A David-Star Magic Square Algorithm for Efficient LED Control

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Abstract: In this paper, we propose a David-Star Magic Square Algorithm for Efiicient LED Control. Existing Lighting system has reduced power consumption and Heat. And it increased the life of the LED module. However light fixtures, there is a limit in accordance with the form and balance of illuminance distribution. Proposed a David-Star Magic square algorithm for efficient LED control is efficience of power consumption, Heat, module life and illuminance distribytion. This paper, the proposed algoritme is arranged twelve sub-module of David-Star frame in 16x16 LED DotMatrix. And the proposed method create a pattern through a specific time interval. Comparison of the conventional lighting system and method using a magic square increased the efficiency of the control

Keywords— **LED, lighting, algorithm, magic square, Illuminance distribution**

1. Introduction

Recently LED developments are known to account for large part of improve energy efficiency because the rapid increase in energy consumption is performed environmental regulatory regime to regulate the use of toxic substances in electrical and electronic products, such as environmentally friendly policies and reduce greenhouse gas emissions. Energy-saving technologies for lighting research and development needs of such highly efficient light source, low lighting (dimming) control is emphasized. Low-power lighting control technique refer to a technology for controlling which is based on the information of illumination, occupancy, temperature of sensor. Recognized as an important technique for the improvement of the illumination efficiency, and effective energy-saving operation. The Relevant research proceeds in great interest.

Low-power LED lighting control method is a method using a magic square to increase the power consumption, life time and Heat Efficiency of lamp. Generic LED lighting control method used a magic square to solve problem of the lamp life, Heat, a change in the Luminous flux. This method used a magic square of the square shape in LED lighting however, LED lighting device has a different shape as well as square. Method Using the magic squares are not suitable for LED lighting devices apply. Solution to this problem used a non-magic square square.

Method using a magic square for energy efficiency is different from the conventional method, and select the magic square of the star shape. the proposed method is placed twelve sub-module in 16x16 LED module. Because it can have a stable lighting control through the reduction of heating value and the balanced illumination distribution when using the character of the star of David magic square. In this paper we propose to supplement the shortcomings of Conformity, unstable illuminance distribution in accordance with the existing lighting fixtures.

2. A David star magic square algorithm for efficient LED control

The magic square is to be arranged in a square shape means that the horizontal, vertical, diagonal created by the sum of the numbers so that they have the same arrangement. If the meaning of the square is missing in the magic square, some form of an array of numbers generated? The results can be found in the ancient books of China. Results can be found in the book of China against which the non-magic square present a square shape. Some characteristics such as having a square shape and utilize method can be efficient LED lighting control. The form of a square is an efficient LED lighting control in a way to take advantage of some characteristics.

2. 1 Concepts and features of the magic square Star of David

In this paper, Method using a magic square for energy efficiency is different from the conventional method, and select the magic square of the star shape. Magic square Star of David are placed two crossed triangles and The six corner points star shape. And it refers to the sum to be the same as all of the four sides in each of the 12 numbers arranged.

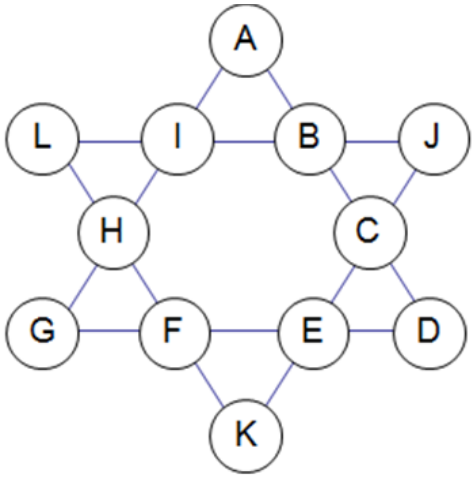

Figure 1. David Star Magic Square

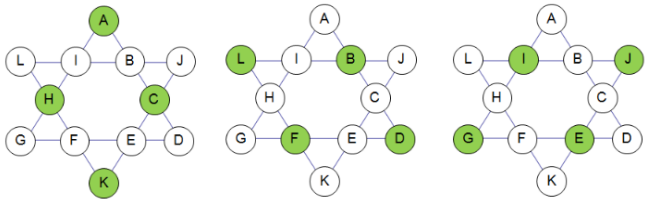

Figure 2. Features of a/the David star Square 1

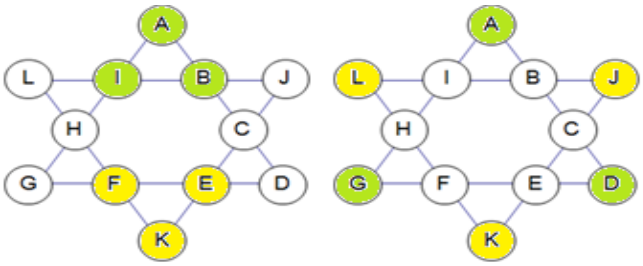

Fig. 3. Features of a/the David star Square 2

Figure 2 is a trapezoid which is the sum of four corner points 26, properties of magic square Star of David. (a), (b), (c) Pattern because it has the same value, it can have three different patterns in the LED lighting control. Figure 3 consisting of three corner point the large or small triangles is created three pattern using sum of the three corner points.

2. 2 Lighting control algorithm structure of the magic square Star of David

Light using a proposed algorithm approach is to light by placing the structure in the form of the algorithm by dividing the sub-modules of 4x4 to 16x16 LED type high power LED 12 to the zone as one zone. Figure 4 is view showing a sub-module of the algorithm structure section disposed on the LED module. In addition to those arranged in the other zone 12 zone is to light up in a way that independently controlled.

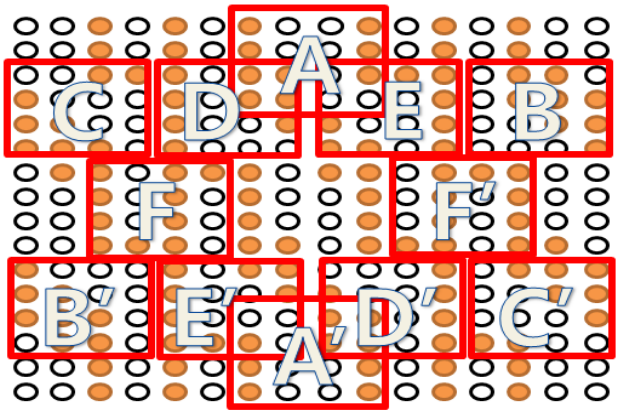

Figure 4. Disposition of twelve sub-module

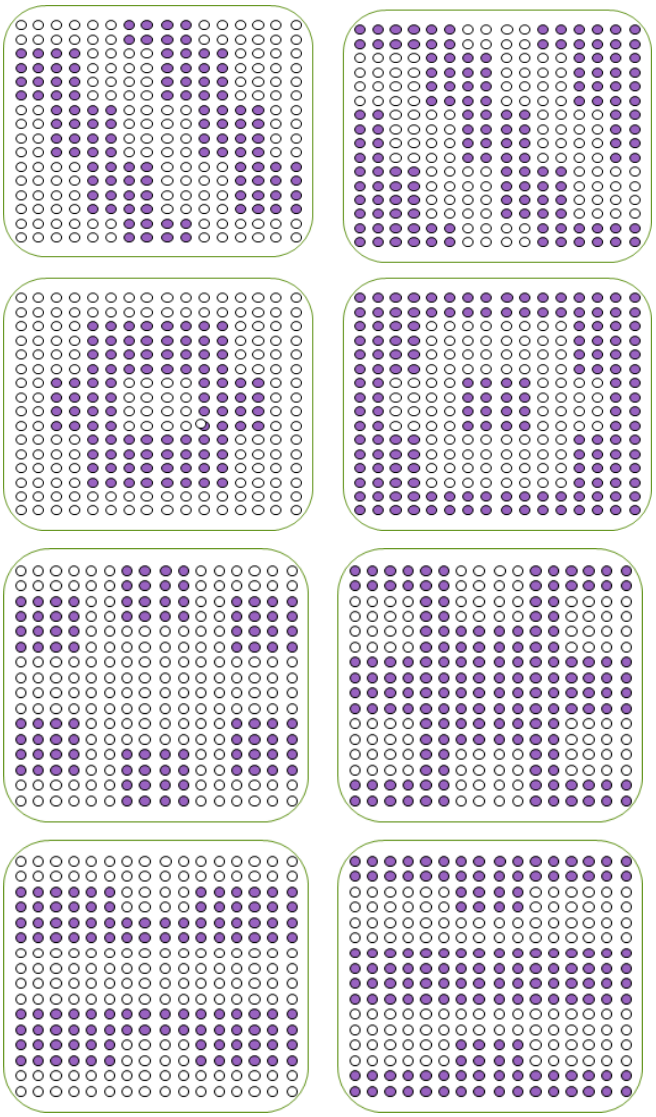

Figure 5. Application LED Matrix of a David Star magic square

Making use of the property of David star magic square algorithm proposed various types of pattern vertically and horizontally, such as lattice pattern, a hexagon, a triangle, the triangle of the diagonal can be generated to determine the simple lighting method of the 12 sub-module and the other areas. Algorithm lighting the proposed method reduces the frequency of use to reduce the number of LED used, whereby the heat output of the LED decreases and may have a stable lighting control through increased and balanced structure of the life of the LED. Also, it can overcome the limitations under the form of a magic square luminaire with a square shape.

Figure 6. A David Magic Square Algorithm Flowchart

Lighting control system using the magic square Star of David are the start of initialization and timer settings of the LED. And receiving a value from the illuminance sensor and have light with a pattern created at regular time intervals through an algorithm lighting pattern generation process to check the day and night, to offer to the interaction with the environment, if the check is low from the light sensor and light ends. Figure 6 is a flow diagram on the left of the flow chart is the overall lighting control system flow chart, the right flow chart is a flow diagram for generating pattern of the proposed algorithm.

3. Experimentme

LED used in the LED light bulb was select the high-power white LED of large low heat resistance and high light flux 30 (lm) for 1W of power consumption, Table 1 shows the properties of these high-power white LED.

Table 1. Characteristics of high power 1W white LED

I_F[mA]	V_F[V]		Color Temperature [K]	View Angle [°]	Luminous Flux [lm]	
	typ.	max.			min.	typ.
350	3.4	4.2	5,000	100	20	30

Also Experiment were 16x16 LED module in the context of a parallel form, was tested by the general lighting system control (1) and the lighting system using the magic square of the square shape (2) Finally, by using the lighting star of David magic square method (3).
Table 2 shows a comparison of the three lighting system (1) and (2), (3).

Table 2. Differences of Three Lighting System

case	(1)	(2)	(3)
LED(ea)	256	256	256
action LED(ea)	256	128	64 ~ 160
Power Consumption (W)	12.5	6.2	3.1 ~ 7.8
Heat(℃)	76	61	42 ~ 55
Luminous flux (lm)	79	62	32 ~ 67
Luminaire types	–	Square	–
Illuminance distribution	Very High	Low	High

4. Conclusion

In this paper, we propose a David star magic square algorithm for efficient LED control. In order to solve the problems such as service life of a typical lighting control system power consumption, heat generation, the lamp used, but the magic square, magic square is a square shape does not meet the diversity of the type of LED lighting device. Therefore, use a star structure of the magic square Star of David. Suggest that the algorithm is high-power white 1W LED for using a parallel structure of 16x16 LED module 4x4 LED sub-modules of one of the region as 12 the area of star structure placed in the algorithm structure of the area and the non-section of the lighting control via lighting pattern this generation and has a brightness distribution over the safety and efficiency, balanced structure of the control. Algorithm of this paper illuminates the number of LED more lighting scheme using the magic square of the general lighting system with square shape is limited to 37.5 ~ 75% but the Luminous flux of light is reduced by about 13.7 ~ 50% power consumption is about 35.7 ~ 76% was reduced, heat generation is reduced about 26%. As a result lighting control algorithm using the magic square Star of David, which is proposed in this paper will be expected to contribute to improved application of the gender-efficient lighting system and lighting-related industry.

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