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Automatic Headlight Beam Controller

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Abstract **–** Headlight 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 and therefore 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 the one from the opposite direction. In this project, an automatic headlight dimmer which uses a Light Dependent Resistor(LDR) sensor has been designed to dim the headlight of our vehicles to avoid human eye effects. This automatically switched the high beam into low beam, therefore reducing the glare effect by sensing the light intensity value of approaching vehicle and also eliminated the requirement of manual switching by the driver which has not done at all times. The MP lab software was employed to program the microcontroller. The system device was able to automatically switch the headlight to low beam when it sensed a vehicle approaching from the opposite side using LDR sensor. It was observed that the maximum spread angle of headlight was 135 degree. At the time the spread light from other sources reached the sensor, its intensity would be very much reduced below the triggering threshold level. The sensitivity of a photo detector determined the relationship between the light falling on the device and the resulting output signal. A server module could be included to this system for receiving and storing headlight rays parameter information in a database application.

Keywords: *LDR, PIC Controller (16f877a), Headlight System*

I. INTRODUCTION

Light is electromagnetic radiation within a certain portion of the electromagnetic spectrum. The word usually refers to visible light, which is visible to the human eye and it is responsible for the sense of sight. Visible light is usually defined as having wavelength in the range of 400-700 nanometers(nm), or 400×10^{-9} m to 700×10^{-9} m, between the infrared (with longer wavelengths) and the ultraviolet(with shorter wavelength). Light can be produced by nature or by humans. "Artificial" light is typically produced by lighting systems that transform electrical energy into light. The human eyes are adaptable to a particular range of vision. There are two visions namely photopic and scotopic vision. Human eyes actually behave differently in different conditions. During bright surroundings, our eyes can resist up to $3cd/m^2$.This is the photopic vision. During dark and unlit conditions, our eye switches to scotopic vision which has the range of 30-45 $\mu cd/m^2$. It takes 4 seconds for our eyes to change from photopic vision to scotopic vision. This is also an example of TROXLER effect. As the brightness increases, the strain to focus on an object increases. This will increase the response time of that person. 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. In all other cases, low beam is preferred. But in a two way traffic, there are vehicles plying 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 distraction is the prime cause of many road accidents.The prototype that has been designed to reduce 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.

II. PROBLEM STATEMENT

Motorists face a huge problem due to high beam light which falls directly onto their eyes when driving at night or foggy conditions. There is medical effect associated with these phenomena. This effect includes temporary blindness, glare, fading effect of image and something causing accident leading to many lives. This effect contributes to a terminology known as troxler effect. 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 create 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 the ages. Anyone exposed to sudden bright light experience this troxler effect. Hence there is a need to design and construct a prototype of this device that automatically dims the headlights for on-coming vehicles using light dependent resistor sensing technique help to solve this problem.

III. METHODOLOGY

A. Background Research

For developing the system which would cater as a solution to the problem of temporary blindness various factors had to be considered as in for developing the architecture. For sensing the light form the headlight of oncoming vehicle LDRs are used. Similarily, the selection of the correct microcontroller all was an elemental part of the research phase. For converting analog signal to digital signal usage of ADC is required. In order to proceed with the implementation of the system one would require knowledge of microcontrollers, analog to digital converter, Light Dependent Resistor also the knowledge of programming related to microcontroller is required. To begin with the system various research work related to different types of headlights being used in vehicle along with the intensity of the headlights which is

perceivable to human eyes is required. Depending on the headlights being used in the vehicle the threshold intensity of the headlight may differ. According to the research, depending on the vehicle it was found that there was a similar variance in the type of headlights the value of threshold intensity will also change. In bright light situation (called photopic vision) the sensitivity peaks around 550 nm, going from 400 to 700. In the dark, we switch to scotopic vision centered at 510 nm, going from 370 nm to 630 nm. In order to develop a system which would sense the light intensity using LDRs, Microcontroller , Analog to Digital converters by which it would automatically reduce the intensity of the headlight of our vehicle reducing the condition of temporary blindness caused due to excessive exposure to headlights.

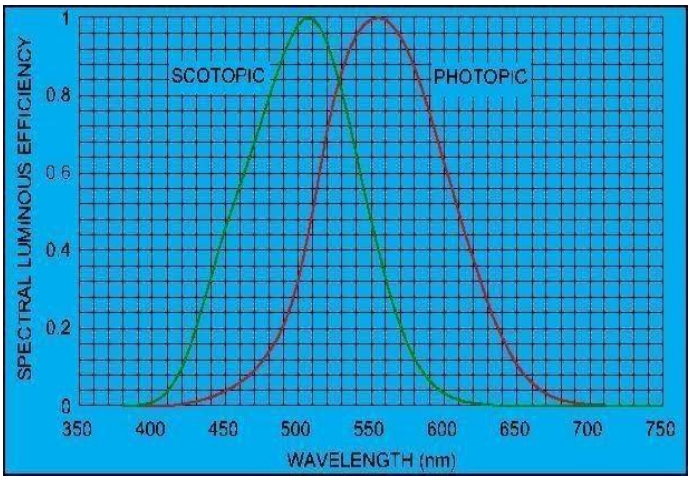


Figure 1: Graph related to intensities perceivable to human eye

IV. PROPOSED SYSTEM

The final proposed system which is expected to reduce the problem of temporary blindness would sense the intensity of the headlight from the oncoming vehicle in analog form, which would be sent to analog to digital converter(ADC) to convert analog signal to digital signals. The ADC would send this digital signals to the microcontroller where the threshold intensity level is set. It would compare the received intensity in the digital form to the threshold intensity and send this signal to relay circuits. There are two relay circuit one for switching to high beam and another one for switching to low beam. If the relay2 circuit receives the signal the high beam light will go to low beam.

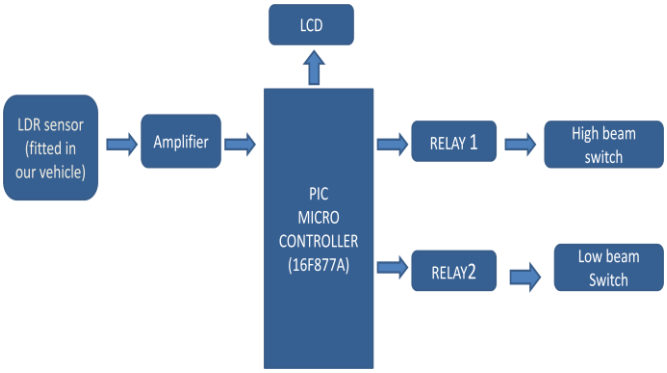
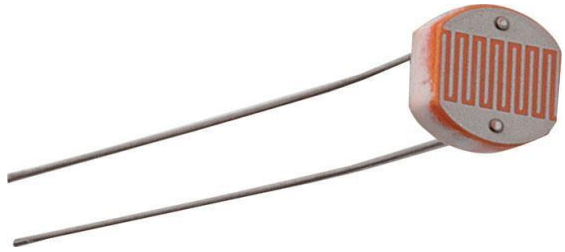


Figure 1: Block Diagram

A. LDR Sensor

A photo resistor or Light Dependent Resistor or cadmium sulfide (cds) cell is resistor whose resistance decreases with increasing incident light intensity. It can also be referred to as a photoconductor. A photoresistor is made of a high resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron(and its hole partner) conduct electricity, thereby lowering resistance.



Photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor, e.g,silicon. In intrinsic devices the only available electrons are in the valence band, and hence the photon must have envough energy to excite the electron across the entire bandgap. Extrinsic devices have impurities, also called dopants, added whose ground state energy is closer to the conduction band. Since the electron do not have as far to jump, lower energy photons (i.e., longer wavelength and lower frequencies) are sufficient to trigger the device. If a sample of silicon has some of its atoms replaced by phosphorous atoms (impurities), there will be extra electrons available for conduction. This is an example of an extrinsic semiconductor.

B. Amplifier

An electronic amplifier is device for increasing the power of a signal. It does this by taking energy from a power supply and controlling the output to match the input signal shape but with a larger amplitude. In this sense, an amplifier may be considered as modulating the output of the power supply. Here we use inverting amplifier as gain amplifier. We can change the gain by adjusting the value of feedback resistance value. As the open loop DC gain of an operational amplifier is extremely high we can afford to loss some of this gain by connecting a suitable resistor across the amplifier from the output terminal back to the inverting input terminal to both reduce and control the overall gin of the amplifier. This then produces and effect known commonly as Negative Feedback, and thus produces a very stable operational amplifier system. Negative feedback is the process of “feeding back” some of the output signal back to the input, but to make the feedback negative we must feed it back to the negative input terminal using an external feedback resistor called RF. This feedback connection between output and inverting input terminal produces a closed loop circuit to the amplifier resulting in the gain of the amplifier now being called its closed-loop gain.

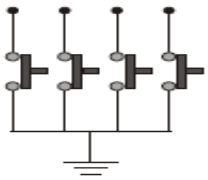
C. PIC Microcontroller

Present industry is increasingly shifting towards automation. Two principle components of today’s industrial automation are programmable controller and robots. In order to aid the tedious work and to serve the mankind, today there is a general tendency to develop an intelligent operation. PIC microcontroller is the heart of the device which handles all the sub devices connected across it. We have used as microcontroller. It has flash type

reprogrammable memory. It has some peripheral devices to play this project perform. It also provides sufficient power to inbuilt peripheral devices. We need not give individually to all devices. The peripheral device also activates low power operation mode. These are the advantages of PIC. The progress in science and technology is a non-stop process. New things and new technology are being invented. As the technology grows day by day, we can imagine about the future in which thing we may occupy every place. The proposed system based on PIC microcontroller is found to be more compact, user friendly and less complex, which can readily be used in order to perform several tedious and repetitive tasks. Though it is designed keeping in mind about the need for industry, it can extended for the other purposes such as commercial & research applications. Due to the probability of high technology used this project is fully software controlled with less hardware circuit. The feature makes this system is the base for future systems. The principal of the development of science is that "Nothing is Impossible". So we shall look forward to bright & sophisticated world.

D. Keypad

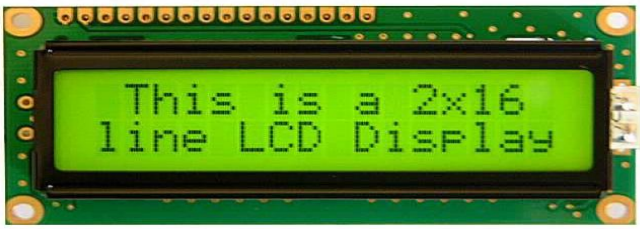
A numeric keypad or numpad for short, is the small, palm-sized, seventeen key section of a computer board, usually on the very far right. The numeric keypad features digits 0 to9, addition, subtraction, multiplication, division symbols, a decimal point and num lock and enter keys. Laptop keyboards often do not have a numpad, but many provide numpad input by holding a modifier key and operating keys on the standard keyboard. Particularly large laptops(typically those with a 17 inch screen or larger) may have space for a real numpad and many companies sell separate numpads which connect to the host laptop by a USB connection.



Numeric keypads usually operates in two modes: when num lock is off, keys 8,6,2,4 act like an arrow keys and 7,9,3,1 act like Home, Page up, Page down, and End. When num lock is on, digits keys produce corresponding digits. These, however differ from the numeric keys at the top of the keyboard in that, when combined with alt keys on a PC, they are used to enter characters which may not be otherwise available: for example Alt-0169 produces the copyright symbol. These are referred to as alt codes. On apple computer macintosh computers, which lack a num lock key, the numeric keypad always produces only numbers. The num lock key is replaced by the clear key.

E. LCD

Liquid Crystal Display (LCDs) have materials which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal. An LCD consists of two glass panels, with liquid crystal materials sand witched in between them.



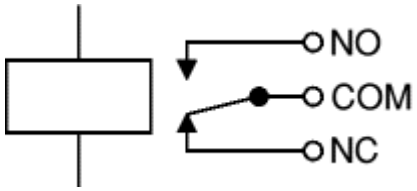
The inner surface of the glass plate are coated with transparent electrodes which define the character, symbols or patterns to be a displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle. One each polarizer are pasted outside the two glass panels. These polarizer would rotate the light rays passing through them to definite angle, in a particular direction. When the LCD is in the off state, light rays are rotated by the two polarizer and the liquid crystal, such that the light rays come out of the LCD without any orientation, and hence LCD appears transparent. When sufficient voltage is applied to the electrodes, the liquid crystals molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizer, which would result in activating/ highlighting the desired character.

F. RELAY

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relay has two switch positions and they are double throw (change over) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery can use a relay to switch a 230v AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical. The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from the lower voltages. Most ICs(chips) cannot provide this current and a transistor is usually used at amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA. So these devices can supply relay coils directly without amplification.

Relays are usually SPDT or DPDT butt they can have many more sets of switch contacts, for example relays with 4 sets of

changeover contacts are readily available. Most relay are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay. The animated picture shows a working relay with its coil and switch contacts. You can see a lever on the left being attracted by magnetism when the coil is switched on. This lever moves the switch contacts. There is one set of contacts (SPDT) in the foreground and another behind them, making the relay DPDT.



The relay's switch connections are usually labeled COM, NC and NO.

- **COM =** Common, always connect to this, it is the moving part of the switch
- **NC** = Normally Closed, COM is connected to this when the relay coil is off
- **NO** = Normally Open, COM is connected to this when the relay coil is on

G. Working

The working of this model will be explained detailed below:

- Our own vehicle travelling at high beam
- The vehicle coming at the opposite side also travelling at high beam
- In our vehicle the LDR will fixed in the windshield nearer to viper system
- If the opposite vehicle comes closer to our vehicle means the LDR will produce the output voltage
- This voltage is given to the amplifier to amplify the signal and then given to PIC.
- PIC itself having inbuilt ADC, so that the analog form of output from LDR is converted to digital form
- This digital value is compared with the set value
- If it equals means the PIC microcontroller will send the signal to the relay circuit
- The relay circuit is acting as a switching circuit
- If the relay receives the signal from microcontroller, it change from NO to NC
- Due to this our vehicle will switch to low beam
- The opposite vehicle driver doesn't experience any sudden glare, so that he will cross our vehicle safely
- Once the opposite vehicle get crossed, our vehicle switch to high beam

Advantages

- It's an cost effective solution for the problem of night time accidents occurring during two way roads
- It can easily mounted on the running cars and low cost cars as an necessary
- Increased safety for drivers & pedestrians

Disadvantage

- Continuous power supply from the battery for the sensory circuit
- The light from street light, tail lamp of vehicle also fall on LDR and cause the switching circuit to continuously switch to high beam and low beam
- The set value selection is a complex one

CONCLUSION

Automatic head light beam controller had been designed using LDR sensing technique. Thus, the system device automatically switches the headlight to low beam when it senses a vehicle approaching from the opposite side using Light Dependent Resistor(LDR) sensor.

Glare during driving is a serious problem for drivers and therefore caused by the sudden exposure of our eyes to a very bright light of the headlights of vehicles. This causes a temporary blindness called the Troxler effect. Eventually this has become the reason for accidents occurring at night and also during bad conditions such as rainy or foggy conditions. The driver should have turned down the bright lights immediately to avoid glare to the other person, however they find it difficult to do. Hence, the idea for the design and development of a prototype circuit called the automatically switches the headlight to low beam when it senses a vehicle approaching from the opposite side. Thus, the implementation of this device in every vehicle does not only avoid accidents but also provides a safe and comfortable driving.

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