Steering Controlled Headlights using Limit Switch with Automatic Dim and Dip Mechanism

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Abstract - Headlight System is an active safety system, where the head lamp orientation control system rotates the right and left headlights independently and keeps the beam as parallel to the curved road as possible to provide better night time visibility to driver. In this system the rack and pinion arrangement is used. This automatically switches the high beam into low beam thus reducing the glare effect by sensing the approaching vehicle. It also eliminates the requirement of manual switching by the driver which is not done at all times.

Keywords – Headlights, Rack & Pinion, Steering, LDR Sensor, Limit Switch.

I. INTRODUCTION

The rate of accident is much and more at the night drive then at the day light, for avoiding this accident this concept is very useful for automobile. The concept of moving headlamps is not a new one. An innovation in lighting was to vertically tilt the beam high to low and low to high beams switching dating back to 1917. Adaptive headlight system moves the headlamp by turning the vehicle through the steering. This places light into the turning radius visibility at the cornering improved. There was Potentiometer used on steering to measure angle and speed of steering. Based on the information swirl headlight can match the light distribution steering wheel angle so that upcoming turns driver can easily see and its increase help to relief stress on mind of driver.

Also 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. He 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. Thus we are expected to dim the headlight and move the head light according to the steering movement to avoid this glare and accident**.**

II. LITERATURE SURVEY

[1] C. S. Martinez, S. L. Macknik and D. H. Hubel, The Role of Fixational Eye Movements in Visual Perception, Nature Reviews Neuroscience 5, 2004

The present invention relates to a vehicle front lamp light distribution control system and more particularly to a vehicle front lamp light distribution control system capable of raising visibility at the time of cornering by controlling light distribution means of the front lamp. According to-
Japanese Patent Publication No. H5-23216,
Japanese Patent Application Laid-Open No. H8-183385, Japanese Patent Application Laid-Open No. H11-78675, and Japanese Patent Application Laid-Open No. H8-192674

[2] S. Aishwarya, Bright Headlights: A Major Cause of Accidents, The Hindu, Online edition, May 02, 2006.

A vehicle head lamp including a fog lamp is provided with a movable reflector and by turning the movable reflector in the steering direction by an amount corresponding to a steering angle of the steering wheel, the light distribution pattern of the front lamp is changed in the direction of vehicle's turn so as to raise visibility at the time of cornering.

However, according to the aforementioned earlier art, the light distribution pattern of the front lamp is changed in the steering direction of the steering wheel by an amount corresponding to the steering angle when the vehicle turns on an intersection or the like, cornering destination cannot be beamed brightly enough before operating the steering wheel. Therefore, an art capable of beaming the cornering destination prior to operation of the steering wheel has been demanded. Czech Tatra and 1920s Cadillacs were early implementer of such a technique, producing in the 1930s a vehicle with a central directional headlamp.

[3] C. Guttman, High Intensity Headlights could cause road accidents by dazzling oncoming drivers, Eurotimes, April 2003

The American 1948 Tucker Sedan was likewise equipped with a third central headlamp connected mechanically to the steering system. The 1967 French Citroën DS and 1970 Citroën SM were equipped with an elaborate dynamic headlamp positioning system that adjusted the headlamps' horizontal and vertical positioning in response to inputs from the vehicle's steering and suspension systems, though US regulations required this system to be deleted from those models when sold in the USA.

[4] Lighting the future Standard and High Performance Automotive Halogen Bulbs – Hella

High-intensity discharge (HID) headlamps use the physical principle of electric discharge and produce light with an electric arc rather than a glowing filament. The high intensity of the arc comes from metallic salts that are vaporized within the arc chamber. An ignition voltage (up to 23 kV in the case of 3rd generation electronic ballasts) ionises the gas between the bulb‘s electrodes and makes the bulb glow based on an arc. During the controlled supply of an alternating current (around 400 Hz) the liquid and solid matter in the discharge chamber evaporate due to the high temperatures. To prevent destruction of the lamp through uncontrolled increases in current, the current is limited by a ballast. Once the full light output has been reached, an operating voltage (not the ignition voltage) of only 85 V is necessary to keep up the physical process.

[5] Boojoong Yong, Heeyong Kang, Sungmo Yang (2002), Auto-Leveling of HID Headlamp Using Preview.

A newly developed high intensity discharge (HID) automotive headlamp results in a high luminous gradient at the cutoff line, and proves the superior concept in safer and more comfortable nighttime driving. This new headlamp technology provides drivers expanded night vision by a significantly improved light pattern. However, the HID headlamp may dazzle other traffics during traversing a rough road or encountering an unexpected bump. To resolve this problem, an automa tic headlamp leveling device is necessary. A preview control is presented for the design of the leveling system. The proposed control algorithm is capable of attenuating a dynamic glare which is one of the major detractors to a driving in dark roads. Compu ter simulations using ADAMS are carried out to confirm the effectiveness on the control system.

III. METHODOLOGY

The maximum accidents happen at the night. It is therefore great importance to make use of available technology to contribute to road safety in improving the visual condition accident by vehicle headlight system is the active safety and the steering control system is the passive safety system.

1. Rack & Pinion
2. Limit Switch
3. LDR Sensor
4. Steering System
5. Headlamps
6. Arduino ATMEGA328

RACK & PINION

A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. A circular gear called "***the pinion"*** engages teeth on a linear "gear" bar called "***the rack***". The rotational motion applied to the pinion causes the rack to move relative to the pinion, thereby translating the rotational motion of the pinion into linear motion.

Rack and pinion as steering-

The Rack & Pinion system is actually a simple system that only uses a few different gears to control the direction of the vehicle. The Pinion is the part of the system that is connected to the steering shaft. As you turn your steering wheel, the pinion rotates. This rotation occurs in the grooves of the rack, forcing the rack to move in either direction (depending on the directional change of the steering wheel).

The Rack of the Rack & Pinion system is attached to a tie rod. This tie rod connects the system to the tires, as the tie rod is connected to the steering arm that is connected to the tire. When you turn your wheel, the tie rod moves to direct the tires in the direction of the turn.

LIMIT SWITCH

A limit switch is an electromechanical device that consists of an actuator mechanically linked to a set of contacts. When an object comes into contact with the actuator, the device operates the contacts to make or break an electrical connection.

Working Principle:

It is just like a SPDT (Single Pole Double Throw) switch which has 3 contacts i.e; COM (Common), NO, NC.

A Single Pole Double Throw (SPDT) switch is a switch that only has a single input and can connect to and switch between 2 outputs. This means it has one input terminal and two output terminals.
NO is the Normally Open contact (open if the plunger is free), NC is the Normally Closed contact (closed if the plunger is free) and COM is the common.
Plunger - a part of a device or mechanism that works with a plunging or thrusting movement.
NO normally will be open with respect to COM while NC will be shorted with COM. When the object hit the plunger, NO will be shorted with the COM while NC will be open with respect to COM.
When plunger is not pressed then C and NC are connected and NO disconnected. When plunger is pressed C and NO connects and NC disconnects.

LIGHT DEPENDENT RESISTOR

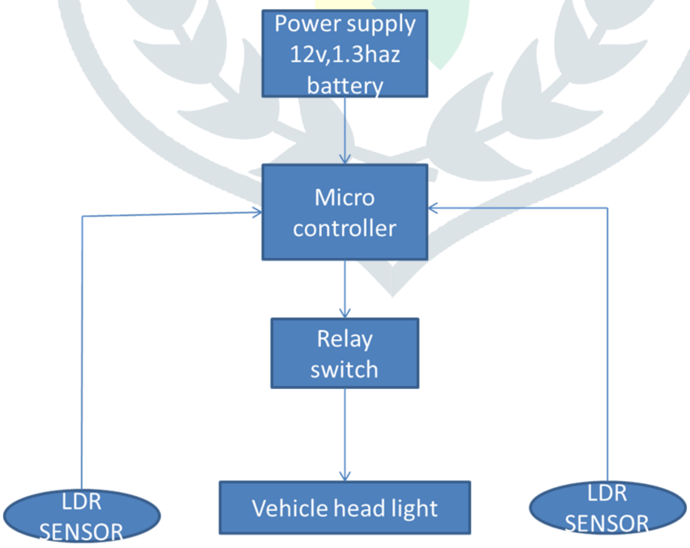
A photoresistor (or **light-dependent resistor**, **LDR**, or **photo-conductive cell**) is a light-controlled variable resistor. The resistance of a photoresistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photoresistor can be applied in light-sensitive detector circuits, and light-activated and dark-activated switching circuits.
An automatic headlamp dimmer uses LDR sensing technique to sense the light. 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 sensor.

ARDUINO ATMEG328

Arduino is a single-board microcontroller meant to make the application more accessible which are interactive objects and its surroundings. The hardware features with an open-source hardware board designed around an 8-bit Atmel AVR microcontroller or a 32-bit Atmel ARM. Current models consists a USB interface, 6 analog input pins and 14 digital I/O pins that allows the user to attach various extension boards.

The Arduino Uno board is a microcontroller based on the ATmega328. It has 14 digital input/output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack and a reset button. This contains all the required support needed for microcontroller. In order to get started, they are simply connected to a computer with a USB cable or with a AC-to-DC adapter or battery. Arduino Uno Board varies from all other boards and they will not use the FTDI USB-to-serial driver chip in them. It is featured by the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

IV. WORKING



When driver rotates steering left or right this motion is transmitted to pinion through steering shaft and universal joint. Rotary motion of pinion is converted into liner motion of rack. It causes clamps to move linearly with rack. Connecting rods are having rotary motion at pivoted end and having sliding motion in slots at other end. Back plates of headlight have rotary motion on pivoted rods. So, when we move steering left the connecting rod the left side pulls the left back plate and causes the headlight to turn left on pivoted rod.

The connecting rod the right side pushes the right back plate and causes the headlight to turn left on pivoted rod. In the same way, when we move steering right the connecting rod the right side pulls back the left back plate and causes the headlight to turn right on pivoted rod.

The connecting rod the left side pushes forward the right back plate and causes the headlight to turn right on pivoted rod. Slots are provided to select the variable change in angle of headlight orientation. Slots are to give some allowance to headlight. So till steering does not move from centre position through some particular angle headlights' orientation does not change.

DIM AND DIP WORKING

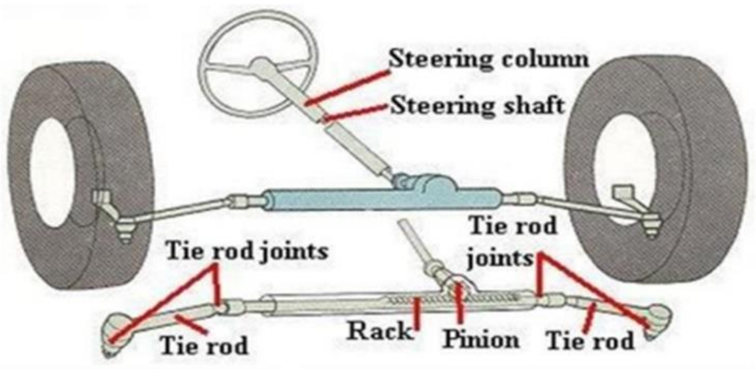


Figure Steering System

Automatic night lamp with dim and bright light works by the LDR sensor, which senses the light vision low or high is been transmitted to the microcontroller. When light from the opposite vehicle senses by the LDR sensor and sends signal to the microcontroller to turn on the low light beam light and when the vehicle passes away LDR senses there is no light and sends signal to the microcontroller to turn off the low beam and turn on the high beam light, similarly during the evening time sun sets down causes the low vision of light sense by the LDR sensor to turn on the vehicle light automatically. The whole system works with the battery as power supply.

DIM AND DIP MECHANISM IN HEADLIGHTS

Presently, studied changes are unfolding in automotive lighting technology. Automobile manufacturers - together with suppliers and representatives - currently aspire to develop the headlights of tomorrow. Freeform headlamp is one of the popular design which offers great flexibility and compactness. The optical design, fabrication and the measurement of the freeform reflector headlamps are investigated

Automatic Night Lamp with head light dim and bright light by using this system manual works are 100% removed. It automatically switches ON lights when the sunlight goes below the visible region of our eyes. This is done by a sensor called Light Dependent Resistor (LDR) which senses the light actually like our eyes. It automatically switches OFF lights whenever the sunlight comes, visible to our eyes.

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. He 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 by dimming the headlight and move the head light according to the steering movement to avoid this glare and accident.

V. DESIGN OF RACK AND PINION Pinion:

This is a gear wheel which is provided to get mesh with rack to convert the linear motion into rotary motion. They are made up of Cast iron.

Rack:

Rack teeth are cut horizontally about the required length to get the accurate turn of 360°. This is made up of Cast iron.

Design of Pinion

Specification of Pinion:

Material	Cast-Iron
Outside diameter	75mm
Circular pitch	4.7mm
Tooth depth	3.375mm
Module	1.5mm
Pressure angle	21°
Pitch circle diameter	72mm
Addendum	1.875mm
Dedendum	1.5mm
Circular tooth Thickness	2.355mm
Fillet radius	0.45mm
Clearance	0.375mm

Specification of Rack:

Material	Cast-Iron
Module	1.5mm
Cross-section	75×25mm
Teeth on the rack is adjusted for 113mm	

VI. CALCULATIONS For Pinion,

From data book (page no.7.18)

$d_{min} > (0.59/\sigma_{cmax}) \times [[Mt]/((1/E1)+(1/E2))^2]^{(1/3)}$ ______________Eq.1 where,

$\sigma_{c\,max}$ = maximum contact compressive stress (N/m^2) E1,E2 = Youngs modulus (N/m^2)

Mt = Torque (N-m)

E1 = E2 = 130x10^9 N/m^2

Calculation of σ_{cmax}

$\sigma_{cmax} = H_B \times C_B \times K_{cl}$ where, __________ Eq.2

H_B = Brinell hardness number

C_B = coefficient depends on hardness K_{cl} = life factor

$K_{cl} = \{[1 \times 10^7]/N\}^{1/6}$ ____________________________________Eq. 3 N = 60 x n x T

Where, n = rpm

N= life in no. Of cycles T= life in hours.

= 8000 hours.

$C_B = 20$

$H_B = 200$

Substituting the values of N, n, T in the Eq.3, The value of K_{cl} is obtained as 1.139.

K_{cl} = 1.139.

Substituting the values in Eq.2

σ_{cmax} = 20 x 200 x 1.139

= 4536 N/mm^2

= 4536 x 10^6 N/m^2

Calculation of Mt:

Mt = 97420 x (K_w /n).

Eq.4

For power calculation Centrifugal force, $f_c = m \omega^2 r$

M = 7kg

W = m x g

$\omega = 2\Pi n/60$ R = 1m

Eq.5

Substituting the values of m, ω, r in Eq.5

f_c = 7.56 N.

Downward force, f_d = m x g

= 7 x 9.81

= 68.67N.

Centrifugal force, f = fc + fd

= 68.67+ 7.56

= 76.23N

Torque = f x r

= 76.23 x 1

= 76.23Nm.

Power = Torque x angular velocity.

= 76.23 x 1.05

= 80.04w

Substituting the value of k_w and n in Eq.4,

[Mt] = 7797.4N-m

Substituting the values of $\sigma_{cmax,}$ [Mt], E_1, E_2 in Eq.1,

The minimum diameter of the pinion is calculated to be 78.7mm. The standard diameter of pinion as 75mm.

For Rack,

Pitch circle diameter of the gear is = 72mm

Circumference of the gear is = ∏ × pitch circle diameter

= ∏ ×72

= 226mm

The dimension is for 360°rotation

For 180°rotation the rack length is 113 mm.

VII. APPLICATIONS

The main objective of this system is to apply automotive vehicle. To move the headlight along with steering on sharp turning.

- To keep the headlight beam parallel to road turning as possible as can.
- To change the place of area illuminated by headlight and direct illumination area of headlight in useful direction.
- To improve the visibility area of driver at night so that driver can judge road turning well.
- To prevent road accidents on sharp turning at night specially in hilly areas.
- To increase safety at night.

VII. REFERENCES

[1] C. S. Martinez, S. L. Macknik and D. H. Hubel, The Role of Fixational Eye Movements in Visual Perception, Nature Reviews Neuroscience 5, 2004, pp.229-240.

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[4] Lighting the future Standard and High Performance Automotive Halogen Bulbs – Hella

[5] Boojoong Yong, Heeyong Kang, Sungmo Yang (2002), Auto-Leveling of HID Headlamp Using Preview. Control, KSME International Journal, Vol. 16 No. 11, pp. 1404-1411