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Development of Automobile Headlight

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***Abstract*—A Light Emitting Diode (LED) is a semiconductor device which converts electricity into light. LEDs are preferred over incandescent lamps because of their long life and their availability in various colours and brightness levels. The aim of this paper is to present the development of vehicle lighting system using LED application. In this system, high power LEDs type is chosen as automobile headlight model and controller circuit using microcontroller is considered.**

***Index Terms*—LED, lumen, LED brightness, PWM, buck converter.**

I. Introduction

Traditional headlights consist of a small number of lamps with simple optics to direct a light beam onto the road. Starting with gas/oil lamps in the 1880s, research has been primarily geared towards developing headlights that can be electrically controlled, have a long working life, and are bright and energy efficient. In 1994, Hewlett-Packard increased the efficiency of the LED in ten times the efficiency of a filtered light bulb. These latest sources provide bright and comfortable colour temperatures improving driving experiences. However, even with these new light sources the only control offered to a majority of drivers is to switch between high and low beams. LED vehicle forward lighting systems are a natural progression in this line of source and optical design advances. The development of white LED technology with increased lumen output per device, and the promise of further light output increases in the near future, has led to the consideration of LED sources for use in vehicle forward lighting. LED sources potentially offer several advantages for use in automotive applications. These include longer life, greater robustness, lower power consumption, and design flexibility.

II. Methodology

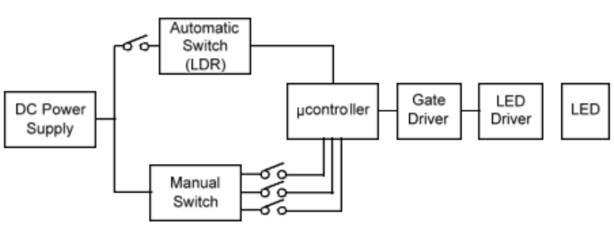

Fig. 1. Methodology

The design concept of the system in controlling brightness of LED is shown in Fig. 1. The system consists of three main parts which are controller circuit, gate driver and LED driver. These parts are used to build up the system of automotive lighting.

TABLE I
DATA FROM CIRCUIT SIMULATION AND HARDWARE MEASUREMENT

Circuit Simulation				
Duty Cycle	**V_{LED} (V)**	**I_{LED} (A)**	**Power (W)**	**Luminous Flux (Lumen)**
80%	5.16	0.98	5.12	N/A
40%	3.93	0.57	2.27	N/A
20 %	2.95	0.25	0.74	N/A
Hardware Measurement				
Duty Cycle	**V_{LED} (V)**	**I_{LED} (A)**	**Power (W)**	**Luminous Flux (Lumen)**
80%	3.44	0.59	1.84	0.88x145=127.6
40%	1.72	0.28	0.49	0.46x145=66.7
20%	0.86	0.15	0.13	0.22x145=31.9

III. Demonstration on the Road

The system was tested on the road at night with three oncoming vehicles show frames captured from inside vehicles driving towards the programmable headlight. In Fig. 2, the blinding glare as the vehicles near each other is shown. Figure show the benefit of our anti-glare headlight. Clearly, the difference in visibility is significant allowing drivers to see the road, vehicle, and surroundings.

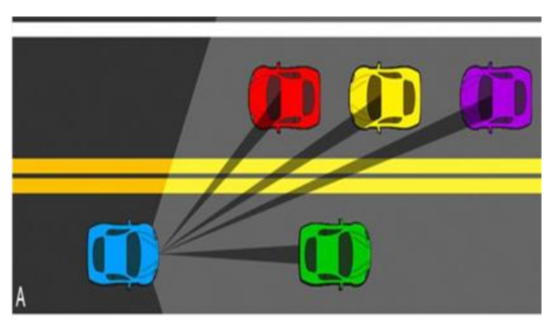

Fig. 2. Blinding glare

IV. Improving Visibility During Snow Storms

Driving in a snowstorm at night is incredibly difficult and stressful. Snowflakes are illuminated brightly and distract the driver from observing the entire road. We can address this problem with a solution similar to that for anti-glare, i.e., reacting to detected bright objects. The main difference, however, is that the density, size, and speed of snowflakes requires high-resolution, low-latency illumination to be effective. Therefore, we exploit the high-resolution and fast illumination beam control of our prototype to distribute light between falling snowflakes to reduce backscatter directly in the driver's visual field. As shown in Fig. 3.

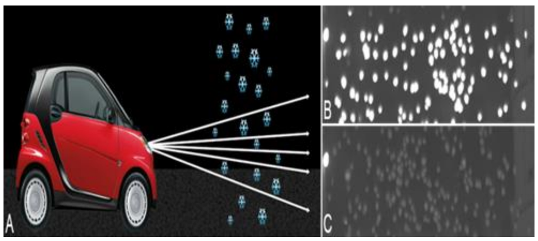

Fig. 3. Improving visibility during snow storms

V. Improving Lane Illumination

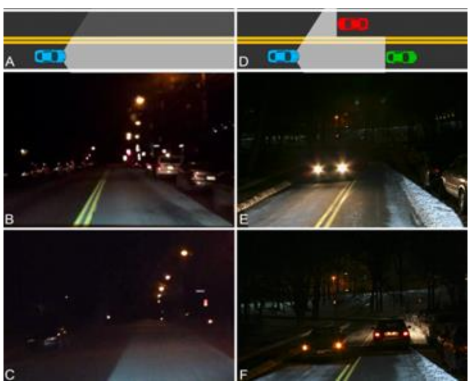

Fig. 4. Improving lane illumination

Sometimes the road is not clearly visible and no amount of illumination from a standard headlight can assist the driver. A few examples of such situations are snow covered roads, roads without lane markings or shoulders, and poorly lit roads. In Fig. 4, the driver's lane and lane markings are fully illuminated, and the adjacent lane is dimly illuminated. The same contrast is used while driving on a dark, unmarked road in Figure 3. The opposing lane is dimly illuminated while the driver's lane remains fully illuminated creating a demarcation line for the driver to follow.

VI. Conclusions and Future Scope

The automotive headlight should not be a passive device that can only be completely switched on or off. It should be capable of adapting to the environment to improve safety in poor visibility conditions. Moreover, the design for adaptive headlights should not be limited to a single task. It should be capable of per- forming many different tasks to help the driver in multiple road environments. The brightness of LED can be controlled by adjusting duty cycle of the generated PWM (Pulse Width Modulation) signal.

Acknowledgement

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