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Driver Circuit for White LED using PWM Technique

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Abstract- This paper describes a system based on driving a white LED's (Light Emitting Diode) using PIC18F1330 Microcontroller. It deals with the implementation of the driver circuit used for the white LED. This system shows a good result with respect to the threshold of the white LED temperature, life time of white LED and current through the white LED, which is the most important factor. The system also describes about how to regulate the variation of current through the white LED by the immense help of the PIC18F1330 microcontroller. The PWM (Pulse Width Modulation) technique provided by microcontroller is in tandem with the driver circuit used to drive white LED under observation. This system comment regarding the nonphysical nature for the analysis and it is also well compatible with conventional HID lamps and offline applications. The proposed system well describes the nature of duty cycle control through PIC18F1330 Microcontroller.

Index Terms- LED, PIC18F1330, PWM, Duty Cycle

I. INTRODUCTION

In recent years, Light Emitting Diodes (LEDs) have become a viable alternative to conventional light sources. Several factors have lead to the displacement, in ever increasing numbers, of incandescent bulbs. LEDs present the following advantages.

• Extremely long life approximate 100,000 hours. However, lamp life must be redefined for LEDs as a lamp module is composed of many LEDs, when one LED fails there are many more them for back-up.

• Extreme robustness: As there are no glass components or filaments they are virtually insensitive to vibration and movement.

• A modular construction, which can be chosen to provide any required shape or light output.

• Relatively high efficacy compared with other coloured light sources as there is no need for coloured filters.

• No UV or IR output.

• They can be dimmed smoothly from full output to off. The LEDs are solid state components, so they do not have fragile envelop, are not filled with toxics gases, do not have any explosion, broken or contamination possibility. They are solid state components. So, they are very robust [4].

Their characteristics allow to generated light and does not extinguish subtly. The light will present a gradual intensity reduction over time. They have longer useful life than incandescent lamps and discharge lamps. [2]

A. BOOST-BUCK^2 AS LED LAMP DRIVER

Figure1 shows the schematic of the boost-buck2. This topology presents non-pulsating input and output current and operates as a boost-quadratic buck cascade converter with the advantage of using single active switch. Static gain (G) is derived assuming that the converter operate in the continuous conduction mode (CCM). All capacitor voltages and inductor currents are dc quantities with a relatively small superimposed ac ripple. Turn-on and turnoff transitions of all diodes are synchronous with switching transitions of the switch S. In the following discussion, for simplicity, we assume that ac ripples in capacitor voltages and inductor currents are entirely negligible. The boost-buck2 converter has two stages of operation on CCM.

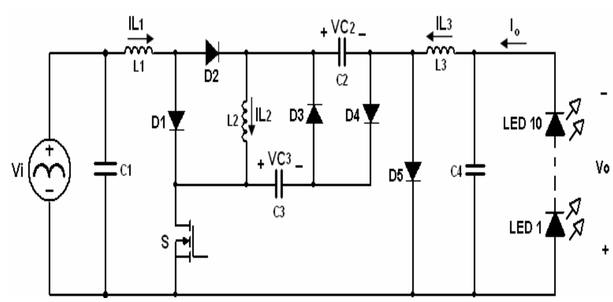

Figure 1: Schematic boost-buck2 Converter

First Stage: When the switch S is turned-on, thus the diodes D2, D3 and D5 are turned-off while the diodes D1 and D4 are turned-on. The inductor L1 store energy supplied by input voltage Vi while inductors L2 and L3 store energy supplied by capacitors C2 and C3 respectively and the LED lamp is supplied by capacitor C4.

Second Stage: When the switch S is turned off, figure 3, thus the diodes D1 and D4 is turned-off while the diodes D2, D3 and D5 are turned-on. As shown in figure 2,the capacitors C2 and C3 store energy supplied by inductors L1 and L2 respectively while the LED lamp is supplied by inductor L3 and capacitor C4[3].

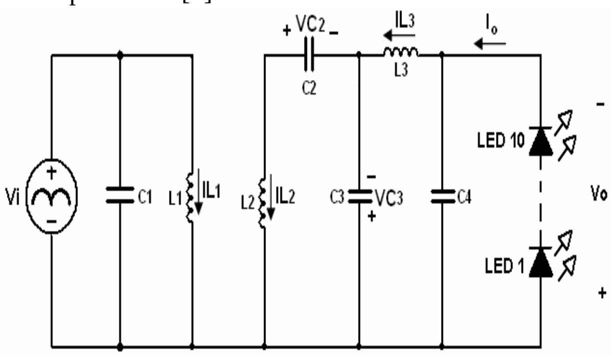

Figure 2: Stage 2 of boost-buck[2]

B. CONTROL STRATEGY OF BUCK BOOST[2]

Figure 3 shows the schematic of the converter with the control circuit. There is a direct relationship between the LED junction temperature and the permanent loss of light output over time. Running XLamp LEDs at higher junction temperatures will decrease the useful LED lifetime. In general, the following three system-level factors greatly influence the LED junction temperature:

•Operating current;

•Ambient temperature;

•Thermal resistance of the thermal path to the ambient environment;

Therefore, the strategy used controls the average current in LEDs and consequently the luminous flux of the same.

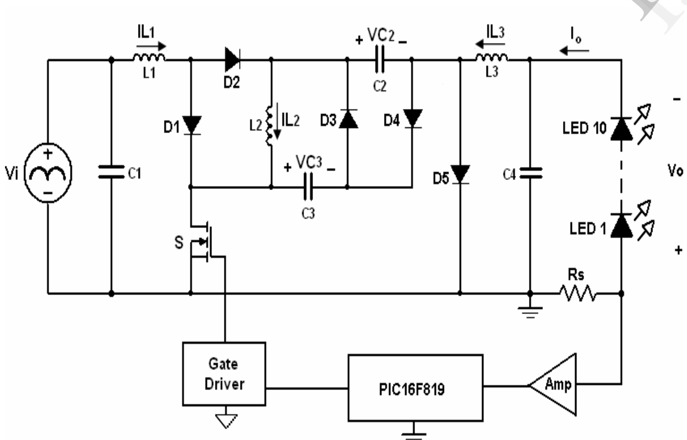

Figure 3: Control Circuit for boost-buck2

It is important to note that current from this system is physically controlled. Figure 3 shows the algorithm of control used in the driver. The value of the current is sampled through resistor Rs which is in series with the LED lamp and applied to port AN0 of the PIC16F819 [1].

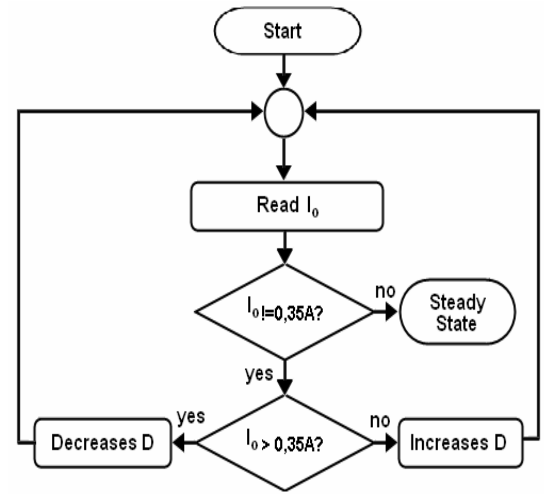

Figure 4: Control Algorithm

This value is compared with the reference in accordance with the source code of the microcontroller. If the average current is greater than the reference value, the duty ratio decreases, otherwise, the duty ratio increases.

II. PROPOSED SYSTEM

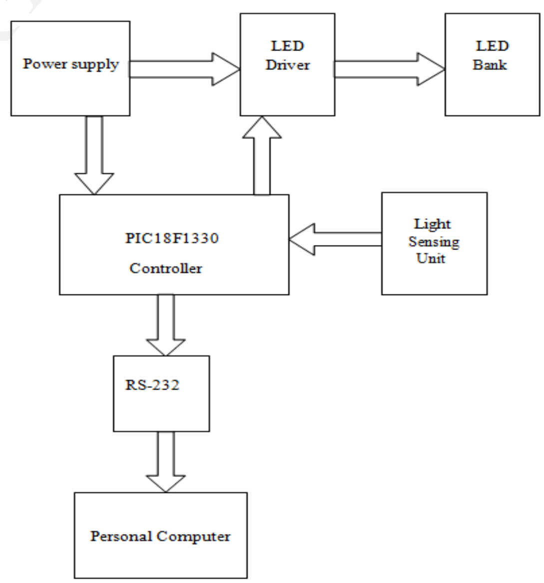

Figure 5: Proposed block diagram

The figure 4 shows use of the PIC microcontroller to control the driver circuit. As shown above input from the light sensing circuit is applied to the microcontroller, by which the controller takes an appropriate action in accordance with the built code. The output provided by the controller will also obtain on the personal computer through the Line converter with RS232 protocol. [5]

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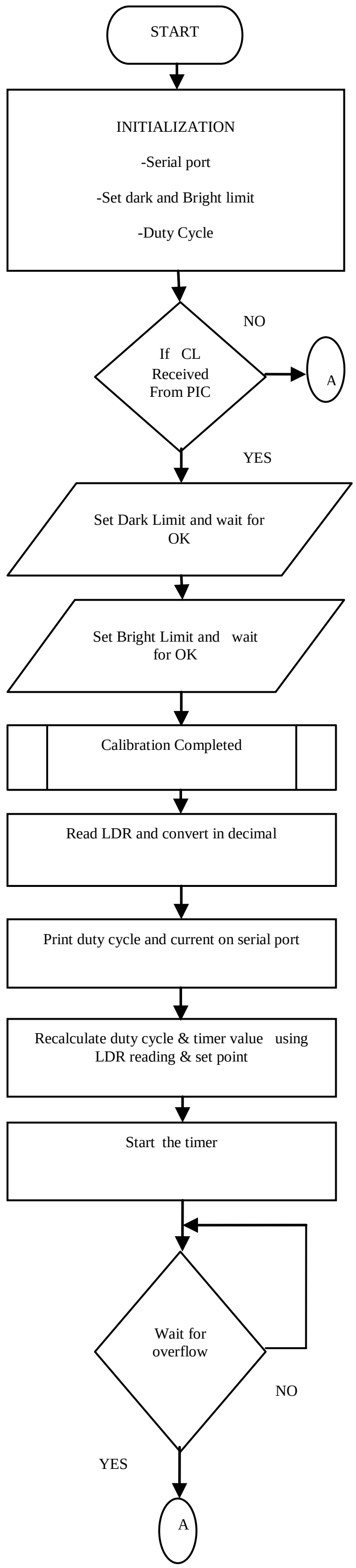

Figure 6: Flow diagram of the proposed system

III. ANALYSIS

The proposed system well defines structure of the control provided by the effective use of the PIC Microcontroller. The system suggests the use of non physical method for the analysis of the rated current through the White Led's. It also suggests that as soon as the Illuminance is increased (by using the lamp source) it causes the Duty cycle to reduce effectively through the moderate control.

IV. RESULT OBTAINED FOR THE SYSTEM

Sr.No	No. of Lamps ON (Source)	Illuminance (Lux)	Duty Cycle
1	0	36	100
2	1	102	70.04
3	2	120.5	64.86
4	3	196	52.37
5	4	234	44.39
6	5	350	33.62
7	6	512	24.78
8	7	626	14.65
9	8	813	9.91
10	9	1031	3.42
11	10	1265	2
12	11	1581	0
13	12	2010	0
14	13	2070	0

Table 1: Lux and Duty cycle response with the source

As Table 1 shows the response of the overall system if Illuminance is increased duty cycle is decreased, which is under the control of PIC Microcontroller. The Table 2 and Figure 7 show the results by comparing the Illuminance and the conversion factor with respect to the proposed system.

Sr.No	Lamp Type	Illuminance (Lux)	Conversion Factor
1	H.P.S.V. Lamp 70 W	1312	5.512
2	H.P.M.V.Lamp 125W	1547	6.5
3	C.F.L.45 Watt	971	4.07
4	C.F.L.45 Watt	733	3.07
5	C.F.L.45 Watt	620	2.60
6	C.F.L.45 Watt	680	2.85
7	Incandenscent lamp 60W	716	3.00
8	C.F.L.45 Watt	240	1.00
9	Fluroscent Lamp 40W	507	2.13
10	LED Bank	238	1

Table 2: Lux and Conversion factor response with Lamp

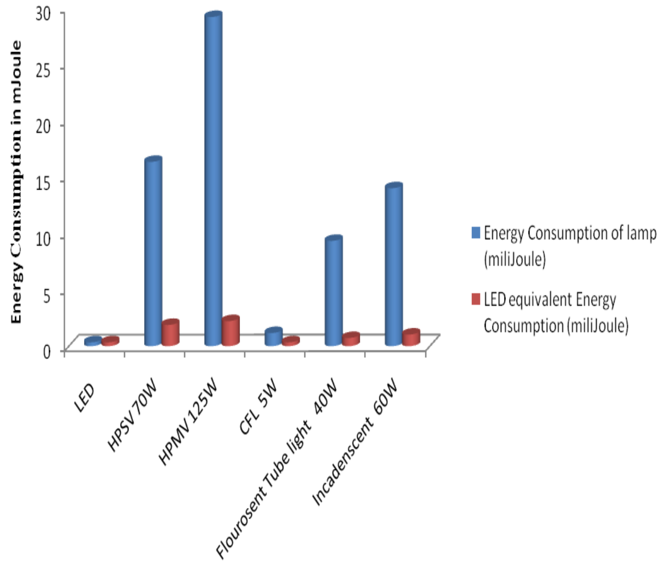

Figure 7: Comparison of results with different lamps

Figure 7 shows the comparison of results with different lamps in terms of energy consumption. As provided by the same energy consumed by the HPMV is quite larger than that of due to the fluorescent tube light and the HPSV.

IV. CONCLUSION

This paper presents the effective way of driving the White LED's through the moderate control of the current using PIC18F1330 Microcontroller. The system also well protects the White LED's and increases life time of the same. The characteristics and the performance of the system explain regarding the Conversion factor depending on the lamp type. Moreover the power quality parameters are also well analysed in the proposed system with respect to the Duty cycle. In the proposed system the PWM technique is been operated through the PIC18F1330 Microcontroller.

V. REFERENCES

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