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Advanced Head-Light Controlling System for Automobile

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***Abstract*— Advanced Head-light controlling system (AHCS) aims at automatically adjusting the headlamps beam of the vehicle in a horizontal direction to illuminate the curved road ahead as much as possible without causing any discomfort to other drivers. Here, our proposed system is based on steering wheel for the headlamp's horizontal adjustment. The two lights are used in the system. One light is for the long distance beam and other light for the near distance beam. When the speed of vehicle is below threshold speed the lower light (low beam light) will be in operation and when the speed is above threshold speed, the upper light (high beam light) will be in operation. We have considered the threshold value as 50 Kmph. The LPC 2138 is used for the processing. The output from the steering wheel is given to the micro-controller and according to the movement of wheel either in right side or left side, the micro-controller drives the head-light in the respective direction. The head-light is mounted on the DC motor. Accuracy, reliability and availability of the components were few considerations during the conceptualization stage.**

Index Terms*— ADC, AHCS, AHS, AFS.

I. Introduction

Safety is the main concern when operating a motor vehicle, aside from functionality. The static headlamp just provides certain illuminating fields for drivers in the night time and is insufficient to serve for curved roads and intersection, over 80 percent of all road traffic accidents occur in darkness and bad weather.

The aim is to improve visibility for the driver, thereby achieving significant increase in road safety and driving comfort. Advanced Head-light controlling system (AHCS) swivel the headlight beams in advance of the vehicle's turning. This will place light into the turning radius, with the result that the driver's cornering visibility being dramatically improved. The vehicle's data network also contains real-time sensor data on steering angle and wheel speed. Based on this information, AHCS equipped headlamps can match the light distribution with the vehicle's turning angle so that upcoming curves and intersections receive maximum illumination, especially at the driver's gaze point. Headlamps with AHCS illuminate the curve of the road when the vehicle is turning at the curved road. Comparison of headlamp light distribution patterns with AHCS and without AHCS shows that the headlamp without the AHCS do not make the full curved road illuminated which blocks the driver from detecting any pedestrian in the way of the vehicle. The headlamp with AFS is able to illuminate the curved road fully which as a result does not block the driver from detecting the pedestrian in the way of the vehicle.

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II. Related Study

The concept of adaptive headlamps is not new in high end cars like Volvo, BMW, Audi etc. where in these mechanisms are already employed but a rather different approach have been taken in doing so. Due to sophisticated devices being used in these cars, the cost is high.

The previous work done to implement this technology used microcontrollers like PIC, externally interfaced analog to digital converters (ADCs), controller area network (CAN) bus and various types of sensors.

In one of the proposed system, a camera and ultrasonic sensors is used to adjust the headlamps horizontally and vertically [4]. This AFS uses camera as image sensor to detect and capture the details of the curved road ahead of the vehicle and Ultrasonic sensor to detect any oncoming vehicle. Image processing is done on each frame of the live scene from the camera. The following figure shows one of the frames captured and the result of the image processing done over it to obtain the angle of the white line. Angle of the white line is calculated for a single frame. The ultrasonic sensor detects the vehicle in front and PWM is generated according to the distance at which the vehicle is present.

LIN (Local Interconnect Network) based design of Adaptive Front Light System of Vehicle Using FPGA was Implemented [3]. The vehicle's motion directly influences the lighting direction of AFS (Adaptive Front-lighting System), and the effect of the vehicle dynamics on the swiveling headlamp can be simulate. It was concluded that when vehicles move on curved roads, the front light longitudinal distance was controlled by the safe stopping distance, the horizontal angles of front light are controlled by the changing value of drivers' visual angle, the front wheel swing and side-slip angles, and the vertical irradiation angles were controlled by the lateral roll angle of the object supported by suspension springs.

In 2014, the system was developed which functions in accordance to the controlled input from Atmel AT89S52 microcontroller unit which drives the stepper motors connected to the headlights [5]. The system is also designed to receive input from the indicator switch wherein a full turn is achieved by the headlight mirror when the indicator input is given. Also, the adaptive headlights are automatically switched on when the amount of light measured by a photo diode falls below a threshold, thereby eliminating the need for the driver to switch on the headlights.

The module of turning light control takes effect when velocity is under 50km/hr, so it doesn't take action in freeway. Audi has employed a suit of forwardly active assistant lighting system on curve roads, which helps to illuminate the turning area.

III. What Is Advanced Headlights

Advanced headlights are an active safety feature designed to make driving at night or in low-light conditions safer by increasing visibility around curves and over hills. When driving around a curve in the road, standard headlights continue to shine straight ahead, illuminating the side of the road and leaving the road ahead of you (on curve side) in the dark. Advanced headlights, on the other hand, turn their beams according to your steering input so that the vehicle's actual path is lit up.

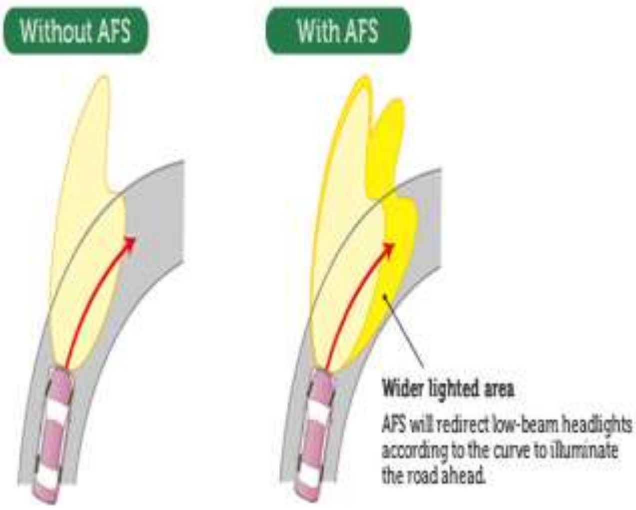

Figure 3.1 Vehicle with adaptive headlight and without advanced headlight

IV. Hardware

In the proposed system LPC2138 microcontroller is being used which is based on 16/32 bit ARM7TDMI-S CPU with high speed flash memory ranging from 32kB to 512kB. Serial communication interfaces, multiple UARTS, SPI, 10-bit ADC, 10- bit DAC, PWM channels and fast GPIO lines are some important features of the controller for which the LPC2138 was chosen. For rotation of Headlight DC motors were selected as they are more suitable for the AHCS system design.

V. Block Diagram and Algorithm For System

The block diagram shows the complete system. It contains the LPC 2148controller, DC motor, potentiometer for speed and steering direction and headlight.

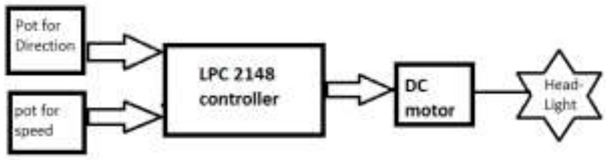

Fig 4.1 Block Diagram of the System

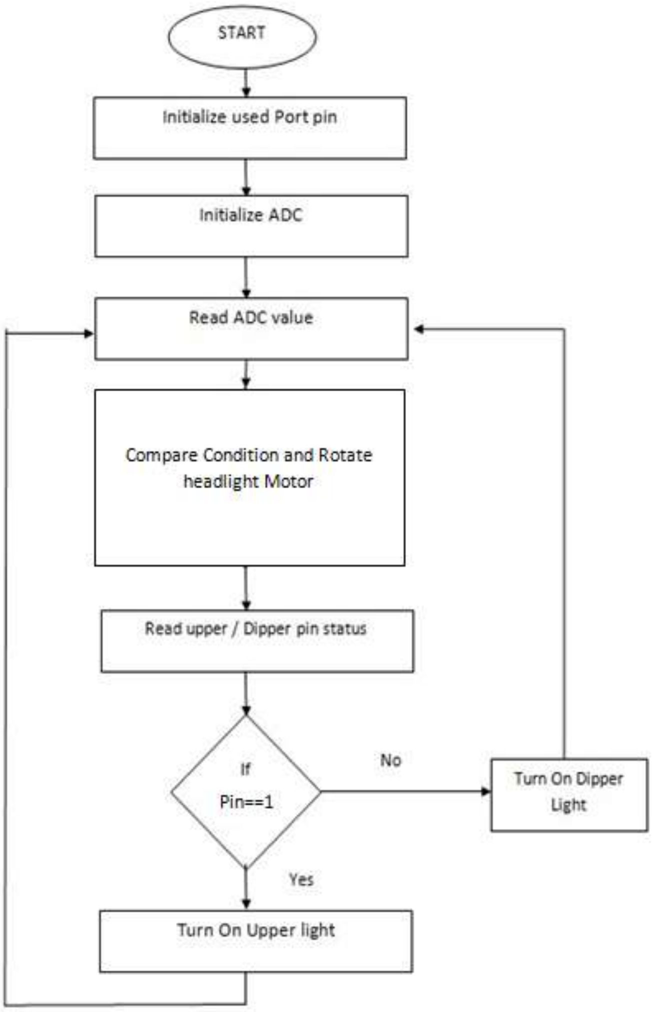

Fig 4.2 Algorithm Flowchart for System

VI. Result

The system is developed for the horizontal movement of the head-light. The system also turns on upper and dipper light according to the speed of the light.

Initially the controller reads signal from both the potentiometer. One potentiometer is for speed variation and other potentiometer for the turning of the vehicle. If there is change in the steering of the vehicle, the ADC reads the changes and accordingly changes the direction and motion of the vehicle. The various ADC values and their respective change in the turning are calculated. This is shown below. If the analog voltage is from 0.1 V to 0.15 V, motor is rotated in full right direction. In next voltage range from 0.16 V to 0.25 V, the motor is rotated in right 300, and so on. The digital equivalent values are also calculated in the A.D.C.

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SR. NO.	ANALOG VOLTAGE	DIGITAL VALUE	MOTOR STATUS
1	0.10V TO 0.15V	1 TO 5	FULL RIGHT
2	0.16 TO 0.25V	6 TO 12	RIGHT 30 DEGREE
3	0.26 TO 0.30V	13 TO 16	RIGHT 15 DEGREE
4	0.31 TO 0.50V	17 TO 25	NO CHENGE STREET
5	0.51 TO 0.56	26 TO 32	LEFT 15 DEGREE
6	0.57 TO 0.63	33 TO 36	LEFT 30 DEGREE
7	0.64 TO 0.68	37 TO 41	FULL LEFT

Table 6.1 Steering Control of the Vehicle

The above table shows the movement of the head-light in the horizontal direction. To control the head-light direction, the various parameters are required to maintain. These parameters are shown below in the table. The comparator reference voltage is 2.4V.

Fig 6.1: Developed System

CONCLUSION

In this project, we study on the control principle of the advanced head-lighting system (AHCS) of automobile at the bend, established the model about this system, and gave the system's overall design. The entire system consists of 5 modules: the sensor module, signal conditioning circuit module, the central controller module, D. C. motor drive module, power supply and power protection modules. In this article, we describe the various hardware performance and the algorithms of the software. The pilot test showed that this system reached the performance requirements of vehicle's advanced curve lighting system at night and had important reference value for improving the advanced curve lighting effects and traffic safety at night.

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