Wrocław University of Science and Technology

Control Engineering and Robotics

Intermediate Project

LED Moving Head Light

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February 15, 2017

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Abstract

The purpose of this document is to describe results and goals of LED Moving Head Light project. The main goal is to understand basic problems occuring during construction of such device. Document contains general description what Moving Head Robot is, Power LEDs connection scheme and description of implementation concept.

1 Introduction

Moving Head Lights are kinds of lights that are most often used on concert stages. Connected to DMX controllers give many possibilities because Lighting Director can program lights color, beam angle and direction. Research under Intermediate Project course allowed to gain author's knowledge in this subject.

1.1 Goals

Main goal of a project was to create LED Moving Head Robot (2R). Whole task could be divided into 3 parts:

- power design
  - power supply for STM32F3 board,
  - power supply for Power LEDs,
  - power supply for serovs
- Power LED lighting control,
  - electric circuit,
  - thermal conditions,
  - lighting effects (strobe, dimming),
  - control algorithm (based on recorder audio),
  - bluetooth connection,
- servos control,
  - electric circuit,

  - PWM control,
  - control algorithm (based on recorded audio),
  - bluetooth connection,
- mechanical design
  - design in Auodesk Inventor,
  - cutting, grinding, assembly.

Unfornately only first two main parts (power design and power led lighting control) was fully made. But some tasks of servos control was made partially, because they are similiar to those in Power LED lighting control.

2 Moving Head Light

Moving head lights are high power lightning robots. Most often that are 2R (yaw, pitch) constructions, but there are some types that have also one translational joint (lens movement) and one rotational joint (rotation of color palette).

Figure 1: Typical Moving Head Construction

There are some main families of moving heads: wash, beam, spot etc.

Moving Heads can use a bulb as source of light (even up to 1500W) and rotational color filters or just power LEDs which becomes more and more popular.

3 Results

Device made in the Intermediate Project course is able to change color pursuant to detected frequency of a recorded sound. There are two main parts:

- LEDs board with STM32F3 microcontroller - controls light intensity,
- Computer application made in Qt environment - detects sound and process it to obtain light intensity values.

3.1 General scheme

Figure 2 shows general scheme of whole device. Only LEDs board works on 12V supply, while others are working on 5V. 5V voltage is generated with L7805 regulator. It supplies STM32F3 Discovery board which supplies HC-05 Bluetooth module. STM32F3 generates PWM signal that controls dimming of Power LEDs. Every LED color (Red, Green and Blue) have their own current supply. They need to be current-fed because they could burn otherwise. Each color is made with 3 diodes (1W per diode and summary 3W per color). Power of all 9 LEDs equals 9W.

Bluetooth controller is needed for communication with computer. Computer process sound from embedded microphone, perform Fourier transform of a sound and converts it to the light intensity. Light intensity for every color channel is sent through Bluetooth to the STM32F3 microcontroller. STM32F3 only changes duty of PWM signal for each RGB channel.

3.2 LEDs board

LED lighting electrical circuit was made at universal board. It contains following elements:

- For each color of LEDs separated current supply,
- 3 RGB Power LEDs,

- DC Power (with input and output ports),
- 3 pins for RGB colors control with PWM signal.

In the figure 4 red block is showing one of 3 Star Power LEDs. They can be bought with radiator which is sufficient for heat dissipation. One such power LED contains 3 LED diodes each producing different color (R - red, G - green, B - blue). There are also 3 radiators, that dissipates heat produced on MOSFET transistors. It is important to assembly them, because PWM signal is switching very fast. Figure 5 shows in detail current-fed for one of 3 LED color channel.

Worth noticing are lens. 22.5 degrees lens were used. Without them lamp would behave more like bulb.

3.3 Implementation

To prepare audio processing, Qt spectrum application (available in Qt Creator examples) was used. It was only modified. Constraint of recording time was deleted and count of last samples taken to Fourier transform was reduced to obtain more sharp signal of signal amplitude changes. Frequency was divided into 4 bands:

- low frequency (red color reacts on sudden amplitude changes) – from 100 Hz to 300 Hz,
- middle frequency (blue color responds to those frequency amplitude value) – from 300 Hz to 500Hz,
- higher middle frequencies (green color reacts on high peaks) – from 1 kHz to 3 kHz,
- high frequency (is not used) – from 10kHz.

Figure 6 shows how application looks.

3.4 Used software

Computer aplication was developed in Qt environment with use of Qt Creator and Qt Multimedia module. Qt is on LGPL license, which allows for commercial use when LGPL licensed part of application is distributed as a shared libraries.

Program for STM32F3 microcontroller was developed in Atollic Truestudio Lite with use of CubeMX plugin. Atollic Truestudio Lite is free to use, but in such edition have some features locked. But for that project was sufficient.

4 Bibliography

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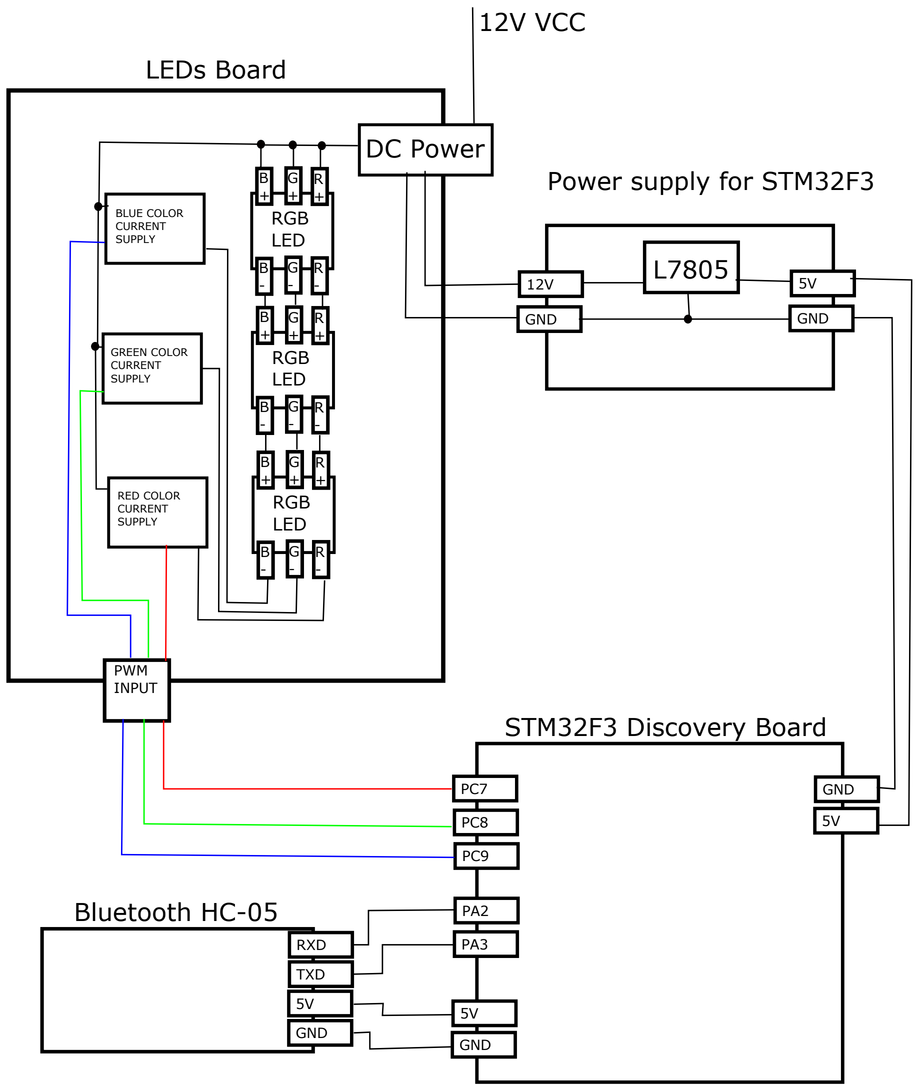

Figure 2: Whole device with power supply

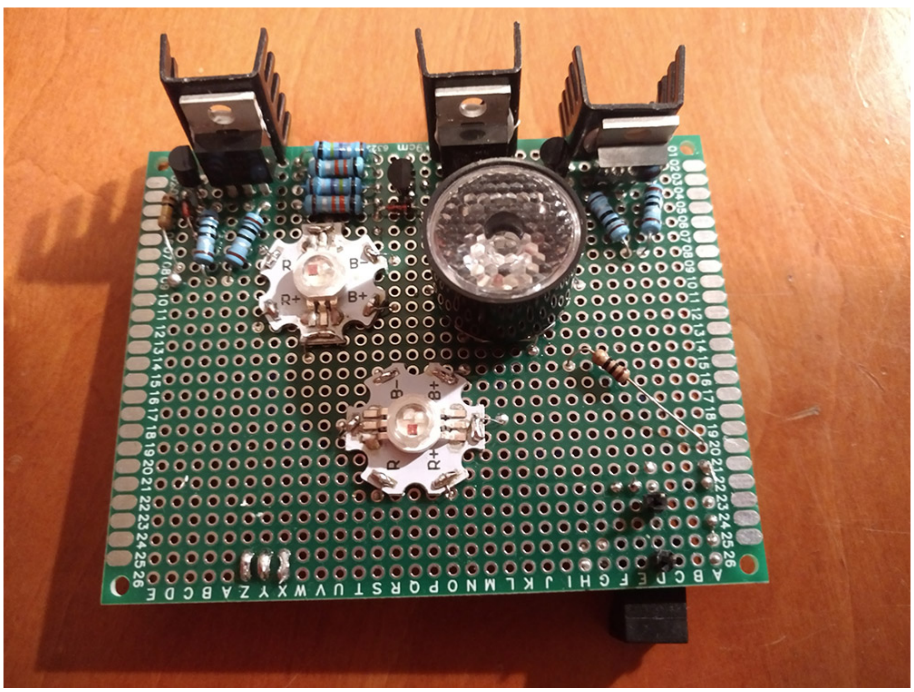

Figure 3: Device construction

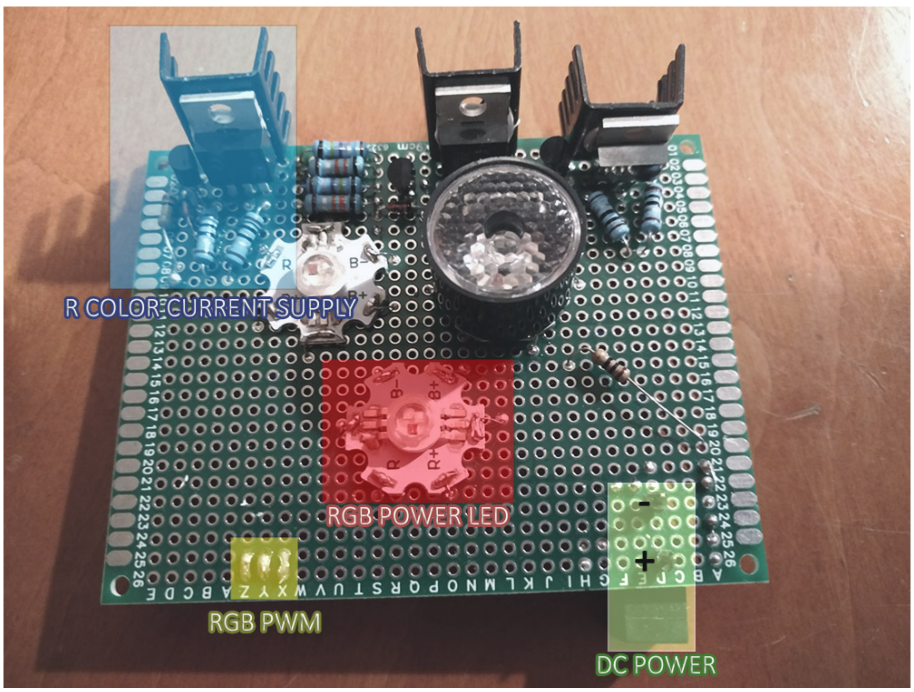

Figure 4: Device construction with blocks description

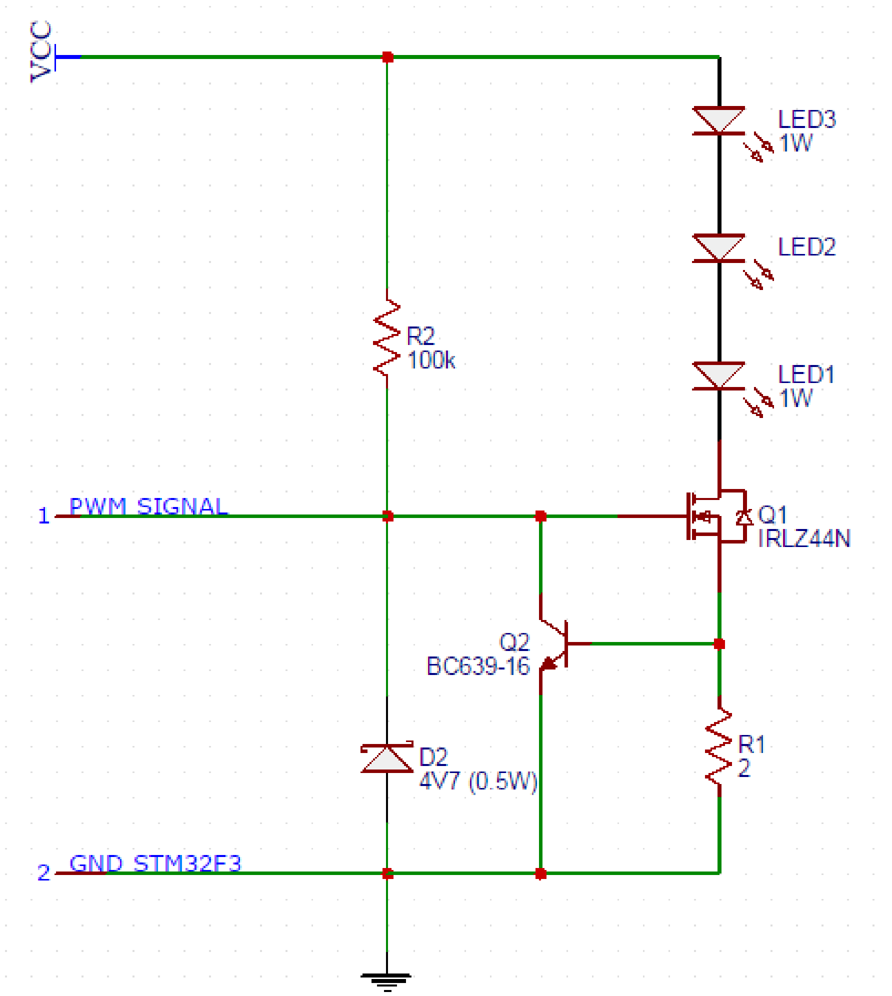

Figure 5: Current-fed for one LED color

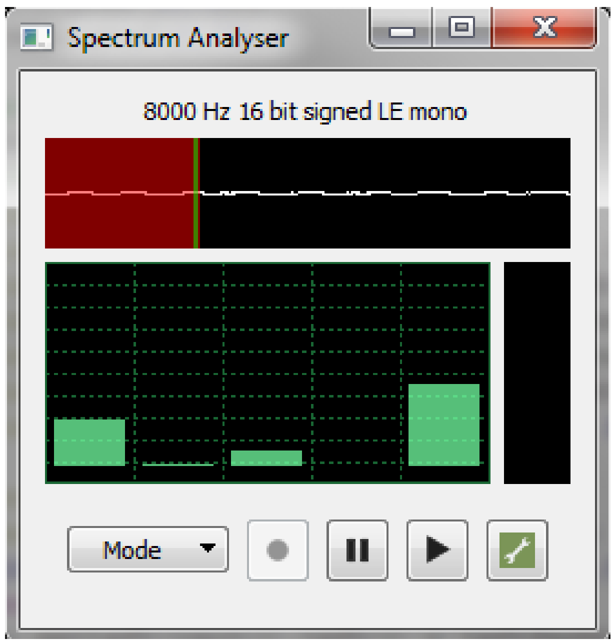

Figure 6: Computer aplication for Spectrum analysis