Adaptive Front Light System (AFLS)
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Abstract—The highest fatal traffic accident rate occurs on curved roads at nighttime. In most cases, the late recognition of objects in the traffic zone plays a key role. These facts point to the importance of the role of automobile forward-lighting systems. In order to provide enhanced nighttime safety measures, this work aims to design and build a prototype of steerable headlights by adapting a conventional static headlamp with a very close eye on cost and reliability. Components that are easily available in the market and suitable for developing a steerable headlight system were tested. Different kinds of tests were done on critical parts of the system in order to determine its accuracy, its response time, and the system impact. Finally, the results acquired from these various tests will be discussed.

Key words: AFLS, AFS

I. INTRODUCTION

The current static headlamp provides illumination in tangent direction of the headlamp without any consideration towards the steering shaft angle and the distance between incoming vehicle and subject vehicle. The driver is therefore subjected to insufficient illumination and unreliable or incomplete view of the road. It is therefore imperative to study new technology. Adaptive front light system (AFS) is an innovative technology and is being studied by researchers across the globe. 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 cornering or turning and distance between the incoming and subject vehicle. AFS therefore improves driver’s visibility during night driving by automatically turning the headlamp in the direction of travel according to steering wheel angle and the distance between two vehicles. Road accidents are human tragedy. They involve high human suffering and monetary cost in terms of untimely deaths, injuries and loss of potential income. Road safety is an issue of national concern, considering its magnitude and gravity and the consequent negative impacts on the economy, public health and the general welfare of the people. The aim of this project is to improve visibility for the driver, thereby achieving a significant increase in road safety and driving comfort.

II. BLOCK DIAGRAM

A. Potentiometer (as steering angle sensor)
A potentiometer is a three-terminal resistor with a sliding contact that forms an adjustable voltage divider. If only two terminals are used variable resistor. A potentiometer measuring instrument is essentially a voltage divider used for measuring electric potential (voltage); the component is an implementation of the same standard, hence its name is potentiometer.

B. Ultrasonic Sensor
This sensors work on a principle just like measuring instrument that evaluates attributes of a goal by decoding the echoes from radio waves or sound waves severally. It generates high frequency sound waves and evaluates the echo that is received back by the device. Sensors calculate the fundamental measure between causing the signal and receiving the echo to determine the space to an object.
C. FPGA
It act as controller of whole project and it is fully assembled with Xilinx Spartan 3E and 4Mbit SPI Flash Memory. It provides an easy introduction to FPGA, Digital electronics and SOC design. USB Connection with two channels for JTAG and Serial communication.

D. Actuators
To make easy the movement of the headlamp depends on steering shaft, the headlamp is located on motors. The servo motors is used as actuator a for horizontal movement. The rotating angle for servo motor for horizontal is 0-180 degree. It requires power source of 4.5 – 6 V.

III. PRINCIPLE OF OPERATION

A. Vertical turning of light in response to distance obtained
Ultrasonic sensor has two signal pins. One is trigger and second is echo. Ultrasonic module needs trigger pulse of 10µs to initiate its operation. In response to the pulse an echo pulse will be generated with width proportional to the distance between the vehicles. A pulse will be received on echo pin. ON width of this signal is proportional to distance of obstacle. If distance decreases speed has to be decreased. So program will reduce ON width of PWM proportionally to distance from obstacle. The output if feed to the FPGA and the FPGA will update PWM width to rotate headlight vertically.

B. Steering angle with servo for horizontal turning of front lights
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. A 10K potentiometer is coupled to steering shaft. Potentiometer will generate varying analog voltage according to turning of steering. This voltage is fed to ADC and then is read by FPGA. The FPGA unit processes the input and updates the PWM width. 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 of 1ms and max of 2ms.

IV. RESULT

Fig. 7: PWM waveform with 1ms + width
The signal period is always 20ms. PWM waveform with 1ms + width (ON time) shows that servo motor is rotating at 0 degree. In this case off time is 19ms. Similarly when +width is 1.5ms, servo will rotate at 90 degree and 2ms it will rotate at 180degree.

V. CONCLUSION
The Adaptive Front Lighting System is a system which regulates automatically the light distribution of a vehicle. A specific control algorithm is developed for different driving conditions – curve roads and incoming vehicles. AFS can be formally defined as maintaining a presumptively desired light distribution adapted to the above road environment. The system tested does so by way of input from in-vehicle parameters like steering wheel angle and distance between incoming vehicle and subject vehicle etc. The horizontal headlight movement through movement of steering shaft and vertical movement of headlamp due to distance between
the two vehicles is achieved by the means of AFS system architecture. Few critical design factors considered during inception stage were ease of availability, affordability and reliability of the components use. It is also observed that the system can be accommodated in the current low cost models without major changes. AFS appears to offer potential for a favorable night driving behavior potentially reducing accident risk, compared to standard headlights. This system relies on information obtained from various sensors and considers only a next vehicle. A step forward can be achieved by adding computer vision based image processing algorithms. Instead of only fixed ultrasonic module we can add radar type mechanism to scan the vehicle coming from all directions. With this consideration, a neighboring and backside vehicle can also be traced. A second dimension may also use external input from satellite positioning (GPS or Galileo) to determine current road environment in order to control desired light distribution.

REFERENCES


