DESIGN AND FABRICATION OF STEERING CONTROLLED HEADLIGHT

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Abstract: This study has been undertaken to design and fabricate the steering controlled headlamp mechanism. Headlights, a device whose failure will make us think twice before commencing any of the journey in the country. The topic of this project is steering controlled (or directional) headlights, and their biggest advantage is that they turn with the steering, so that the driver of the vehicle can see the entire trajectory of the path that he is going to follow. The headlights can be connected to the steering linkage by means of rods or cables, operated hydraulically by the power steering or nowadays it can be electronically adjusted, it can even be controlled by satellite navigation system. Our project deals with the fabrication of the automatic headlight. As for Indian road transport scenario is concerned, accidents are becoming a day to day cause and an attempt has been made in this project to reduce such mishaps. In our project the following operation occurs automatically in the vehicle. That is, when the steering of the vehicle is rotated to the left to progress in a leftward movement then the headlamp assembly moves to the left as well and when the steering of the vehicle is tilted towards the right the entire headlamp assembly moves towards the right which enables the driver to have an enhances visibility of the road. Not only this, the trajectory of the light on the right path can also alert the driver of the oncoming traffic and will make him aware of the presence of other vehicle. The head light remains in the steady position while the vehicle is moving straight ahead.

Keywords: Steering Controlled Head Light, Satellite Navigation System

I. INTRODUCTION

A lot of cars mean a lot of chaos on the road. Which increases the probability of one getting involved in a car accident. Car accidents are the mishaps that can be avoided easily by following lane discipline, and other basic laws setup by the authorities, but the question that arises here is the fact that a lot of accidents are unavoidable due to the low visibility post sunset or due to lack of awareness which is an aftereffect of poor lighting. Here unlike usual automakers and manufacturers we are not trying to widen and brighten the headlamp which does opposite to what is been required from it. It causes a blinding effect on the oncoming traffic and increases the risk of a head on collision by a substantial amount.

Here with the help of basic materials and linkages we aim to obtain a headlight mechanism which moves or operates with coordination to the steering of the vehicle. We as the residents of union of India are blessed to be surrounded by huge amount of natural beauty. We have multiple mountain ranges and peaks, plateaus, plains as well as the twists and turns of the ghat sections. With this wide variety of terrain we cannot have the equipment designed to cater the needs of just one type. Thus we wish to generate a steering controlled headlamp system which will work in coordination with the steering. That is, when the steering of the vehicle is rotated to the left to progress in a leftward movement then the headlamp assembly moves to the left as well and when the steering of the vehicle is tilted towards the right the entire headlamp assembly moves towards the right which enables the driver to have an enhances visibility of the road.

1.1 Increasing number of private light motor vehicles [1]

According to the 2011 Census, Mysore had a population of nearly 9 lakh and this number has almost touched 14 lakh at present. In 2011, the city had 4 lakh vehicles. But according to recent statistics, the number of vehicles in the city has crossed 8.15 lakh as at the end of the December. Two-wheeler form the largest chunk of the vehicle population with a share of nearly 80 percent. Cars and other four-wheelers come second, followed by auto rickshaw (21,645 numbers), Goods Transport vehicles (16,554), Delivery Vans (8,839), Cabs (5,155), Tractors (4,509), KSRTC buses (4,039), Omnis (4,026), Tractors Trailers (3,709), Maxi Cabs (2,238) and other vehicles. These statistics are as per the records at the two RTO officers in the city. Apart from these figures there are over 10,000 vehicles from the other States plying in the city.

With city roads unable to bear this huge traffic, the roads often get congested and traffic snarls and jams have become common these days. The narrow roads have only compounded the problem. Also, there is little scope for widening important roads.

1.2 Rapid Increment in number of road accidents [2]

India has been on the top of the list of countries with the highest road fatalities since 2009, when the first global status report on road was published by WHO. One in every 11 road deaths globally occur on Indian roads. A rapid rise in car registrations – India rans 5 globally and added almost 3 million new cars in 2019 and complimented with the road network spanning over six million kilometers makes it one of the busiest countries in terms of road traffic. United States of America and Japan have more accidents but most of the deaths are in India.

In 2019, India reported a total of 449002 road accidents of which 151,113 were fatal and 451,361 had injuries, says the recently released government of India report of road accident in 2019. In percentage terms there was a decline in all three, though a marginal one. There were 3.86% fewer accidents in 2019, 20% fewer fatalities and 3.85% fewer injuries. This is still huge and signifies the number of cases that might have been in the previous years. However, road accident severity measured by the number of persons killed per 100 accidents increases 1.3% points in 2019 over the previous years.

II. Literature Survey

In the Indian context in particular, accidents are in a particular rise at places like steep turnings and curves especially in four wheelers and heavy vehicles like lorry's and busses during the night time. In a way to have a financially viable solution to reduce

these accidents, an attempt has been made to design and fabricate a mechanism to increase the visibility of the path for vehicle driver during night driving. [3]

Chi on-Dong Lin, proposed by car light piloting system objective of the present invention is to provide a steering wheel controlled car light piloting system which automatically turns the lights of the motor car to coincide the projections of the lights with the steering direction of the motor car. The present invention comprises an electric contact mechanism consisted of electric brushes and metal contacts dispose around the steering column of the steering wheel of a motor car, a motor drive consisted of at least one servomotor, a control circuit connected between the motor drive and the electric contact mechanism to control the revolving direction to the turning direction of the steering wheel, and a transmission mechanism consisted of at least one hydraulic cylinder systems and controlled by the motor drive to turn the light of motor car causing them to coincide with the steering direction of the motor car. [23]

2.1 Types of Headlamps Available

- Standard Halogen Setup
- Projector Beam
- HID lights
- LED lights
- Laser Headlights

2.2 International Headlamp Styling

In 1983, granting a 1981 petition from Ford Motor Company, the US headlamp regulations were amended to allow replaceable-bulb, nonstandard-shape, architectural headlamps with aerodynamic lenses that could for the first time be made of hard-coated polycarbonate. This allowed the first US-market car since 1939 with replaceable bulb headlamps: the 1984 Lincoln Mark VII. These composite headlamps were sometimes referred to as "Euro" headlamps, since aerodynamic headlamps were common in Europe. Though conceptually similar to European headlamps with non-standardized shape and replaceable-bulb construction, these headlamps conform to the headlamp design, construction, and performance specifications of US Federal Motor Vehicle Safety Standard 108 rather than the internationalized European safety standards used outside North America. Nevertheless, this change to US regulations made it possible for headlamp styling in the US market to move closer to that in Europe. The D series cars equipped with the system used cables connecting the long range headlamps to a lever on the steering relay while the inner long range headlamps on the SM used a sealed hydraulic system using a glycerin based fluid instead of mechanical cables. Both these systems were of the same design as their respective cars' headlamp leveling systems. The cables of the D system tended to rust in the cable sheaths while the SM system gradually leaked fluid, causing the long range lamps to turn inward, looking "cross-eyed." A manual adjustment was provided but once it was to the end of its travel the system required refilling with fluid or replacement of the tubes and dashpots. Also there have been many journal papers published and the International Journal of Modern Trends in Engineering and Research is one among the many that have already developed this system. In this project we aim to improve the design with few more advancements.

2.3 Different Steering Mechanism

- Rack and Pinion steering system
- Linkage mechanism
- Four Bar Mechanism

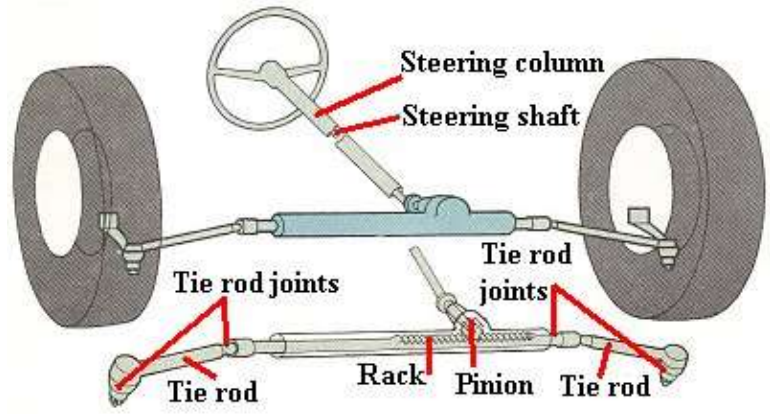

Figure 1. Rack and Pinon Steering Mechanism

III Methodology

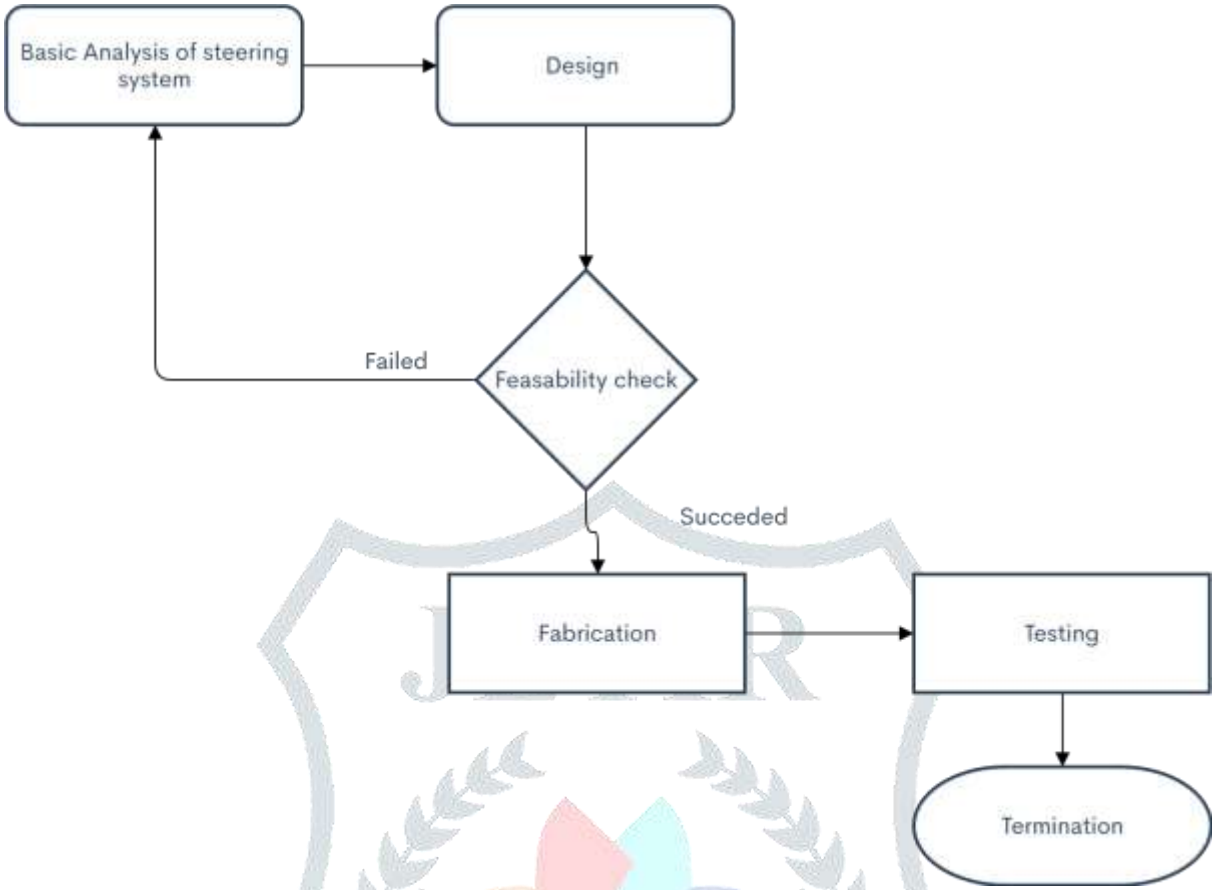

Figure 2. Methodology flow chart

IV Design and Fabrication

Rather than building the entire frame and chassis of the vehicle to embed the headlamp assembly. The GO Kart that was used by the racing team of Reva University was utilized to demonstrate how this mechanism and the steering wheel system works. We first analyzed the steering assembly that was already present in the go kart fabricated by Reva University.

Figure 3. Go Kart Model

The steering system present in the Go kart was manual, that is, it did not get any assist from the motor or any kind of electrical system to steer and move in the desired direction. The design of the steering mechanism was then analyzed and also few 3D models were made to find out an optimal solution to this. This Go kart vehicle was found using an offset 4 bar mechanism for the steering

purposes, which not only gave it a limited angle of tilt but also if anything was attached to the steering wheel it would obstruct the body. The steering mechanism is shown in the image below for the reference.

Figure 4. Steering Assembly of Go Kart

There is steering rod that is connected to the steering wheel used to give inputs and is supported by links. With that there is a metal piece attached at the bottom that is providing a little bit of offset and has 2 holes. The two connecting rods from the wheels come and terminate at one out of these two holes. So whenever the user rotates the steering wheel, due to the offset of the connection, one of the rod is pulled while the other is pushed, this generates the push and pull action on the trailing edge of the wheel which makes it turn.

Table 1. Components and Specification

Serial Number	Component	Material	Size (mm)
1	Outer Frame (L – Bar)	Mild Steel	2x1200 mm 2*200 mm
2	Holder For Headlamps	PVC Pipes	4*50 mm
4	Connecting linkages (Rods)	Mild Steel	2*450 mm
5	Headlamps	Multi Material	-

There were 5 major components assembled together to obtain the structure –

- Outer Frame
- Holder for Headlamp
- Connecting link
- Headlamps

The outer frame is made up of L – Bars made out of mild steel. It is a rectangular frame that also supports and hold the headlamps in position. In the rectangular shape the, length of the frame is 1200mm and then width being 200mm, just enough to hold the headlamp and not to make the design bulky. The entire frame is welded together at the 4 vertices, then two M8 holes are drilled on the lower length of the frame which gets affixed with the wooden frame already present in the car with the help of the specified bolts and nuts. The frame is rigid and holds the equipment well.

This frame is lightweight and can hold our equipment rigidly without installing huge amount of structure. It is effective and convenient to install and uninstall as well as it just uses two bolts for the purpose.

Headlamps will be affixed in within the frame but to hold them in position and to provide them a rotatable mount we used PVC pipes of approximately 50mm length on axis of the headlamp that we wanted it to rotate on. Two screws were affixed on the headlamp on top and bottom which were congruent with the imaginary axis of rotation of the headlamp, which went inside the PVC pipes providing it the hollow cavity to move on and also the support to hold them in place. The pipe was then affixed from the top using M5 bolt through the drilled hole in the frame. This made sure that the structure was stable and did not move unnecessarily.

Figure 5. Lights getting fit on the holder

Connecting links are the linkages that connect the offset of the steering wheel to the offset location of the headlamps. These are also made up of Mild Steel and were 450mm in length. We had connected them to the offset provide in the steering wheel and then this was further connected to the headlamps to translate the push or pull action. Since the headlamps are affixed on a pivot they tend to rotate on the free and loose axis.

The headlamps were an integrated and pre-assembled unit from the two wheeler named YZFR15 from the manufacturer Yamaha. These were used to demonstrate the rotation of the assembly and were affixed with the help of other supporting materials mentioned in this section of the report. A picture of the headlamp assembly is also attached. This headlamp comes with the dual bulb feature which will further enhances the visibility and also it gives us the opportunity to attach them separately on both sides.

IV Results and Discussion

This project enabled us as a team to learn new techniques and operation of various tools. With the completion of this project we obtained various results. The headlamps used already had acceptable visibility, with the customization and the completion of this project we were able to direct the light where we want to look at.

This project also enabled us with a headlamp system that turns with the steering and the input is proportional to the steering. The visibility on the turns increases and there is practically no lag between the input and the output. That is, since the system is manual and is mechanically connected to the steering, the output is achieved immediately after, there is no time delay between the input and the output.

One of the major objectives of this project was bound to the finances, we wanted to achieve and build an effective system at a very low price which would allow the nation to have access to the accident free roads with low cost automation project. The project works in this field which have been done already are using sophisticated materials which comes with a premium price. We have used simple materials that are available readily at any hardware shop and do not rob the pocket of anyone. This will allow automation of headlamps to different segments of vehicles and will not restrict them or limit their usage to only higher end luxury vehicles.

The model of the entire idea was fabricated successfully and was demonstrated. The entire working of the system with the rotation of the headlamp. This model and the system provides us a safer option which can be incorporated with existing systems as well.

The infrastructure of the country needs a lot of times and efforts to develop and manage, whereas on smaller lever or an individual level it is not such a big of the task. It is relatively easier and faster as well. With this type of system we wish to achieve the safer roads and better world for everyone.

Since the reports of the various accidents pointed out that the country is immensely lacking infrastructure, and this project is reducing the requirement we can expect a significant drop in the number of accidents. The elimination of the entire need for the infrastructure cannot be achieved as there are a number of types of vehicles and users of the road. A pedestrian, cyclist and other users will need the infrastructure as well. Apart from these there are animals and animal powered vehicles that do not operate with any kind of lighting equipment, without any infrastructure the number of fatality will increase.

Talking about pedestrians and other non-illuminated vehicles, they will be alerted better due to this system. As this headlight rotates and illuminates the path ahead rather than projecting just on the front, the pedestrians get aware of the incoming vehicle and will be cautious of crossing the road.

This will improve the safety standards in all aspects while someone is using the roads whether it is the driver of any vehicle or a pedestrian.

V Conclusions

1. The System of automated headlight system is an effective solution to the issue of the visibility as seen on the Indian environment and provides an effective solution to the problem
2. The system aligns itself as expected with the input to the steering in both the directions.
3. The System is cost effective and can be implemented to low cost automobiles as well.
4. With the improved visibility the accidents that are caused due to the poor visibility will lessen the numbers and also reduce injury on the roads, this will also improve the ranking of the nation worldwide about the road safety and quality.

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