictures:



IV. Conclusion and Future Work

Headlamp glare is an issue that has grown in terms of public awareness over the past decade. This is caused due to the sudden exposure of our eyes to a very bright light; the bright headlights of vehicles in this case. This causes a temporary blindness called the Troxler effect. However too much light or improper lighting can result in glare. Glare occurs when visual field brightness is greater than the luminance to which the eyes are adapted. Glare is caused by both direct and indirect light Sources. Disability glare can be a major problem both in terms of the ability to see and visual comfort. Also it leads to annoyance, and fatigue.

The driver should actually turn down the bright lights immediately to avoid glare to the other person which is not happening. Due to which over five lakh accidents take place in the country out of which, 41% are due to road mishaps during night, and 18% are due to the vehicle headlight glare. In the Current Scenario, most of the Automobile manufacturers in India are zero inning only on the Mass Production of their cars in order to fulfill their economic and financial goals without considering the accidental factors arising from the situation mentioned above. There is almost

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no provision for switching the headlight beam of the vehicle, automatically. Hence an Automatic Headlight Beam Shifter could play a crucial role in shifting the headlights from driving beam to meeting beam and vice versa.
In the current tentative implementation of the Automatic Headlight Beam Shifter, we plan to include some improvements. Such as we can use some of the sensors along with the microcontroller to enhance the range of applications of this project

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