A lightsource for printing on Multicontrast paper

Overview

I habe built a LED replacement light source for condensor lens enlargers.
It eliminates the need for contrast filters and extends the contrast range compared to an incandescent lightbulb source.
It can also be used as a light source for contact printing.
It replaces the opal lamp in the enlarger and does not need irreversible modificatios to the enlarger.
All components are cheap and easy to find.



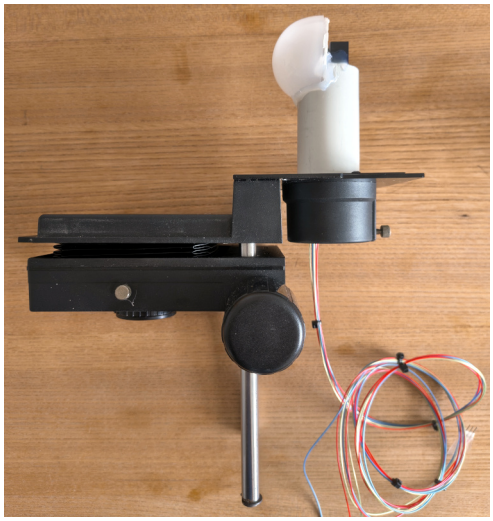
Background

A while ago I found an old enlarger in the trash. It was dusty but still working, and after a good cleaning i did some enlargements from 35mm negatives.
I found a few boxes of cheap photo paper at a thrift store but the proper contrast grades were always missing, so I bought some multicontrast paper.
These papers are available from Ilford, Foma and other manufacurers and have two different silver crystals: One is sensitive to green light and yields a very low (00) contrast. The other is sensitive to blue light and yields a very hard (5) contrast.
One can dial in any contrast grade by changing the ratio between green and blue light in the exposure.
This can be done by inserting filters that are calibrated to a certain contrast value or by adjusting the filters in a colour head to certain values listed in the papers datasheet.
Incandescent lightbulbs emit much more yellow- and red light than blue, so the highest contrast values can only be archieved with halogen based light sources.

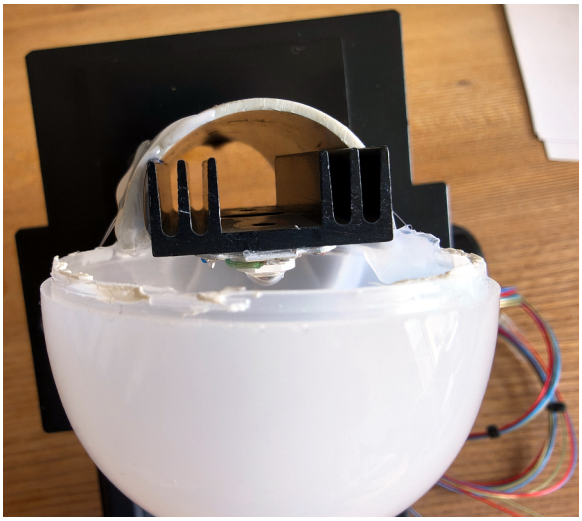
Concept

The LED light source replaces the light bulb and socket in a Durst M370 BW enlarger.





It would work in any enlarger that has a condensor lens and Light bulb.
I use a SMD RGB LED that is already mounted on a star board.
The green and blue LEDs are used for exposing the paper whereas the red light acts as a safelight for adjusting focus etc.



The source can easily be modified to expose RA4 or other colour papers.
The LEDs are controlled with an Arduino Nano with a logic chip and some transistors.
Total parts price is below 20€.

Details



The controller is an Arduino Nano with a mini oled / *rotary encoder / pushbutton module* as its interface.
The Arduino produces a 0-100% PWM signal and control signals for the LEDs
A logic circuit (74HC00 Quad NAND) combines the outputs into a bursts with two complimentary channels for the green and the blue LEDs.

My safelight is a single deep red (666 nm) 2W LED on a heatsink, powerd by a USB power supply with a 2W power resistor to limit the current.
I use a transparent film canister as a diffusor - the LED is too bright to look at directly - and bounce it off the low ceiling in my improvised darkroom.
This does not fog any of my BW papers, even after prolonged exposure.

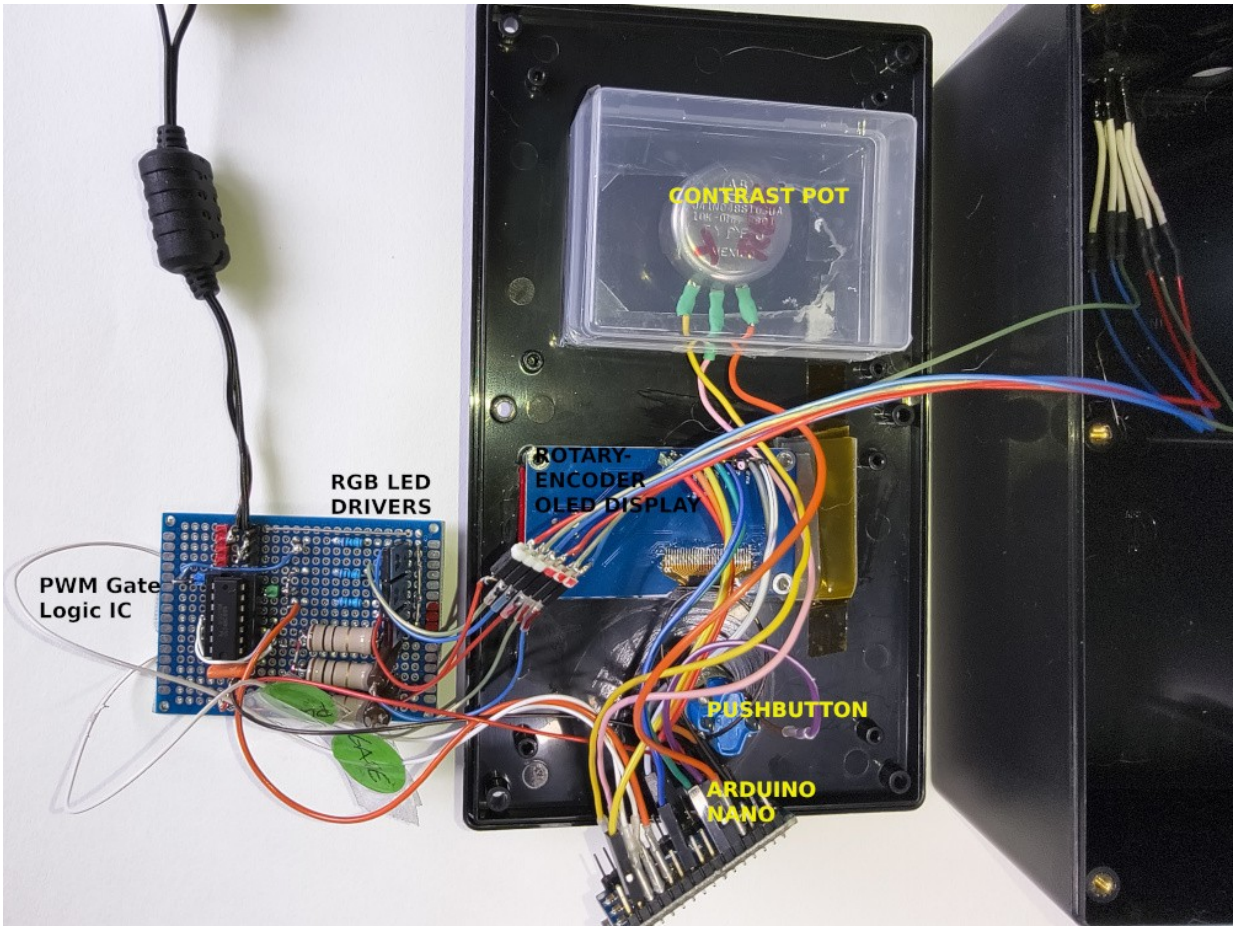
I also use the red channel in my diy RGB enlarger lightbulb instead of the red filter to focus and position the paper, which does not fog it either.
The R, G and B channels are switched on and off by BD681 NPN Darlington transistors (because I had those here, other transistors or MOSFets will do).
LED curent is set to R:200mA , G and B : 100 mA by series resistors which may include potentiometers to balance the ratio between green and blue.

The effective brightness of the green and the blue channel are balanced to allow change of contrast while keeping middle grey brightness the same.
With my LED module at 100mA each, it seems to be fairly well balanced.

The exposure light is PWM modulated between green and blue.
Only one LED is on at any time.
At position 0 only the green LED is on.My safelight is a single deep red (666 nm) 2W LED on a heatsink, powerd by a USB power supply with a 2W power resistor to limit the current.
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At position 20 the green is on 80% of the time and blue 20%
At position 50 the green is on 50% of the time and blue 50%
At position 70 the green is on 30% of the time and blue 70%
At position 100 only the blue LED is on.
The fast PWM allows for dodging and burning without interference by the light pulses.
While the exposure is not active, the red LED is on. The red light does not expose the paper while adjusting size and focus.

Mechanical build

The 3 LEDs are close together but they still need a diffusor to evenely illuminate the field below the condenser lens. I used the dome of an dead LED lightbulb, which does the job well.
Like an incandescent lamp, the LED source needs to be positioned in the right spot, by shifting up and down and rotating it.
The electronics are in a plastic case with a red plexiglas filter in front of the white OLED display.
At first I had used the push button of the rotary encoder as the starter button, but it kept changing the setting when pushed, so I installed a separete pushbutton.
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The Light source is powered by a 5V, 1A power supply.
Any USB charger will do.
The controller is an Arduino Nano clone.
The display+encoder is a ESTARDYN white 1.3"OLED Module with I2C interface / ED11 encoder.
RGB LED Model LC-3RGB-C30
Red 620-625 nm / 2.0-2.4V / 300-350 mA / 40-50 LM
Green 520-525 nm / 3.0-3.4V / 300-350 mA / 60-70 LM
Blue 460-465 nm / 3.0-3.4V / 300-350 mA / 15-25 LM
from Aliexpress
The Logic IC is a 74HC00 quad NAND
The driver transistors are BD681 NPN Darlingtons, a small logic level Mosfet would do as well.

Circuit diagram

