Design and Experiment of Laser Induced 10 × 10 Array LEDs Interactive Electronic Drawing Board

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Abstract: In this study, the laser induced 10 × 10 array LEDs electronic drawing board is successfully demonstrated. The circuit lay-out contains several simple optoelectronic components, such as LEDs, photoresistors and relays. The experiment results reveal that the variable digital numbers can consequently be drawn on this electronic drawing board. Due to higher collimation of laser light, the painting can be drawn in the correct location and the long distance painting is achievable. Most importantly, this design will bring us the function of interaction on the large outdoor LEDs display; people are able to draw any pattern on it whenever we like. [Jiann-Hwa Lue, Shen Cherng, Shuan-Yu Huang, Tai-Chuan Ko, Rong Seng Chang, Ting-Jou Ding, Wen-Ming Cheng. **Design and Experiment of Laser Induced 10 × 10 Array LEDs Interactive Electronic Drawing Board.** *Life Sci J.* 2014;11(5):425-427] (ISSN:1097-8135). http://www.lifesciencesite.com. 59

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1. Introduction

Within a time frame of about twenty years, due to the advancing optical and electronic technology, large outdoor displays have become very popular in many commercial applications, for example, automotive design, building architecture, outdoor movie, scientific visualization, etc. Large, high resolution displays may be hung on walls and built into tables to create "smart spaces" that allow new methods of collaboration, visualization, and interaction.[1] [2] Many researchers have constructed large displays with various hardware configurations, from multi-monitor configuration to tiled LED panels or seamless displays. [3]

Large interactive displays have potential to change the way of which people interact with computers, so many researchers are interested in this field. [4,5,6] There are two typical interactive ways, one is using camera to catch the digital image (indirect way), and the other is using materials to touch the display (direct way). [7,8] The second one (direct way) has more precise interaction location than the first one (indirect way), but it is still limited by the sensing distance. So, the indirect way is a better choice for the outdoor interactive display. For the indirect interactive way, cameras are able to capture the dots extracted by laser pointers and then transmit its image signals back to computer so that the response cursor can be identified on the display. However, the locations of cameras still limit the interaction applications. Last time, we have proposed a brand new way of optical induced LEDs approach to solve this problem.

In this article, the continuous study of laser induced 10 × 10 display drawing board is demonstrated. By using the simple circuit design, the variable digital numbers can consequently be drawn on our LEDs electronic drawing board. Due to laser higher collimation features, the precise and long distance drawing on outdoor displays become feasible.

2. Principle of relay and light-sensitive resistors

Relays are electrically actuated switches. The three basic kinds of relays include mechanical relays, reed relays, and solid-state relays. Typical mechanical relays are designed for switching relatively large currents. They come with either DC (direct current) or AC (alternative current) coils. DC-actuated relays typically come with excitation-voltage ratings of 6, 12, and 24V DC, with coil resistances (coil ohms) of about 40, 160, and 650Ω respectively. Actuated relays typically come with excitation-voltage ratings of 110 and 240V AC, with coil resistances of about 3400Ω and 13600Ω respectively. Switching speeds approximately range from 10ms to 100ms, and current ratings range from about 2A to 15A. [9]

Photoresistors are made from a special kind of semiconductor crystal, such as cadmium sulfide (for light) or lead sulfide (for infrared). Photoresistors are light-controlled (or light-dependent resistor, LDR) variable resistors. In general, a photoresistor usually has as high as a few mega-ohms (MΩ) in the dark. However, when it is illuminated, a photoresistor may drop as low as a few hundred ohms. When this semiconductor is placed in the dark, electrons within the structure cannot flow through the photoresistor because they are strongly bound by the crystal's atoms. However, when illuminated, incoming photons of light collide with the bound electrons, driving them from the binding atom, thus creating a hole in the process. These liberated electrons can now contribute to the current flowing through the device (that is, the resistance goes down).

Photoresistors are sensitive to specific optical frequency (or wavelength). By illuminated with certain light frequency, the bound electrons of the photoresistors will absorb enough energy to jump into the conduction band. Then, free electrons will increase its conductive electricity and lower its resistance. Moreover, particular photoresistors may react differently to photons within certain wavelength bands. For example, cadmium sulfide photoresistors respond best to light within the 400-nm to 800-nm range.

In terms of applications, photoresistors are used in light-activated and dark-activated switching circuits and in light-sensitive detector circuits.

3. Electric circuit design and Setup

Experimental LEDs device unit contains LEDs, light-sensitive resistors (CDS) and relay. Direct current will be supplied through the network by the power supply. CDS is used as an optical energy receptor. Relay is used as an ON / OFF switch for a particular trigger controller. Laser provides illumination light energy to trigger the circuit ON.

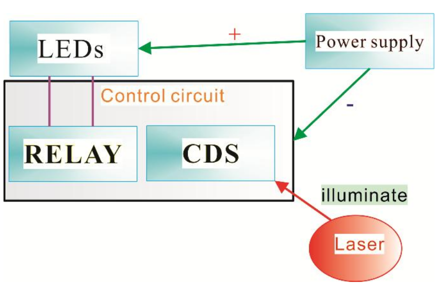


Figure 1. The design circuit of the experiment. There are several main components including: LEDs, light-sensitive resistors and relay.

Circuit schematic diagram of LEDs is shown as figure 2. It shows that the LEDs lighted up by laser illumination. The mainly used types and characteristics of electronic components in this experiment include relay (RY5W-K, LEG-5), blue LEDs, light-sensitive resistors and power supply.

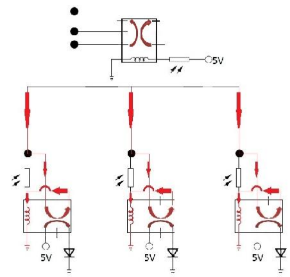


Figure 2. The experimental circuit schematic diagram of the LEDs

The design process diagram is shown as figure 3. The relevant experimental procedure steps are as follows:

Step 1: Control circuit design.
Step 2: Electronics and photoelectronics components Selection.
Step 3: 10 × 10 array LEDs design
Step 4: 10 × 10 array LEDs test and debug.
Step 5: 10 × 10 array LEDs drawing board assembled.
Step 6: LEDs electronic drawing panel experiments.

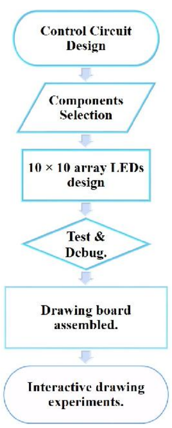
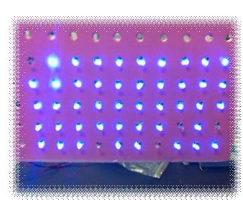
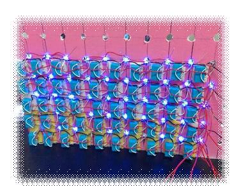


Figure 3. Design process diagram.

The simple test board of 10×10 LEDs electronic circuit is shown as figure 4. It is composed of 100 LEDs, 101 photoresistor (CDS), 101 relays. Each LEDs is connected with one relay and one CDS. When CDS is illuminated by laser, it will trigger the LEDs lighted. The 101th CDS and relay are used as main ON/OFF switch of the panel.

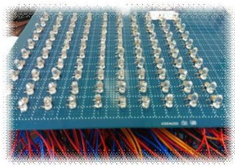


Front.

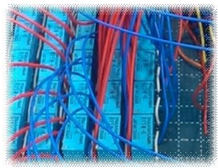


Back.

Figure 4. Simple test board of 10 × 10 array LEDs electronic circuit.



Front.



Back.

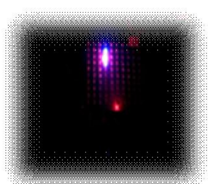
Figure 5. The assembled 10 × 10 array LEDs electronic drawing board and its circuit.

After the drawing panel is repeatedly testing and correction, the final assembled 10×10 array LEDs electronic circuit board is shown as figure 5.

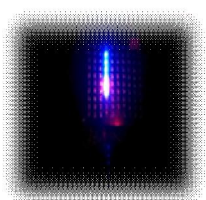
Experiment Result and Discussion

Figure 6 shows the drawing process of the assembled 10 × 10 array LEDs electronic board. Figure 6(a) to (c) are drawing process of number ten on the electronic drawing board. Figure 6(d) is the final results of variable digital numbers (1 to 9) on the electronic drawing board.

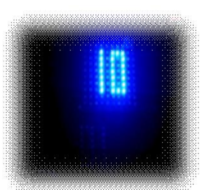
The results are shown as figure 6(c) and we can successfully draw the digital number (10) on our 10 × 10 array LEDs electronic drawing board. Moreover, the variable digital numbers (1 to 9) could be clearly drawn on it as figure 6(d). Meanwhile, the 101th CDS and relay are used as main ON/OFF switch to turn ON/OFF the electronic drawing board so that we can draw different number one by one on the panel.



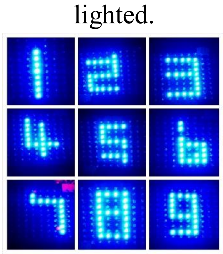
(a) 3 LEDs are lighted.



(b) 7 LEDs are lighted.



(c) 23 LEDs are lighted.



(d)Variable digital number test.

Figure 6. The drawing test of 10 × 10 array LEDs electronic drawing board. Figure 6(a) to (c) are drawing process of number ten (10) on the electronic drawing board. Figure 6(d) is the variable digital number drawn one by one on the electronic drawing board.

Conclusion

In this study, the laser induced 10 × 10 array LEDs electronic drawing board is successfully proposed. With the simple circuit design, the variable digital number can consequently be drawn on our LEDs electronic drawing board. The experiment shows that laser light possesses higher collimation so we can have our drawing in precise location no matter in short or long distance. Furthermore, while we utilize it on large outdoor display for commercial purpose, it will help us for cost saving since LEDs are energy saving; most importantly, this design will bring us the function of interaction so we can do real-time editing or revision whenever we like. As a result, the practicality of large outdoor display will be increased.

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