1.introduction

1.1 Objective

In the photography industrial, there is new trend of playing with the LED light. Some photographer use led light to take some shots. In those pictures, result of the light effect are perfectly displayed. I can give an example about the result of using the LED light.

Figure 1: Rick Kessinger Studio Automative

From the above figure, we can see that the curve of the car is perfectly displayed in the picture. This picture has no following editing, and all shooting is done by the one shot. Many people still don't believe that a single shot can be that impressive, but those shots can be possible with the usage of LED lighting. In that case, it's so meaningful to upgrade the LED lighting device.

Our main goal of this project is to add some control units into LED strip and make it more functional and easy to adjust settings. Also we are going to implement the battery to the device, so people can carry this device outdoor. For the control unit part, we are going to implement both hardware and software control units. We will use the potentiometers and transistors circuits to control the dimmer of the LED. Also we will use the CPU and shift register chips to build the memory. For the battery part, to ensure the battery will deliver the stable voltage, we will implement the voltage converter.

1.2 Background

We did the research about the price of each elements. For the CPU and the shift register chips, I think we can get it from the Digital signal processing lab. We will order the LEDs on line, the model we choose is the High CRI LED light strip-LED Tape with 18 SMDs/ft. The price starting at 11.64$/1.64 ft. The potentiometer we choose is the 200Ω one. For the voltage converter, I think we will choose the 4V to 12V converter. The price of that type converter is around 12-14$. As for the transformer, we will build it in the lab. The battery we choose is BRC Li-ion Lithium 18650 Battery 4000mAh&3.7V.

1.3 High-Level Requirements

1. Fade Mode; (push button) controls the direction of the fade, top to bottom, bottom to top, center to out and out to center.

2. Fade Adjust; (thumb wheel) controls where the fade starts.

3. Dimmer; (thumb wheel) after fade is selected, dims all light, including fade, to dim in sequence. From full on to off.

2.Design

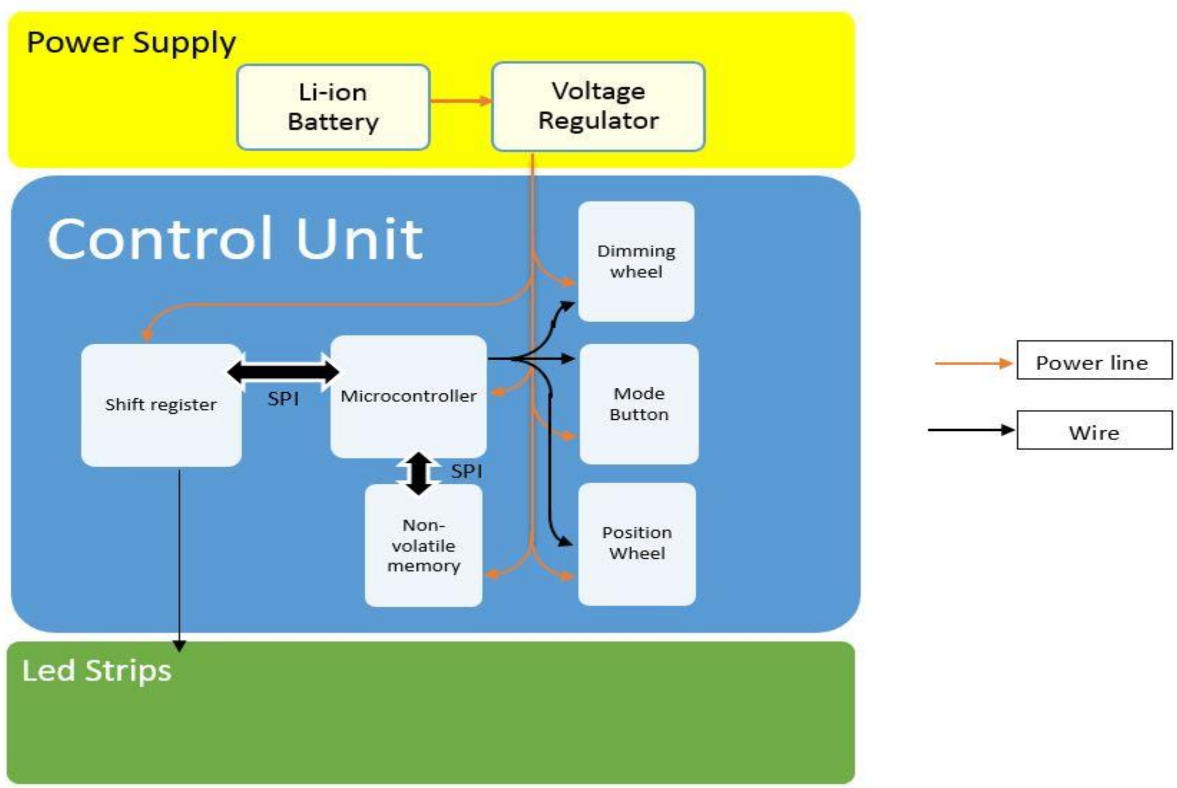

Figure 2: the overall block diagram of the design

The LED light that we are going to build will require of three part to successfully work: a power supply, a control unit and the actual LEDs. The power supply ensures that the light can be powered continuously throughout a normal photo shoot at 12V. The control unit contains a microcontroller to manipulate the LEDs in the different modes as well as the positioning of the reference for the dimming of the lights, having all of this controlled by 4 buttons and 2 wheels. There is also a non-volatile memory of small capacity to ensure that the settings of the light are preserved even when turned off.

2.1 Power Supply

A power supply is required to provide stable power for our LED-lighting device. Power is come from the Lithium-ion battery, and we use voltage converter to stable the voltage around the 12V, which is also the regulated voltage for the rest of the system.

2.1.1 Battery

The type of the battery we choose is BRC Li-ion Lithium 18650 Battery. This type of battery will provide the voltage around 3.7 V and the current going through the system is around 4000mA per hour.

Requirement: Must provide > 3000mA between 3.5V-4V when the system is working.

2.1.2 Voltage convert

The voltage converter converts the voltage from Lithium-ion battery to system regulated voltage(12V). The type converter we choose is T12D2, which can convert 4V to 12V DC/DC.

2.2 Control Unit

A control unit manages the shift register to manipulate the LEDs and chose which ones are on and how much brightness should they give out. This would be controlled by the user by means of multiple buttons and wheels. The non-volatile memory will ensure that even if the power goes off the settings will be maintained.

2.2.1 Microcontroller

The microcontroller chosen is a ATmega328 which will read the previous setting from the memory when turned on, and will control the shift register to manipulate the LEDs accordingly.

Requirement: must support SPI connection at a rate of kB/s.

2.2.2 Non-volatile memory

This memory will keep the previous status of the device when turned off so that it can be ready to use at any time. Not much memory will be needed, so the memory already present in the microcontroller should be enough.

Requirement: Must be able to hold the state of every LED as well as the last state of both wheels defining the reference for the start of the dimming and the dimming itself.

2.2.3 Shift register

The shift register will control which of the LEDs is on as well as the duty cycle to control the dimming.

Requirement: must be able to manipulate all the LEDs at a frequency that will not be perceptible when taking long or short exposure pictures.

2.2.4 Mode buttons

These buttons will set the mode in which the dimming will happen, either from top to bottom, center to outer or outer to center.

Requirement: Must stay pressed so that the mode will be stored analogically when the device is turned off.

2.2.5 Position wheel

A wheel that will control the reference for the dimming.

2.2.6 Dimming wheel

A wheel that will control the duty cycle at which the shift register turns on and off the LEDs to dim them.

2.3 LED strips

LEDs that will do the actual lighting. The strips will be powered 12V and per our calculation it will consume around 50 watts. There are two requirements that LED strips need to fulfill. The first requirement is that LED strips must light without flickering. The second is that the temperature of the LED strips must go up to 4500k.

3.Safety and ethnics

There are many safety hazards with our project, the most important one being those that comes with the use of Lithium-ion batteries. This is an issue since they will explode when overcharges and/or brought to extreme temperatures. Also the battery can experience a thermal runaway which can cause battery failure and even an explosion. We will bypass this with hardware to monitor the temperature of the charging node. We will design the charging circuitry to shut down when the temperature gets above 45 degrees Celsius. Also since our goal is to design a lighting instrument there could be radiated heat from the light, which can cause unstable temperatures, we will once again build in a hardware control that will shut down the entire system when the temperature rises above 45 degrees. To address the overcharging problem, we will design a voltage regulating and monitoring circuit that will ensure that the battery charge never exceeds 4V, which is the maximum voltage that battery can tolerate.

Another safety issue could be the potential of a short circuit, since the lighting device is designed to be portable and usable in outdoor environments it could get wet. We will be insulating the circuit board and all electrical components of our circuit inside of water proof material to reduce the chance of a short circuit happening.

Our project is solely for the use of photography, and light painting photography so there aren't many ethnic problems that we need to be wary about. That being said our project and design do have the potential to infringe IEEE code of ethics [9]. As if we do not nullify the potential safety hazards of the battery the use of our design could lead to potential injuries, so we must solve all of our safety issues in order to comply with the IEEE code.

Our project is based on the IEEE code [5], as we are taking available parts and technology and applying it to something new. By doing so we are expanding and developing a new use for technology, as well as making a new breakthrough in the photography field.

4.Risks

The main risk that we might run into with this project is that we are implementing a feature which makes sure that the device will return to the last setting once powered off and back on. This feature is needed because a single photo shot could span over a long period of time, and if the batteries run out or for other reasons the light needs to be turned off, returning to the exact same light fade setting could become a problem for the photographer. To do this we would prefer not using a non-volatile memory as they cost space and most need some other sort of power source once the main power source is turned off, making them unstable for long term memory storage. However, if we implement this feature with hardware, we could run into many problems with how to store the fade location with the wheels.

Also the other risk is that some fade modes are hard to achieve, we are still thinking how to start fade from center to out and out to center.

Reference

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