Accident Prevention with Adaptive Headlight System

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Abstract— The recent developments in the sensors and the IoT (Internet of Things) technologies are transforming many of the devices smart and to act independently or with minimum human intervention. The researchers are identifying many existing systems and trying to address the current problems in the functionalities or limitation of these existing devices. The researchers are also working to discover the technologies which are very expensive and not in the reach of the common man so that it would be possible to bring out the better solution for the ever-growing mankind with suitable affordability. This project focuses on the design of a system based Adaptive Headlight System for vehicles. Also discuss the advantages of AHS, how it can avoid certain types of accident and help optimize lighting at curves.

Keywords: Adaptive front lighting systems (AFS), Adaptive Headlight System (AHS), Troxlers effect

I. INTRODUCTION

Accidents during night have become very common in the current scenario. Automobiles have headlights that lights up the road in front of the vehicle and fails to provide illumination at bends. Reasons like lack of visibility, inability to view objects at the corner of a turn have plagued automobile drivers during late night travel. To overcome these situations, several mechanisms have been sought after to mitigate once an accident occurs but there were not much solutions proposed to prevent an accident even before it occurs. The main reason for accidents in roads having steep turns and curved roads in hilly areas is due to the presence of blind spots. Blind spots are the areas around the vehicle that cannot be directly observed by the driver. These areas cannot be seen directly by looking forward or by looking through either of the side mirrors. Blind spots may occur due to inappropriate positioning of the vehicles' side mirrors, thickness of the A-pillar, height and width of the vehicle, etc. Other causes of blind spots are steep curves in roads, lack of visibility due to weather conditions etc. Blind spots can occur due to the condition of the driver as well. Poor infrastructure, like improper street lights create problems for the driver, especially in the highways. These blind spots must be eliminated for safe driving. Temporary blindness of the driver can occur due to dazzling of headlamps. Dazzling occurs when the headlights of the vehicle coming in the opposite direction falls directly into the eyes of the driver. This result in the driver being blinded for some time and in turn increase the probability of accidents. This problem is more prevalent when the road is curved. A vehicle with normal headlights sends the light rays tangential to the curve. Thus, the probability of dazzling of lights in the eyes of the driver of the vehicle coming in the opposite direction is very high. This driver, with his eyes momentarily blinded, can go off the curve and off the road and create a major accident, hence, killing him and others on the road. There are also instances where the driver fails to switch on the head lamp during night or when the visibility is not sufficient to guarantee safe driving, accidents occur especially in highways. Hence a mechanism to ensure that the head lamps are turned on automatically is required. This mechanism again is incorporated only in high end cars like BMW, Audi, Volvo etc. In order to incorporate this mechanism in low end cars, a cost effective and efficient method is the need of the hour. This can be incorporated by mounting a photo diode on the windshield behind the internal rear view mirror. Thus, theremust be a cost effective mechanism to address the problems of blind spots, dazzling of head lights and low visibility. The main purpose of this system is to present a technique to illuminate that blind spot while driving at the night and during the time when the visibility is reduced significantly so as to make the objects visible in those darkened locations and thereby prevent accidents.

II. PROBLEM AT NIGHT

It's a common problem faced by driver during night drives that whenever there are curves the straight facing headlight direct towards the outer sides of road and about 50-60% road is illuminated with lights, further creating a blind spot on right front end of car(driver's end). This paper focuses on providing solution to this and further providing more alternates to it.

Big automotive industries have been using AHS as a luxurious feature in expensive car like Audi, Subaru, Toyota and General motors, but usually it is more like a light intensity adjustment system which is responsible to set the light to on or off mode in different conditions day, night or bad weather).

A. Dipper

Sometime people ignore the importance of dipper in ALS but the thing is Dipper (low beam) can help in avoiding Troxlers effect (explained in following passage) , if somehow with technology (like LIDAR of Tesla motors) we can sense the car coming from opposite direction and automate the system so as to set head light in low beam. We know how the high beam of car approaching towards anyone's driving direction can create a blind spot that can be cause of losing control on vehicle causing accident.

Another function of low beam is to balance out the visibility of driver whenever a vehicle passes by, driver just needs to switch back and forth. This is very important feature but also very distracting for a new inexperienced driver. So by creating an auto-switch for this function (included in AHS) we can decrease one function for driver.

B. Troxlers Effect

A study by Dr. Alan Lewis, who runs the College of Optometry at Ferris State University in Big Rapids, Michigan, found that during nighttimes driving, headlight glare from the vehicles travelling with you could be blind anyone. Even after the source of the glare is removed, an after-image remains on the eye's retina that creates a blind spot. Known as the Troxler Effect, this phenomenon increases driver reaction time by up to 1.4 seconds. That

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means that if driving at 60 mph, a motorist would travel 123 feet before reacting to a hazard. Normal reaction time to a change in driving conditions is .5 seconds and the distance travelled before applying the brakes is 41 feet when travelling at the same speed.

The point of Dipper and TROXLERS EFFECT is we can combine certain technologies to make a more secure added feature in AHS.

III. LIGHT ADJUSTMENT WITH CURVE/TURN

Following are some practical solutions that can drive AHS:

A. Operational Method

In the given figure 1 if we observe the difference between with AFS and without AFS we can see how light is directing away from road. But with AFS we can direct the light with some servo motors or reflection technology to change the direction[4-5].

Clearly it cannot be controlled mechanically because there are two main factors that will decide the direction of adjusted beam that are:

1) Speed of vehicle
2) How much you rotate your steering

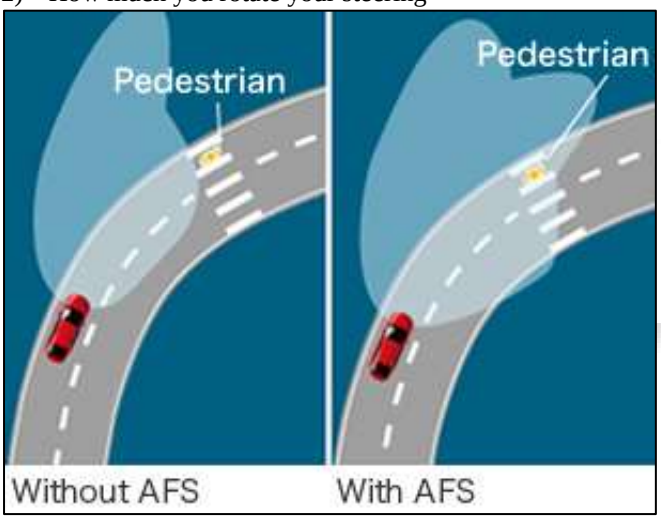

Fig. 1: difference between with AFS and without AFS

B. Electronics Used

The key feature we discussed above is important to give the output results, for this we can use vehicle's speedometer and to calculate the turns steering make we can use laser sensors or any analog sensors. This will give input to a controller device which has certain calculated parameter to derive the direction of lights accordingly.

IV. CONCLUSION

Adaptive headlights do not compensate for unsafe driving or poor road conditions. Drivers must still take precautions when driving at night because the system is there is to improve the visibility not the reflexes and driving experience. This feature is only applicable in certain conditions, namely night times, when cure is specifically narrow and have limited bend and when there is low light. The biggest problem faced is that, when at curve if a vehicle is approaching another vehicle enabled with AHS. The approaching vehicle will get the light directed to him and that though on curve, that makes up the biggest reason to avoid the use of AHS.

In future, the adaptive headlight system can be made more efficient by controlling the spread of the light beam from the head lamps using an 'automatic range extender' depending on the vehicle speed. The beam can be made to diverge when the vehicle is travelling at high speeds and can be made to converge when the speed is low. Also automatic low beam-high beam adjuster can be incorporated to reduce accidents due to dazzling of lights. As 70% of accidents occur during night, this can be decreased with increasing the optimization of front-lights. AFS should not be limited to luxury; including it to a mandatory safety system can avoid many mishaps. It can be considered as a new step towards automation in automotive industries.

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