Adaptive Flexible Headlight System

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Abstract—**The aim is to design and develop a "Steering Controlled Headlight Mechanism" which acts as directional headlights. This is done by connecting headlights and steering. Present day automobiles don't have effective lighting system. Due to these many accidents are taking place during night times especially in ghat sections. The accidents can be avoided by incorporating Steering Control Headlight Mechanism. When the steering wheel is rotated and rotary motion is converted to translator motion through the rack and pinion mechanism. When the front wheels are steered, the headlights follow the same path and the light is focused on more divergent area. In the present project, it is planned to design "Steering Controlled Headlight Mechanism" and a live model unit is fabricated.**

Keywords— **Steering control Headlight Mechanism, Directional headlight, Ghats, Divergent Area**

I. INTRODUCTION

In the present scenario, a headlight of an automobile has a fixed path for the emanation of beam of light in front direction only. So when the vehicle takes a turn, the beam of light follows the tangential path as a result some part of the roads remains dark, thereby creating a dead angle of illumination and such lack of visibility poses danger in driving at night or on steep turn. This causes a lot of accidents. [1] Mentioned that driving is a visual task and if light is not there, it can get risky. The driver has to drive by his own personal experience by using clutch and brake more often than on the straight path. Additional to this, [2] classified vehicle lighting as active safety. So this creates a need for simple solutions that help us cater this problem and increase road safety by improving the visual conditions provided by vehicle headlights Thus this mechanism of turn able headlight is devised to enhance the safety of drivers and pedestrian especially on curvy roads in hilly areas. This mechanism also enables us to save some fuel, expended in hilly driving due to frequent clutch and brake operations. Although the effects of "high beam" or "low beam" can be achieved by switching the different filament of the bulb. This moves the beam of light in up and down direction which help to cut off the significant amount of light from being cast into the eyes of drivers of preceding or oncoming cars. But the direction of emanation of beam of light still not adjustable as to the left or right. Illumination of beam of light during turning is shown in the figure 1

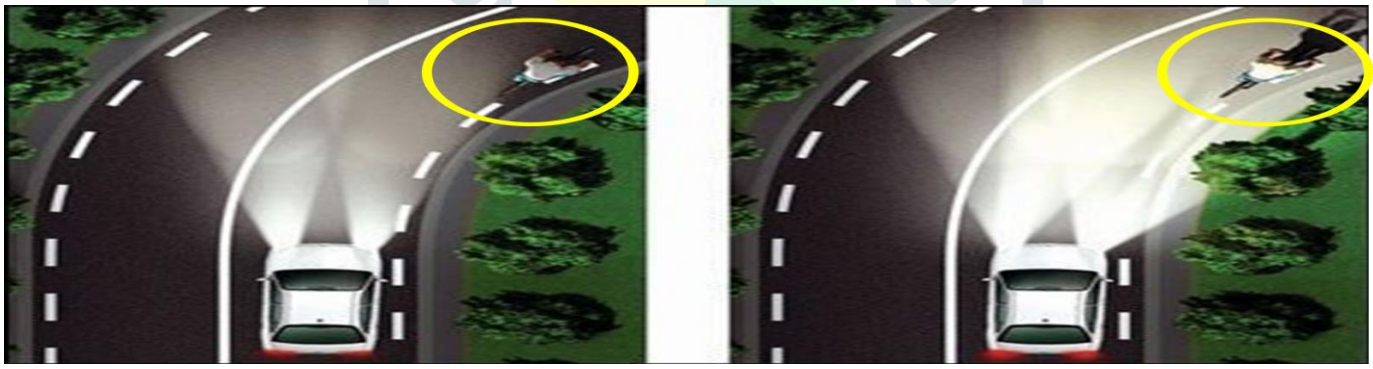


Figure 1 – Variation in illumination while driving on a curved road

Therefore, it is highly desirable to create a mechanism of high utility to solve the above problem that to at an economical cost. In this project the headlights of an automobile, moves from left to right more particularly to a direction corresponding to the front wheel when the steering wheel rotates. We designed the whole system involved in this mechanism on computer based designing software Solid works including headlight, steering column linkages, gears etc.

II. LITERATURE REVIEW

Before proceeding to this project we perform a survey with the lorry drivers, who travel to curvy road and hill areas often. Based on their responses and suggestions we had coddled in this project. According to [3] related to turning headlight 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 increase 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. Also according to [4] includes a headlight structure, a running gear and a server, the headlight structure being mounted through a rotatable main shaft at the front side of the car. The server receives a signal to turn and to transmit a force to the shaft to drive the main shaft to make the headlight turn left or right, following the movement of the steering wheel. In view of the above prior arts, the mechanisms available either require more vertical space or do not provide a mechanism which can be engaged or disengaged at the will of the driver. Hence, there is a need to develop a mechanism which is compact, cost effective and can be engaged or disengaged at the will of the driver. Therefore, the present development relates 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. It provides method for steering controlled headlights turning with a non-significant increase in the turning effort. Also it was necessary that this additional mechanism doesn't hike the cost of the vehicle. Also it was necessary to inspect that the mechanical system used doesn't turn out to be fragile increasing the maintenance costs.

III. DESIGNING

To design the improved steering-controlled headlight mechanism in Solid works we made each part involved in the mechanism separately and then assembled the whole parts in the Solid works to achieve complete the mechanism. At the very first step of designing we design the headlight in Solid works by taking the standard dimension from the available headlight in the market. A disk is attached at the rear side of the headlight and a hole is made eccentric to the axis of rotation of the headlight. This eccentric hole helps in rotation of headlight in leftward or rightward. Then Steering Column is designed and a spur gear is mounted on the steering wheel to transmit the motion of rotation of steering wheel to the headlight with the help of semicircular spur gear and the linkage mechanism. The spur gears are used because of simple structure design, high power transmission at low rpm and reliability when the power is to be transmitted in parallel axis. Also the axis of rotation of spur gear mounted on steering column is parallel to the axis of rotation of semicircular spur gear. Then the semicircular spur gear is designed which is in mesh with the spur gear mounted on the steering wheel. It is used because to rotate the headlights up to extreme left or extreme right position only half of the gear profile is sufficient and if full gear is used then it would add unnecessarily weight to the improved steering control mechanism. Then the linkage is designed according to the length available between steering column and the headlight. The linkages are of two types one is solid and the other one is slotted. One the linkage is made slotted because during the rotation of headlight the length of linkage first increases and then decreases and then increases. Moreover the slotted linkage helps to avoid the problem of location of hinge point and provide variable length of the linkage. To provide the facility of engaging and disengaging of the semicircular spur gear with the steering gear a fool proof mechanism is made so that engagement and disengagement can be done only when the headlight is at mean position i.e. when the headlight is front facing. The semicircular gear contains the pivot, which moves inside a groove guide plate. The guide plate consist a vertical slot, which provide provision for the engagement and disengagement only. Solid works design of guide plate used to provide fool proof engaging and disengaging .The whole assembly of the steering controlled headlight is made in the solid works is shown in figure

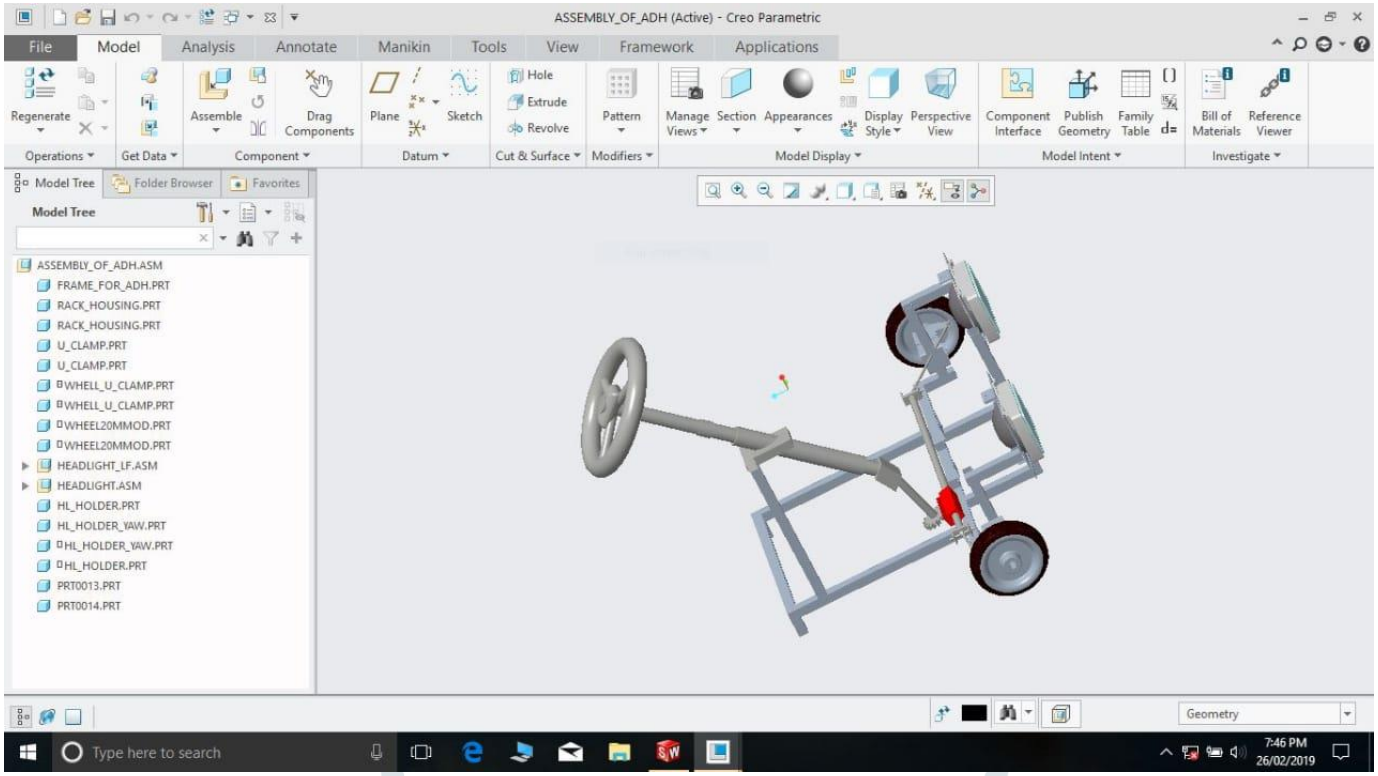


Figure 3 – Complete Assembly

IV. WORKING

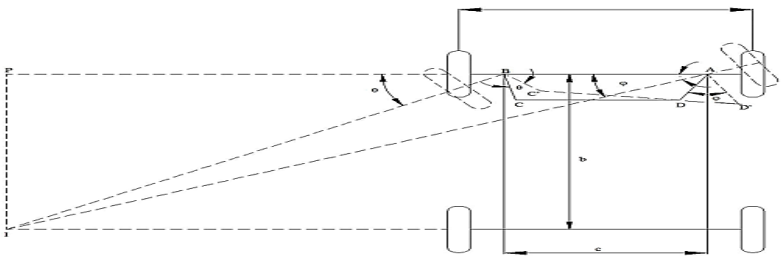
I) YAWING OF THE HEADLAMPS

When supply is given, The code is first saved in Arduino microcontroller. At first, the headlamps are at normal position. When the supply is given, the system activates. Now, as we steer the steering wheel in anti-clockwise direction, the tie rod moves towards right. This increases the distance between ultrasonic sensor and the acrylic sheet placed in front of it. This generates the signal in the Arduino which sends the output signal to driver controlling two stepper motors responsible for horizontal movement, and the headlamps are turned towards left hand side. Similarly process repeats as we turn the steering wheel in clockwise direction.

II) Pitching of the headlamps

When the system is placed at upward slope, the accelerometer senses the acceleration and sends signal to the Arduino. It works on the input according to the saved program, and sends output signal to the driver controlling servo motors which are responsible for vertical motion of headlamps. Thus headlight is lowered by the relative angle. Similar process goes for downward slope. By iterative method, we have set the Horizontal spam of the headlights to 60˚ (30˚ each on left and right) and the vertical spam is fixed to 20˚upwards and 20˚ downwards from normal axis.

V. CALCULATION



We have taken referenceof Maruti 800 for designing the adaptive headlight system .

Now, by Ackerman steering mechanism,

$\cot \varphi = (y+c)/b$ (φ = angle of outside lock)

$= \cot\theta + (b/l)$ (θ = angle of inside lock)

$\cot\varphi - \cot\theta = b/l$

Where, l = wheel base=1500 mm

b=Track width=1206.5mm

angle of inside lock **(θ)=46°**

By substituting the values we get

$\alpha = 20^{o}$

$\sin(\alpha+\theta) + \sin(\alpha-\varphi) = 2\sin(\alpha) \rightarrow (1)$

$\cot(\varphi) - \cot(\theta) = b/l \rightarrow (2)$

We get, from equation (1)

$\varphi = 23.73^{o}$

φ = angle of out side lock

θ = angle of inside lock

α=Ackerman angle

From the calculation we have calculated in how much angle our steering system is going to turn with respect to the tyre and headlight

VI. CONCLUSIONS

This paper has conferred the development of "Development of an adaptive steering controlled headlight for low cost vehicles " in which the headlights rotates with a same angle as with which the front wheel of the vehicle rotates by the rotation the steering wheel. The linkage mechanism of steering controlled headlight proved to be robust and cost effective option, which can be used in vehicles especially in heavy-duty vehicles to transmit the rotation motion of the steering wheel to the headlights when the mechanism is engaged. It also increases the safety of drivers as well as passengers by providing appropriate field of view during ride in night and hilly areas, which consists of frequent sharp turns. Moreover other existing mechanisms for steering controlled headlight such as electrically controlled mechanism, adaptive headlight mechanism it is simple, economical and can be easily customized for the any king of vehicles.

VII. FUTURE ASPECT

As there is always a scope of betterment is available in anything. In the same way the above mentioned mechanism can be made more flexible and easy to accommodate in less available space by changing the linkage mechanism with wire like clutch wire or gear wire used in automobiles to rotate the headlight. In future we can improve this headlight system on to more advance headlight system by using state of the art LED technology. IN this camera is use which will detect the traffic situation at night and passes the information on to the headlight. The headlight adapt to the light distribution according to the traffic situation. Headlight remains active without glaring any road participants.

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