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Modeling and Fabrication of Movable Headlamp System in Automobile

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Absract-- *The maximum fatal traffic accident rate occurs on curved roads at night time. Because of less illumination area on roads with conventional headlamp. Only 25% of the driving is done at night but 55% of the driving accidents occur during this period. The conventional light systems in the vehicles do not provide illumination in the right direction on curvy roads. Due to this constraint, need to understand an alternative technology solution. The aim is to improve the visibility area of driver to achieve a significant increase in safety and driving comfort. This is called a flexible front light system for automobiles and to illuminate the road in the night time at corner. From this system improves the driver's visibility at night time for achieving safety. The position of the headlights is dependent on the direction of the vehicle wheel so the input to the headlight system is attached to the vehicle's steering shaft. A simple geared mechanism is attached to a low-power type rotary encoder that can then feed directly into the microcontroller. As the steering shaft rotates(taking corners), it will turn the shaft of the rotary encoder and therefore vary the input. A microcontroller reads the information from the rotary encoder it turns the motor as programmed.*

Keywords- *Safety, visibility, Curved Road, Steering Mechanism, Adjustable Headlamps.*

I. INTRODUCTION

Every automobile necessary need is Headlight. Headlights have many parts associated with it, but they all intended to serve the same function. The main intention of Headlight design is to better illuminate the road(way) at night time and also at poor visible conditions like bad weather conditions(rain) or severe fog. And also provide high beam and low beams for the purpose of better visibility, it is operated by using switch[4]. The higher beam gives a better illumination than the low-beam. The low beam covers a small distance. The head lights are operated by using vehicle battery. [In 1898, the Hartford, Connecticut-based Electric Vehicle Company unveiled the world's first electric headlamp, but it wasn't until four years later in 1904, that the "Pockley" Automobile Electric Lighting Syndicate offered lights powered by an 8 volts battery.] The main part in the head light assembly is headlight bulb. The headlight bulb emits the light from filament. It produces a illumination by passing electric voltage through a filament(tungsten) that glows due to the electrical resistance. The emitted light is reflected out by using specially designed reflectors(Aluminum coated) that spread the light across the viewing area of the driver.

By using conventional headlamp, it's provides a certain illuminating area for drivers in the night time and it is not suitable to serve in cross-sectional roads and the intersection of the roads, the Automatic Headlamp System(AHS) has been proposed by many researchers for increasing the visibility.

Automatic Headlamp Steering System(AHS) swivel(rotate) the headlight beams in a vehicle's turning. This area of light known as turning radius, and with this result the driver cornering visibility is dramatically improved compared to the conventional method[1]. The vehicle's information collected by using real time sensors like speed sensor and temperature sensor,etc. AHS designed headlamps gives a light distribution with the vehicles turning angle, from this system we easily recognize the area of cross sectional roads and intersectional roads at drivers gaze point. The significant increase in light helps reduce driver's stress and fatigue and also improves the ability to see obstacles that fixed-beam headlamps might not illuminate[5].

One of the intelligent lighting system is cornering lighting system it is not conventionally approved and it has automatic cornering lights based up on the steering wheel. conventionally the cornering lights are operated by switch[3].

II. Problem Identification

AHS is one of the most useful system for Automobile. It is independent on manual beam control system. And also no need to adjust the headlight beam every time, because it will adjust itself for the given conditions. In some cases, some people forgot to adjust the headlight beam, so it provides a self protection to adjust the beam based up on the vehicle condition. And also it contains the programming part and electronic and electrical part.

Approximately one third of all traffic accidents happen at night, even though there is less traffic at night than during the day. Based up on the steering wheel and angle of the front wheels the circular path is generated. When the vehicle is in running the headlights could not move because it is fixed with vehicle so we can't recognize the objects in sharp turning. The position the headlight is fixed in static conditions.

III. Objective of Study

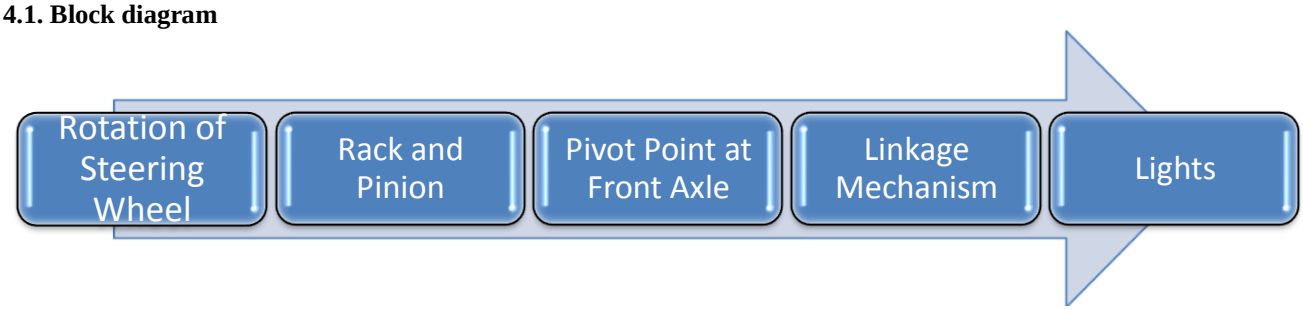
The main features of this system is to apply automotive vehicle are :

- To swivel the headlight along with the steering on sharp turning
- To maintain the headlight beam parallel to road at 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 the driver at night time so that driver can judge road turning as well.
- To prevent road accidents on sharp turning at night time specially in hilly areas and improve safety at night.

IV. Conceptualization and Research Methodology

The purpose of this system is to disassemble the conventional headlight and modify the projector light for beam rotation. In order to manage system costs and complexity, a simple framework was laid out for the developed AHS in this way.

4.1. Block diagram



4.2. Simple Linkage Mechanism:

A mechanical linkage is a combination of bodies, from this linkages easily manage forces and movement. By using the geometry of the body calculate the movement of link. The connections between links are known as joints. This movement may be rotational or sliding. If the links are in closed loop, the links may be ideal position or rigid it is known as kinematic chain.

Linkages may be open chains, closed chains, or a combination of a open and closed chains. Each link in a chain is connected by a joint. A kinematic chain can be modeled as a graph in which the links are paths and the joints are vertices, it is known as linkage graph.

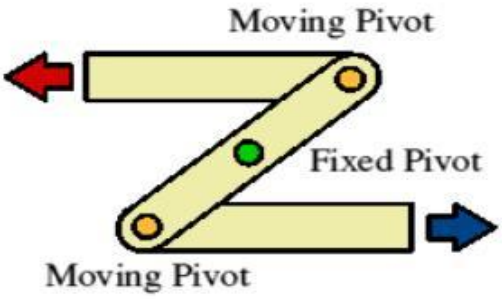


Fig. : Links and Joints

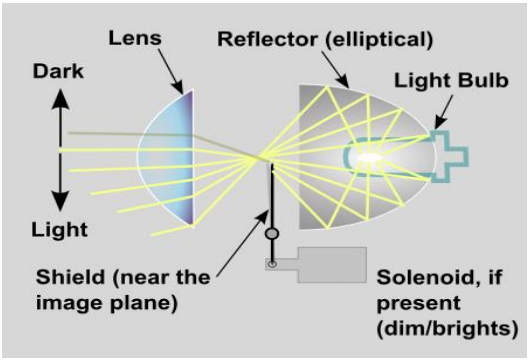


Fig. :Projected lights

If the linkages are stationary it is known as structure and if the chain may be fixed or rigid is known as mechanism.

4.2.1.Development:

In this system designed a two clamps(C1 and C2) on rack as shown in figure. By the using of two connecting rods the headlight and clamp is mounted. This connecting rods are fixed at clamp end and are simply supported in the slots of headlight back plate. Here in the each back plate of the headlight has one slot is provided for desired movement of headlight. Headlight back plates are pivoted on two vertical rods to have an angular movement. The total construction developed by using CATIA Software and the modeling as shown in fig.

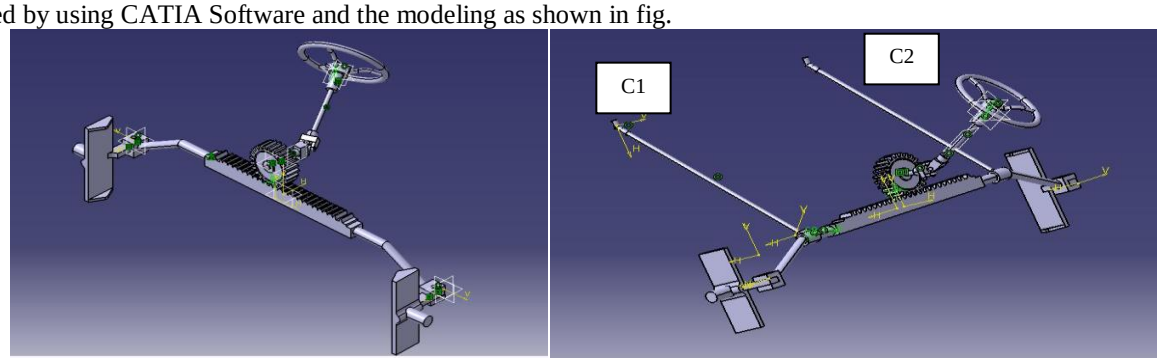


Fig. : Rack and Pinion Mechanism with Connecting Roads

When driver rotates steering wheel left or right, this motion is transfer to pinion through a steering shaft and universal joint. Rotary motion of pinion is converted into a liner motion of the 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 and vice versa.

4.3. Conclusion :

Huge amount of space required for this system. This system only applicable for some design of Heavy vehicles like buses, lorry's. This system works based on the steering wheel. When the vehicle is moving automatically the system is in process and it is independent of the light conditions (Day time/Night time), and the system blindly moving. For this system maintenance is high. To overcome above disadvantage of the simple construction, I proposed a alternative method called Automatic headlamp system(AHS).

V. The Development

5.1. Automation Method:

In this method, the system first collect information from the Steering shaft, and process them, and then move the actuator as output. The main components are

1. Rotary Encoder
2. Arduino UNO
3. LDR
4. Servo motor
5. Voltage Regulator

5.2. Block Diagram:

To develop AHS, the system consists mainly three components, The developed flow task diagram shows the working of Automatic headlamp system. In this system first collects inputs, processes them, and then moves the actuator as output. In this design, there is no requirement for a feedback loop between the headlight positioning and the microcontroller.

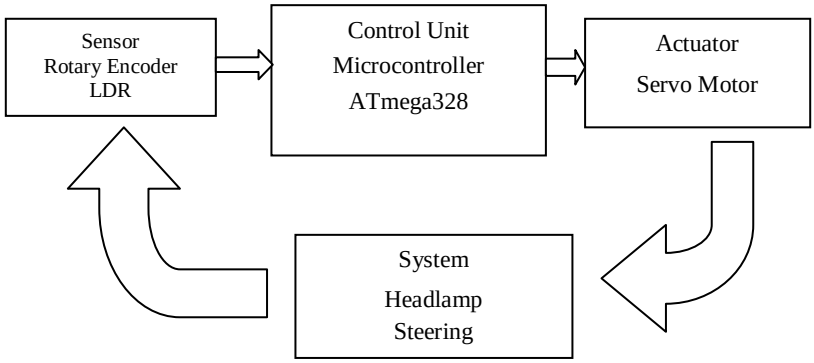


Fig. Block diagram for automation method

5.2.1. Sensor Block:

The position of the headlights is dependent up on the direction of the vehicle, so the input to the headlight system is a vehicle's steering shaft. From the steering shaft a simple geared mechanism is attached to a low-power type Rotary Encoder that can gives input directly into the microcontroller. As the steering shaft rotates(taking corners), it will turn the axle of the Rotary encoder and therefore vary the input. The input that varies from 0-360 degree is converted into digital input via the A/D channel of the microcontroller. For example, if the headlight is set at the center with an initial value of 90°, if the value increases as the rotary encoder turns, the microcontroller reads this value increment and will turn the motor as programmed.

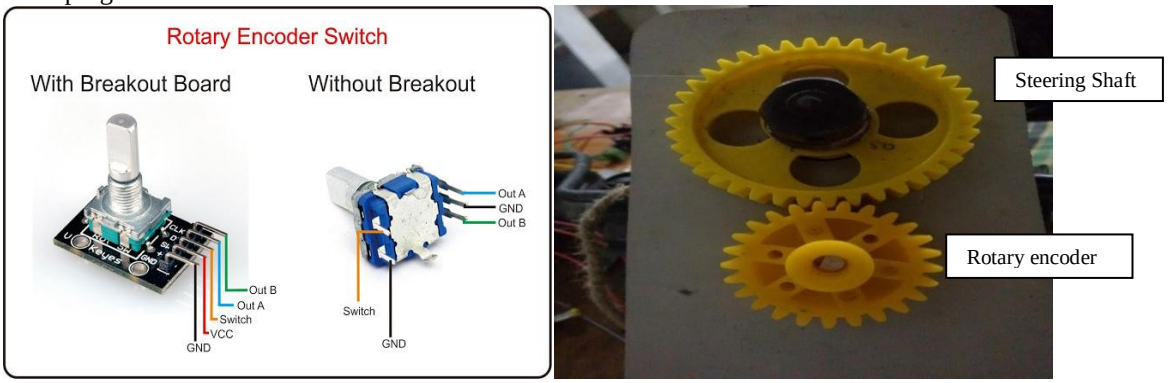


Fig. Simple Geared mechanism

Mainly the rotary encoder consists of FIVE pins in that, two power pins or input pins(GND,VCC),one switch and two output pins(DATA & CLOCK).

The proposed system works on independent of manual operation of headlights and works automatically by surrounding intensity values. These intensity values are calculated by using LDR sensor. This sensor is a electromechanical device. It works on the principle of photoconductivity. If the voltage supply given to LDR, the LDR sense the light intensity from surroundings. The input intensity values below the lower limit and upper limit, the system operates LED's as programmed in microcontroller. Similarly the light intensity value above the upper limit, the system turn off the LED's, as programmed. The light intensity value in between lower limit and upper limit, the system turn on the LED's.

5.2.2. CONTROL UNIT

A microcontroller is to be used to control the servomotor. The microcontroller contains a 28 pins in that 14 pins are digital I.P/O.P pins, and 6 can be used as PWM outputs and 6 input pins(analog). These I.P/O.P pins account for 20 pins. And it is a 8 bit microcontroller and 32k flash memory, 2k of internal RAM and it is a low power type microcontroller it needs only 1.8- 5.5V of power for operation.

5.2.3. Actuator Block:

The selection of a motor mechanism is a main step in the steerable headlights design. For this application, servo motors is used because it contains a analog feedback control but they differ in a number of ways. Typically, this involves a rotary encoder to provide feedback about the rotor position, and some mix of circuitry to drive a current through the motor inversely proportional to the difference between the desired position and the current position.

5.3. Data presentation and Analysis:

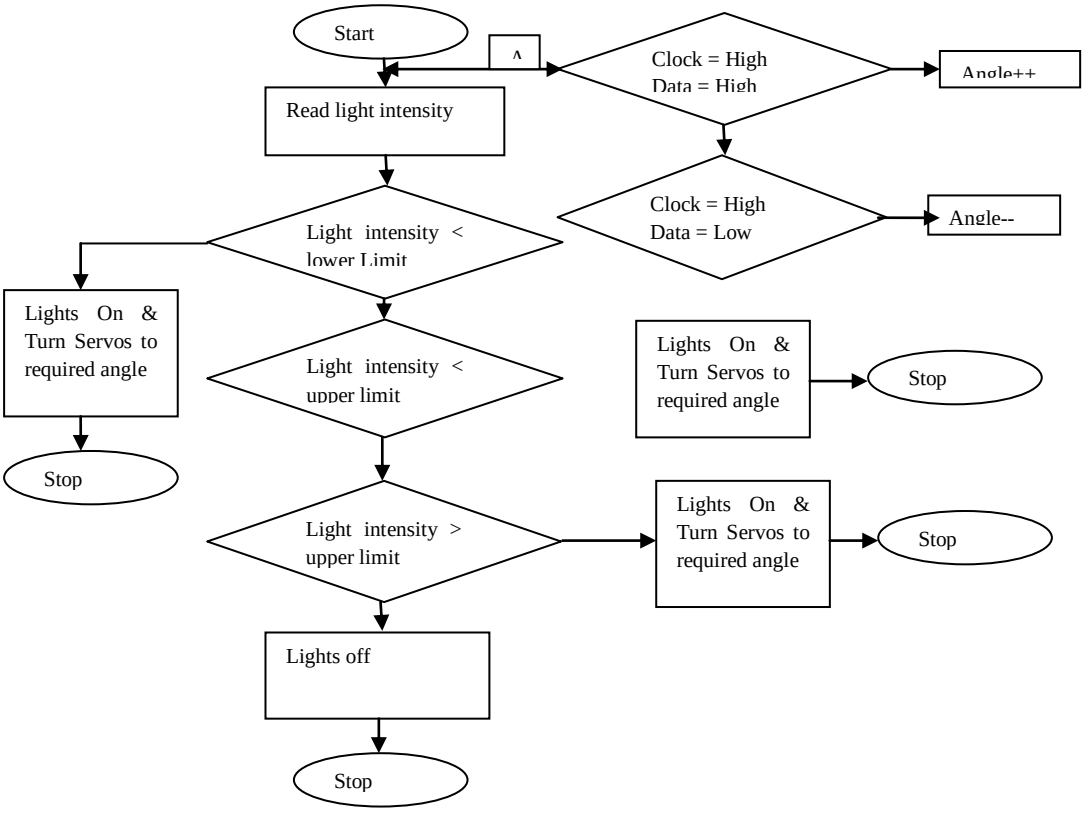
5.3.1. Modification of the Headlights:

A rotary encoder is to be mounted on the steering shaft giving variable inputs. As the steering wheel rotates automatically steering shaft turns the rotary encoder. The rotary encoder gives an analog input into the controller unit. The controller unit(Atmega 328) processes the input and gives the exact output to turn the servomotor as initially programmed. To move the headlight maximum15 degrees from left to right proportionally with car steering. For example, if the car turns right, the headlight will turn right also with the steering shaft, therefore illuminating more on right hand side of the road.

The modified light is attached to the servomotor. The projector light is mounted on a bended aluminum strip for reflection of light. Next, if the fixing of the servo motor was done, by attaching it to the bended aluminum strip, so that it can be attached to the headlight casing. The aluminum strip and projector light are then mounted back in the casing of headlight. The position of the mounting is adjusted so that the projector light can rotate at least 10 degrees left to right, per the specification.

5.3.2. Programming of the microcontroller:

When input (steering shaft rotation) is given to the control unit (microcontroller Atmega328) via rotary encoder, it will rotate the headlamps as per the program stored in the memory. The working of control unit based on different positions of steering.



A is the interrupt for Angle

5.3.3. Synchronizing the motor

The selection of a servo motor is to provide a necessary torque to control the headlamp. Maintain the alignment carefully for motor shaft and headlight assembly. The control given by the microcontroller in the digital form and it is received by the motor and necessary amplifications are to be performed to provide the necessary swiveling of the headlamp.

VI. Results and discussion

To put this whole system into practical use, there are several issues may be tested and analyzed.

- The first issue is to determine the moving of headlight with respect to steering shaft and also maintain the swiveling in a desired prior are not.
- The second issue is to maintain a response time of the motor(Time taken for the swiveling of headlight from one position to another in a useful direction)

VII. Conclusion

Based on the conventional head lights, the steerable head lights of design is achieved. Moving the headlights from left(L) to right(R) or vice versa continuously corresponding to a sensor is achieved. The main advantage of this of the developed headlight system is, it require a less space and suitable for all design of vehicles. And also it provides a bending illumination that allows for angular displacement of the light beam of a headlamp assembly, without excessive light beam distortion and without the need to move the entire headlamp assembly. Furthermore, the system is of low cost and simple construction.

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