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Research Paper

DESIGN AND DEVELPOMENT OF LOW COST ADAPTIVE LIGHTING SYSTEM

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ABSTRACT-

This paper describes the development of adaptive lighting system during night time, as the highest fatal traffic accidents occurs on curve roads at night time. Night time driving with existing conventional headlamps is particularly unsafe because it does not provide illumination in the right direction on curve roads. Due to this constrain, we need to understand an alternative technology solution to improve visibility for driver at night time during curve road. Headlamp swings in the horizontal direction by sensing steering angle and vertical by sensing distance between subject vehicle and next vehicle. So, when a person turns their car, the headlamp of the car also turns according to the steering angle so that the person driving the vehicle will have better vision.

KEYWORDS-Headlamp; Sensor; AFS (Adaptive front lighting system); steering angle.

I. INTRODUCTION

The oldest headlamps were fueled by acetylene and oil and were introduced in the late 1880s. The first electric headlamps were introduced in 1898 on the Columbia Electric Car from the Electric Vehicle Company, and were not mandatory **[3].** The concept of swiveling headlamps is actually old one. An old innovation in lighting was to vertically tilt the beams high-beam-to-low-beam (dipped) switching dating back to 1917.Automatic high/low beam system firstly existed in 1952 by general motor called "Autroic Eye**" [3].** New developed AFS is based on image processing. New kind of AFS system uses image recognition technology to collect the corner information from a certain distance and then it adjust the horizontal movement of the headlamp **[1].** For sensing the obstacle coming from front side ultrasonic distance sensor is used accordingly vertical movement of headlamp is takes place. Horizontal swiveling is important in the automotive industry. The current static headlamp provides illumination in tangent direction of the headlamp without any consideration towards the steering shaft angle. The AFS controls the aiming direction and lighting Distribution of the low beams according to the amount of turn applied to the steering wheel during visibility and discomfort glare of adaptive front light system.

Fig. 1 Implementation of AFS
(source: MAZDA active safety technology)

AFS therefore improves driver's visibility during night driving by automatically turning the headlamp reliability **Fig. 1** To achieve the solution for stated problem, we present the basic concepts of this new way to light roads, called Adaptive Front Light System (AFS).Various Studies on swivel beam-head lamps has shown upto 30%increase in illumination of the driver as the vehicle incornering on the road. The additional corner results in increase of 58% in the drivers ability to recognize an obstacle **[2]**

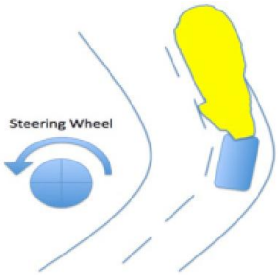

Fig. 2 Turning of head lamps with respect to steering wheel

II. MATERIALS AND METHODS

Adaptive head lamps are helpful when driving on winding roads at night, during twilight, or in other low-light conditions. They can address many potentially dangerous situations, including;

1. An oncoming vehicle negotiating a turn accidentally drifts into your lane.
2. Cresting a hill on a narrow road, you are unable to see whether other motorist is coming.
3. As you round a curve, your headlights temporarily blind oncoming traffic.

Adaptive head light also benefit other motorists on the road. For example, when a vehicle turns around a bend in a low-light conditions, standard headlights will temporarily point directly at oncoming traffic. This can lead to discomfort and avoid appearance of lighting visual" blind spot**"[10]Fig. 2** This problem is avoided with adaptive head lights ., since their beam stay on the road and do not point at oncoming traffic. In addition, since headlight do not point other motorists, it is safe for drivers who own a vehicle with adaptive headlights to use bi-xenon lights. Emitting a slightly visual blueish tint lights in the direction of a travel according to steering wheel

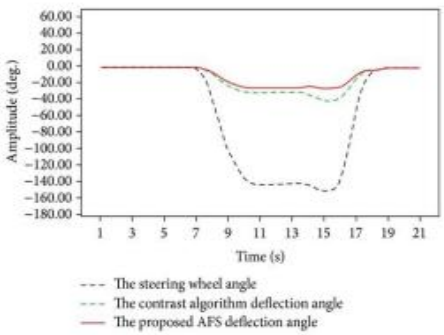

Fig. 3 Head lamps deflection angle and steering angle (source: Research gate)

To get clear visual on road and obstacles on road at night time along curved road, it is necessary to turn headlight along that direction **Fig. 2** A 10K potentiometer is coupled to steering shaft. Potentiometer will generate varying analog voltage according to turning of steering. Angle of potentiometer sensor ranges from 0 to 180 degree**[4].** This voltage is fed to a DC and then is read by controller. The controller unit processes the input and updates the PWM width**[6].** The output is feed to the servo motor. This in turn helps to rotate headlight horizontally. Servo motor needs PWM pulse of 20ms period, min on time of1ms and max of 2ms. As per ON width of PWM servo motor will have rotation angle**[7].**

III. METHODOLOGY

The basic idea is that the head lamp turns according to the direction of the steering wheel. The potentiometer which is attached to the steering axis and gives signal to the microcontroller. The microcontroller analysis the signal received from the potentiometer and then send signals according to the servo motor, which rotates the head lamp according to the signals received **[8].** The horizontal swings of headlamp by sensing steering angle and vertical swings of headlamp by sensing distance of incoming vehicle**[3].** So, when the vehicle takes a turn the head lamp also turn according to the direction of the steering axis and hence provides the better vision to the driver while driving.

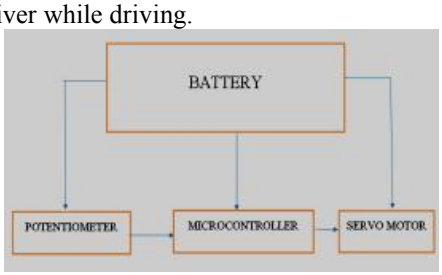

Fig. 4 Block diagram of adaptive lighting system.

IV.SIMULATION ANALYSIS

The main components are ARDUINO microcontroller board, potentiometer, servo motor, 9V battery. Here, the steering wheel axis is modelled as a potentiometer which is used to rotate a servo motor by the rotation of the steering wheel axis in anticlock wise direction **[8].** Instead of 9V battery, we used an USB cable to get the power from the laptop and then the power is send to the microcontroller. The microcontroller receives input from the potentiometer in the form of analog waves. Then the microcontroller process the analog input signals and convert them into digital form. The processed digital data is sent to the servo motor as input signal. Thus the corresponding turn of headlamp is obtained with respect to the input from the steering wheel (potentiometer).

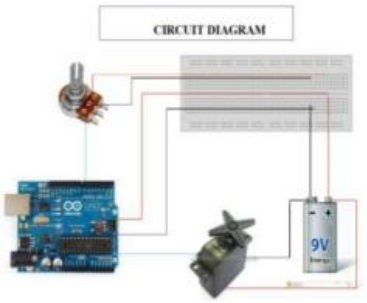

Fig. 5 Experimental setup for the system.

V. RESULT AND DISCUSSION

Thus, the system is completed by connecting the potentiometer, arduino microcontroller board and servo motor accordingly. So, when a vehicle takes a turn, the head lamp of the vehicle turns according to the direction of steering wheel and comes back to normal as soon as the steering wheel returns to normal.

VI.CONCLUSION

This type of lighting system provides the better vision to the driver by turning according to the direction of the steering wheel. It will function as soon as the vehicle takes a turn. But, using this system along with automatic dimming lights can be proven to be even more effective as it automatically dims its light when a vehicle comes at a closer distance, and thus, providing a better vision to the passer-by.

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