GLOW Lighting research

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Content

Current solution

The lighting source used for the prototype is the Showtec Compact Par 18 MKII. It holds 18 x 3W RGB LED's, has a beam of 25 degrees and utilizes both wired DMX input and output connections. It produces 2323 lumens of brightness or 3112 lux at 2m and consumes 60W of power. The dimensions of the unit are 250 x 290 x 96 mm.

Requirements

When selecting a lighting solution, we need to address the following key requirements:

- **Brightness**
  The light source must provide sufficient brightness to ensure clear visibility around the edges of the 2-meter tall, 0,5-meter-wide cylinder.
- **Power Requirements**
  The chosen light source should align with the chosen power supply. In our case the lighting will be connected to the main power grid.
- **Control**
  The light must be controllable via a microcontroller using a wired interface, for example through the DMX protocol.
- **Durability and Cost**
  Considerations such as heat dissipation, energy efficiency, lifespan, and overall cost must be considered to ensure long-term viability.

Renting vs buying

It may be worth consulting the GLOW organization for potential lighting solutions. Additionally, Fontys might want to retain some of the tubes for future showcases, which would mean purchasing a set of lights ourselves. For all other purposes, renting would be the preferred option.

Par lights

The simplest solution for scaling up our lighting system is to increase brightness by either using brighter lights or combining multiple lights. The table below provides a clear comparison between the price per lamp and the corresponding brightness (in lumens). Additional testing is necessary to determine the precise lumen output required for the 2-meter cylinder.

Product	Size mm (LxWxH)	LED's	Beam angle	Lumens	Price for 1	Link	IP
Showtec Compact Par 18 MKII (current)	250 x 290 x 96	18 x 3W RGB LED	25	2323	189	Thomann	IP20
Cameo Flat Pro 12 G2	156 x 292 x 300	12 x 10W 5-in-1 RGBWA LED	30	4300	535	Thomann	IP65
Elation Six+ Par L	340 x 260 x 260	14 x 20W Multichip LED	12	7000	999	Thomann	IP65
Elation Limelight Par L	248 x 340 x 450	12 x 60W Multichip LED	40	8213	1.639	Thomann	IP65

Flood lights

A viable alternative to LED Par lights could be floodlights commonly used for security or illuminating city buildings. These may offer greater illumination at a lower cost; however, they may lack a DMX connection. A key advantage of floodlights is their typical water protection rating (ideally IP65-IP67), making them suitable for outdoor use.

Product	Size mm (LxWxH)	LED'S	Beam angle	Lumens	Price for 1	Link	DMX	IP
Floodlight FUTT08	360x60x470	200 W	160	17000 LM	230,57	ledgrothandel	X	IP65
Ayra Armageddon 648 RGB LED	405 x 250 x 88	110 W			146	link	✓	n/a
BeamZ StarColor 128 outdoor	230 x 120 x 240	16 x 8W	20		259	link	✓	IP65
Cameo FLAT PRO VLOED IP65 TRI	180mm x 180mm x 120mm	1x60 W	120	830lux at 1m, 2,600 lummens approx	355-422	link	✓	IP65
Cameo FLOOD 600 IP65		9 x 6 12w	40	7500 lx @ 1 m			✓	IP65

Alternative mounting solution

An alternative mounting solution could involve vertically attaching LED strips to a 2-meter-tall square wooden bracket. This setup may provide more even lighting throughout the tube, though it requires testing. Additionally, a mirror could be used to reflect light towards the top of the cylinder, helping to distribute light more evenly across the upper section.

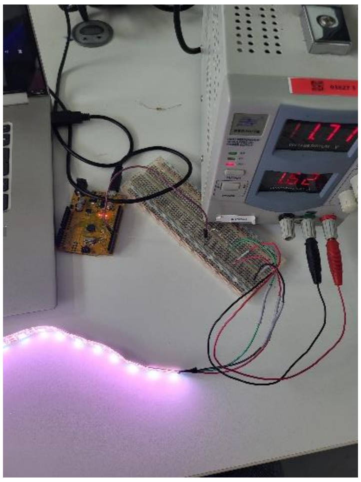
Future questions

Currently we’re not sure how bright the venue will be, will they turn of the lights because of Glow or will they remain the same. We recommend further, on-sight, testing to check how dark it gets.

Lights

The lights used for testing consisted of the par lights used in the previous Glow prototype, the rectangular lights provided by Martijn and a 0,5-meter LED strip.





Testing

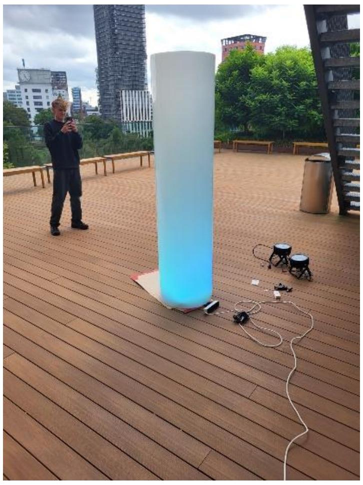
Since Glow starts around midday, we experimented both indoors and outdoors, although the weather during testing was cloudy. We documented the tests with photos and personal observations to provide detailed insights into the light produced, we initially considered using measurements for our tests but lacked the necessary equipment, such as a light meter. This led us to rely on visual observations instead, this was going to speed up the testing and give us a quick overview on what we should focus moving forward.

Par light outdoor

Unfortunately, the DMX par lights used for the Glow prototype lack the strength needed to produce visible light outdoors. Switching from a single light to two lights had minimal impact on the amount of light produced, as seen in the right image.


Flood light outdoor

A combination of the two rectangular lights produced a significant amount of light outdoors, illuminating about 40% of the pillar with visible colour. Interestingly, blue, pink, and purple hues were much more prominent than red, orange, or yellow, which were less noticeable.



Par light indoor

We also tested our lighting in a more nighttime environment. While the par lighting provided just enough visible light to distinguish colours, the overall effect was quite underwhelming and didn't meet our expectations. This could be used for the software testing phase however and could even be used for Glow if we lack further budget.

Flood light indoor

Unsurprisingly, the rectangular lights provided the most illumination indoors, coming quite close to the amount needed for Glow, at least in our opinion. However, the final effectiveness will depend on the ambient light at the location. To be safe, we should consider using lights that are even brighter to ensure we have a sufficient margin.

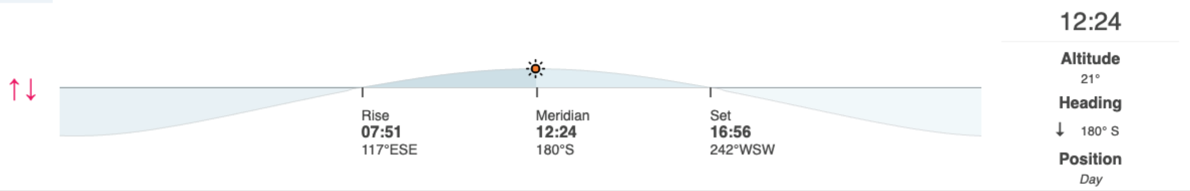
Led strip indoors

Unlike par and rectangular lights, LED strips provide a nice, even light throughout the tube. In a dark environment, the brightness is sufficient. LED strips don’t need to be DMX-connected, which is a huge advantage.

Sunlight during glow

A thought that we had during the testing was that glow is in November and it starts at around 18:00 every day, at the moment we are still in September this means that the days will get shorter as we get closer to Glow. We found a helpful chart online that illustrates the phases of twilight, which can guide our expectations for the sun in November.

2024	Sunrise/Sunset		Daylength		Astronomical Twilight		Nautical Twilight		Civil Twilight		Solar Noon	
Nov	Sunrise	Sunset	Length	Diff.	Start	End	Start	End	Start	End	Time	Mil. km
1	07:37 ↘ (113°)	17:10 ↙ (247°)	9:33:09	−3:41	05:41	19:05	06:20	18:26	07:01	17:46	12:23 (23.0°)	148.467
2	07:38 ↘ (114°)	17:08 ↙ (246°)	9:29:28	−3:40	05:42	19:04	06:22	18:24	07:02	17:44	12:23 (22.7°)	148.429
3	07:40 ↘ (114°)	17:06 ↙ (245°)	9:25:50	−3:38	05:44	19:02	06:23	18:23	07:04	17:42	12:23 (22.4°)	148.391
4	07:42 ↘ (115°)	17:04 ↙ (245°)	9:22:13	−3:36	05:45	19:01	06:25	18:21	07:06	17:41	12:23 (22.1°)	148.352
5	07:44 ↘ (115°)	17:02 ↙ (244°)	9:18:38	−3:35	05:47	18:59	06:27	18:20	07:07	17:39	12:24 (21.8°)	148.314
6	07:46 ↘ (116°)	17:01 ↙ (244°)	9:15:04	−3:33	05:49	18:58	06:28	18:18	07:09	17:37	12:24 (21.5°)	148.277
7	07:48 ↘ (116°)	16:59 ↙ (243°)	9:11:33	−3:31	05:50	18:56	06:30	18:17	07:11	17:36	12:24 (21.2°)	148.239
8	07:49 ↘ (117°)	16:57 ↙ (243°)	9:08:04	−3:29	05:52	18:55	06:31	18:15	07:12	17:34	12:24 (20.9°)	148.202
9	07:51 ↘ (117°)	16:56 ↙ (242°)	9:04:37	−3:26	05:53	18:54	06:33	18:14	07:14	17:33	12:24 (20.6°)	148.165



Nov	Sunrise	Sunset	Length	Diff.	Start	End	Start	End	Start	End	Time	Mil. km
10	07:53 ↘ (118°)	16:54 ↙ (242°)	9:01:13	−3:24	05:55	18:52	06:35	18:12	07:16	17:31	12:24 (20.3°)	148.129
11	07:55 ↘ (118°)	16:53 ↙ (241°)	8:57:50	−3:22	05:56	18:51	06:36	18:11	07:17	17:30	12:24 (20.0°)	148.093
12	07:57 ↘ (119°)	16:51 ↙ (241°)	8:54:31	−3:19	05:58	18:50	06:38	18:10	07:19	17:29	12:24 (19.8°)	148.058
13	07:58 ↘ (119°)	16:50 ↙ (240°)	8:51:14	−3:16	05:59	18:49	06:39	18:09	07:21	17:27	12:24 (19.5°)	148.023
14	08:00 ↘ (120°)	16:48 ↙ (240°)	8:48:00	−3:14	06:01	18:47	06:41	18:07	07:22	17:26	12:24 (19.3°)	147.989
15	08:02 ↘ (120°)	16:47 ↙ (240°)	8:44:49	−3:11	06:02	18:46	06:42	18:06	07:24	17:25	12:25 (19.0°)	147.956
16	08:04 ↘ (121°)	16:45 ↙ (239°)	8:41:40	−3:08	06:04	18:45	06:44	18:05	07:26	17:23	12:25 (18.8°)	147.923
17	08:05 ↘ (121°)	16:44 ↙ (239°)	8:38:35	−3:05	06:05	18:44	06:45	18:04	07:27	17:22	12:25 (18.5°)	147.891
18	08:07 ↘ (122°)	16:43 ↙ (238°)	8:35:34	−3:01	06:06	18:43	06:47	18:03	07:29	17:21	12:25 (18.3°)	147.860
19	08:09 ↘ (122°)	16:41 ↙ (238°)	8:32:35	−2:58	06:08	18:42	06:48	18:02	07:30	17:20	12:25 (18.0°)	147.830

Here's a quick breakdown of twilight phases:

Civil twilight: Sun is 0° to 6° below the horizon. There is enough light for most outdoor activities without artificial lighting.

Nautical twilight: Sun is 6° to 12° below the horizon. The horizon is still visible at sea, and brighter stars are visible.

Astronomical twilight: Sun is 12° to 18° below the horizon. The sky appears dark enough for most astronomical observations, although a small amount of light from the Sun still affects the sky.

Once the Sun descends more than 18° below the horizon, **true night** begins. In November, this will happen between **18:42 and 18:54** each evening. Prior to this, the venue will be in nautical twilight, which is already fairly dark.

Other factors influencing the overall brightness at the venue include weather conditions, such as cloudy or rainy skies, and the **light pollution** from nearby restaurants and buildings. These considerations will impact the lighting setup needed for Glow.

This means that it will not be as bright as the test that we did today but as we said previously it is better to be prepared for extra brightness just in case.

Conclusion

In conclusion, our research has revealed several key insights into the lighting requirements for the GLOW event. The current lighting solution, the Showtec Compact Par 18 MKII, falls short in terms of brightness and light dispersion. While flood lights offer more robust illumination and are generally better suited for outdoor environments, their lack of DMX connectivity makes them less viable given our time constraints.

Our testing highlighted a significant issue with light distribution, with the intensity being stronger at the bottom of the cylinder compared to the top. This uneven lighting could compromise the overall visual effect and needs to be addressed.

To resolve this issue and based on our other findings, we chose LED strips as the final solution. They can be directly connected to our Arduino and provide consistent, even brightness throughout the tube.