Six-Channel Digitally Controlled (Color) Light Organ
A Light Organ (or Color Organ) is a sound-to-light device which allows one to “see” sounds and music through a display of colored lights.
Design Comparison

Traditional Light Organs:
- Fully analog designs
- Usually use coarse RC filters
- Typically 3-channel designs for lows (100Hz), mids (1kHz), and highs (3kHz)
- Mediocre performance due to their often “low” tech implementations

The Lightor Design:
- Analog/digital hybrid design
- Resonant RLC filters for tighter control
- 6-channel (60Hz, 250Hz, 500Hz, 1kHz, 3kHz, 6kHz) design aims to provide more clarity across the audible spectrum and more flashing lights mean extra fun
- Dimming/flashing of the lights is achieved using 8-bit PWM for precise control of the light show.
The Preamp Stage uses a simple op-amp circuit to amplify the inputted line-level audio signal to a more usable level.
The Filter Stage uses capacitors, resistors, and inductors to form six resonant band-pass filters tuned to six frequencies across the audible spectrum.
The Conversion Stage uses a microcontroller with integrated ADC to convert the audio signals to 8-bit binary numbers which it then multiplexes and outputs.
Main [PWM] Stage

The Main Stage collects & processes data from the Conversion Stage. It controls the voltage of each output channel based on that data using Pulse Width Modulation

```pascal
pwm := pwm + '1';  -- Increment the main PWM counter
if (pwm > "11111111") then
  pwm := "00000000";  -- Check for counter overflow
  Start over again
end if;

if (pwm <= per0) then output0 <= '0';  -- Turn off the output
else output0 <= '1';  -- Now light it up!
end if;
if (pwm <= per1) then output1 <= '0';  -- Turn off this output
else output1 <= '1';  -- Now light it up!
end if;
```
To evolve Lightor from a prototype to a more polished, finished “product” consider:

➔ Add a power stage (to allow the driving of line-voltage, higher power loads)

➔ Use either **real audio-grade inductors** or switch to **RC filters** for tighter frequency control

➔ Add **averaging capabilities** to the main stages' VHDL code – to reduce jitteriness of the lights

➔ **More “fun” features**, such as the ability to rotate which outputs respond to which frequencies