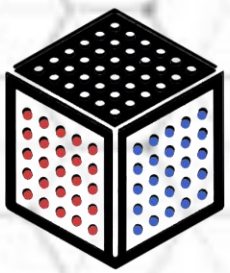
CASA0021: CONNECTED ENVIRONMENTS
GROUP PROTOTYPE AND PITCH 23/24

UCL



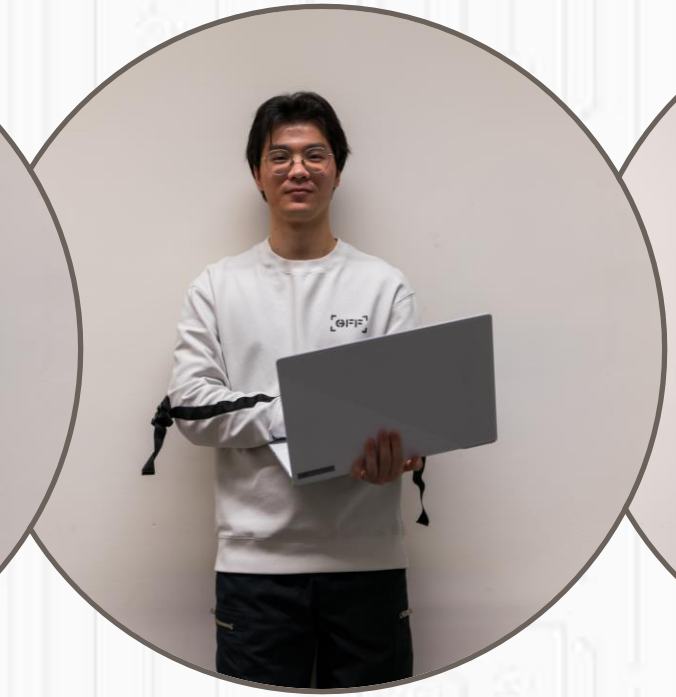
Cube Matrix

Bringing Your Environment to Life !

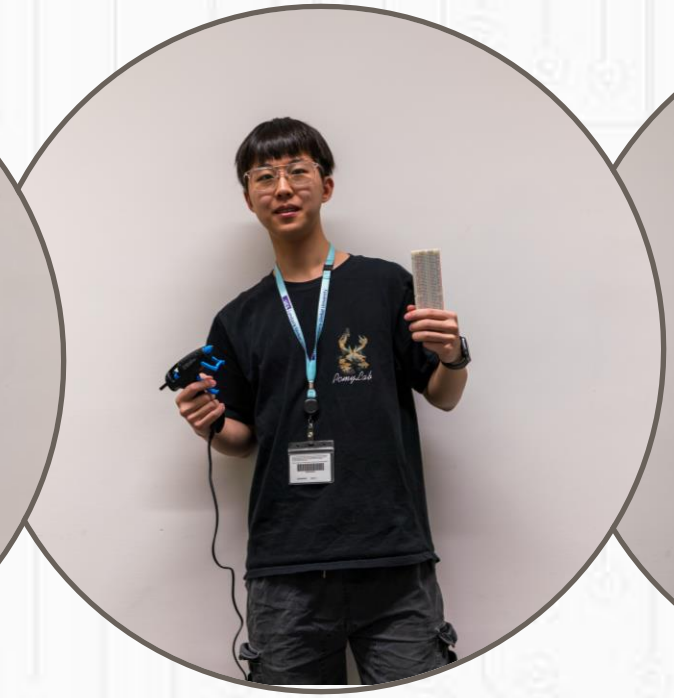
Satria Utama
Guandi Chen
Zekun Wang
Huanchao Hong

Team Members

Satria Utama



Huanchao Hong



Guandi Chen

Zekun Wang

Background

Monitoring Importance:

Temperature, humidity, and CO2 are crucial for indoor health.

Tools' Limitations:

Most tools provide data through numbers and charts, which can be tedious and non-intuitive.

Challenge:

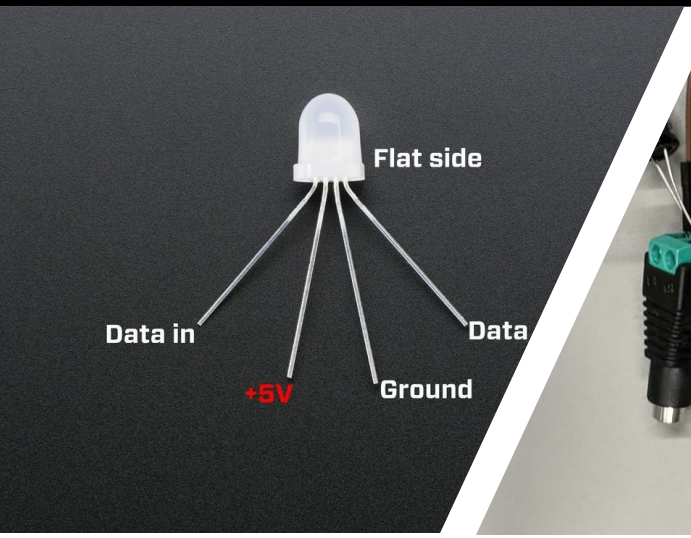
To create a device that simplifies understanding and interaction with indoor environmental data, while being engaging and enhancing environmental awareness.

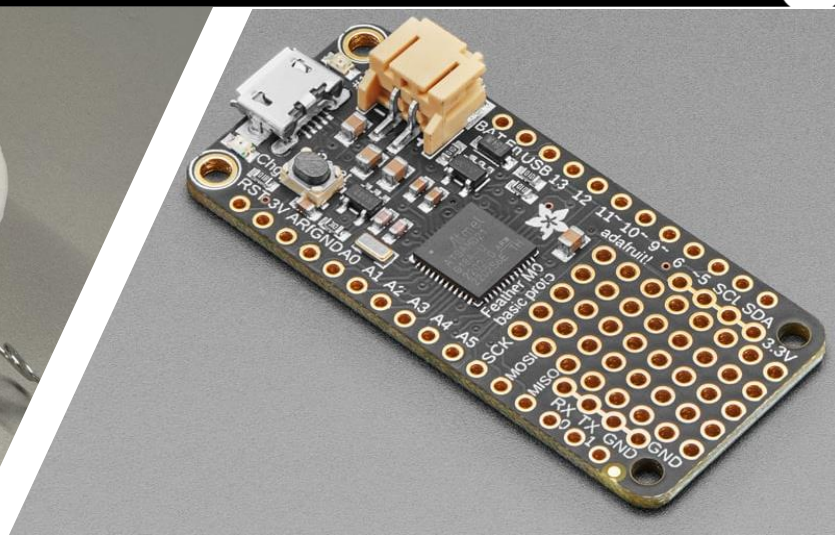
Solution: Cube Matrix

- **Innovative Approach:** Combines advanced sensing technology with dynamic visual displays.
- **Intuitive Visualization:** Uses visual changes to represent environmental data clearly.
- **Light as Medium:** Transforms complex data sets into easily understandable visual information using light.

Promotional video

Technology and Development





- 512 LED lights: APA106 RGB LED (8mm)
- Sensors: SCD-30
- Wire: Jewelry Wire (Tinned copper wire)
- Microcontroller: Adafruit Feather M0
- Power Supply: 5V 2A Power Supply
- RGB Push Button
- Capacitor 1000uF 6.3V
- JST connector

Components

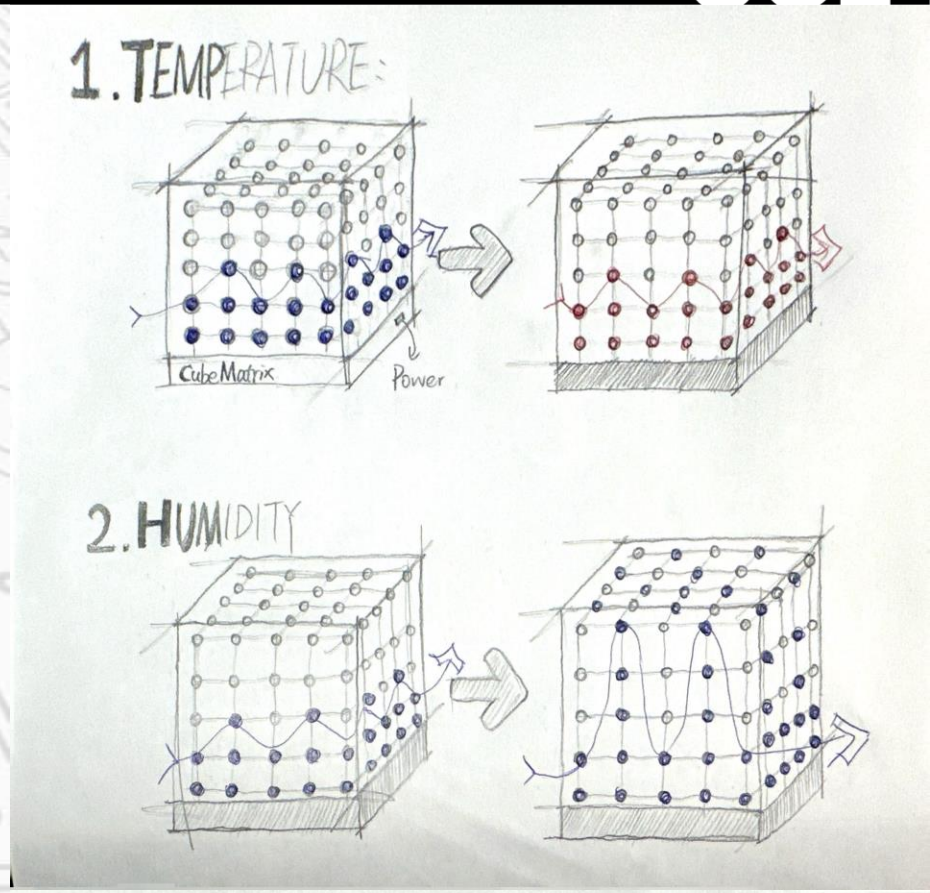
Evolution of the Idea

Initial Concept:

- 5x5x5 cube to display temperature, humidity, and CO2.
- Temperature via color changes;
- humidity by wave height;
- CO2 by wave frequency.

Challenges Encountered:

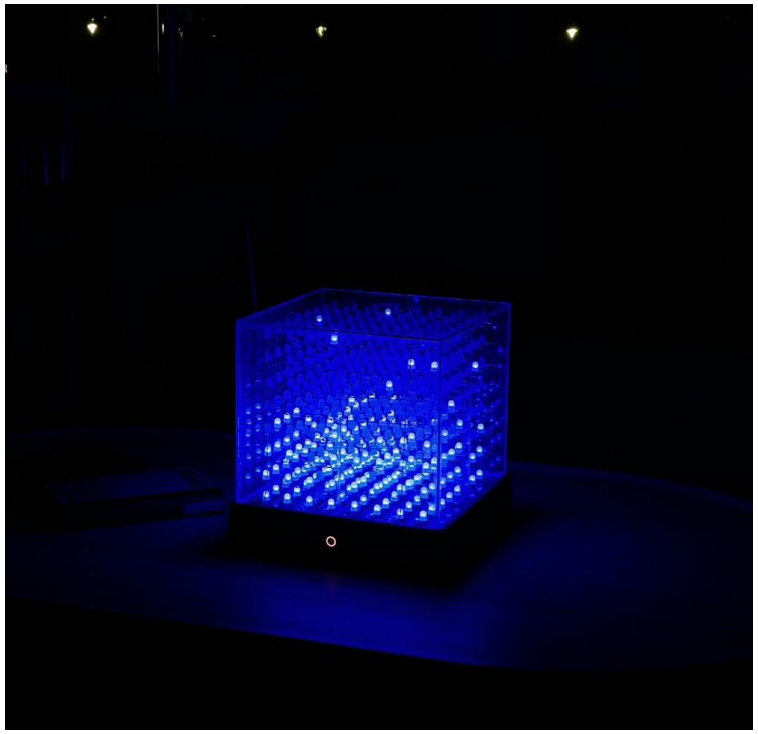
- Difficulty in clearly showing **all data simultaneously** due to LED Cube's limitations.
- Design constraint in conveying three environmental data types **in one animation** without losing clarity.
- Complexity in using common **anode LEDs**, requiring numerous **resistors** and **registers**.

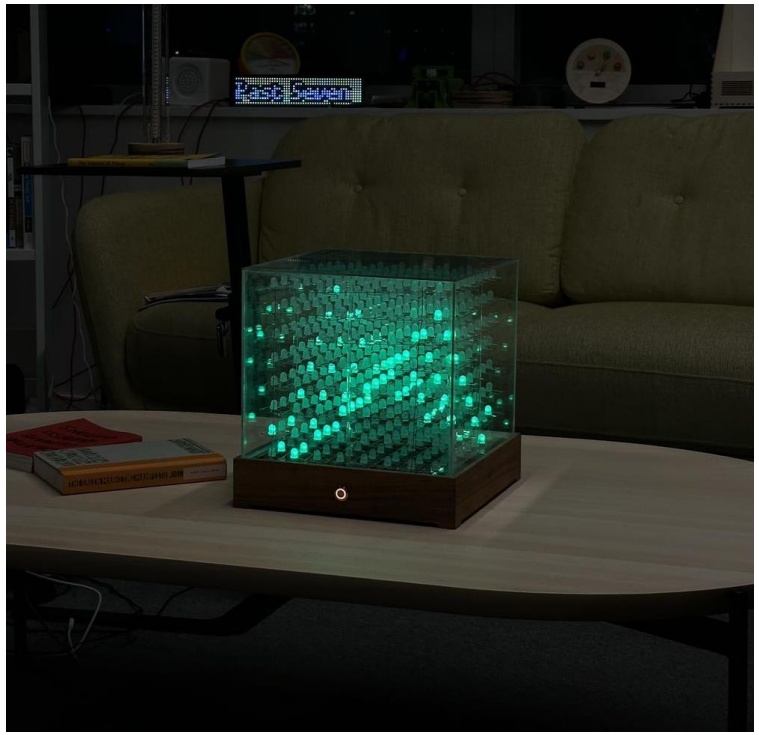


Evolution of the Idea

Refined Approach:

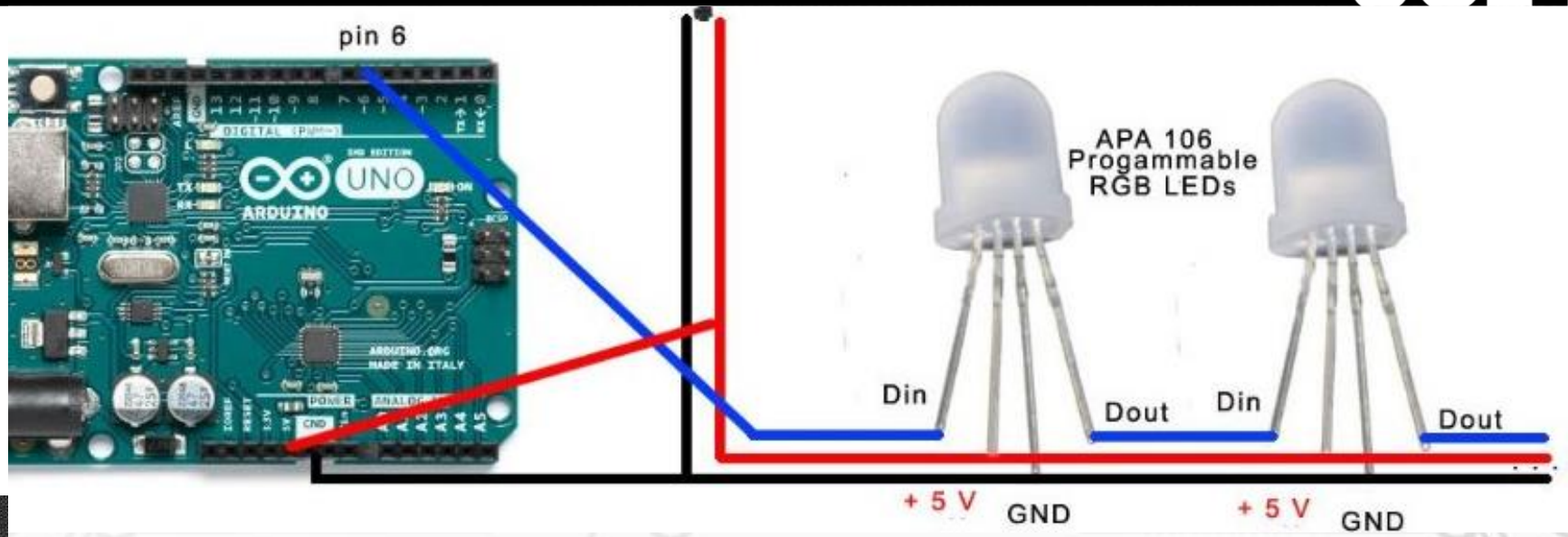
- Upgraded to an 8x8x8 cube for better visual clarity and data conveyance.
- Split data points into separate animations for clearer, more accurate representation.

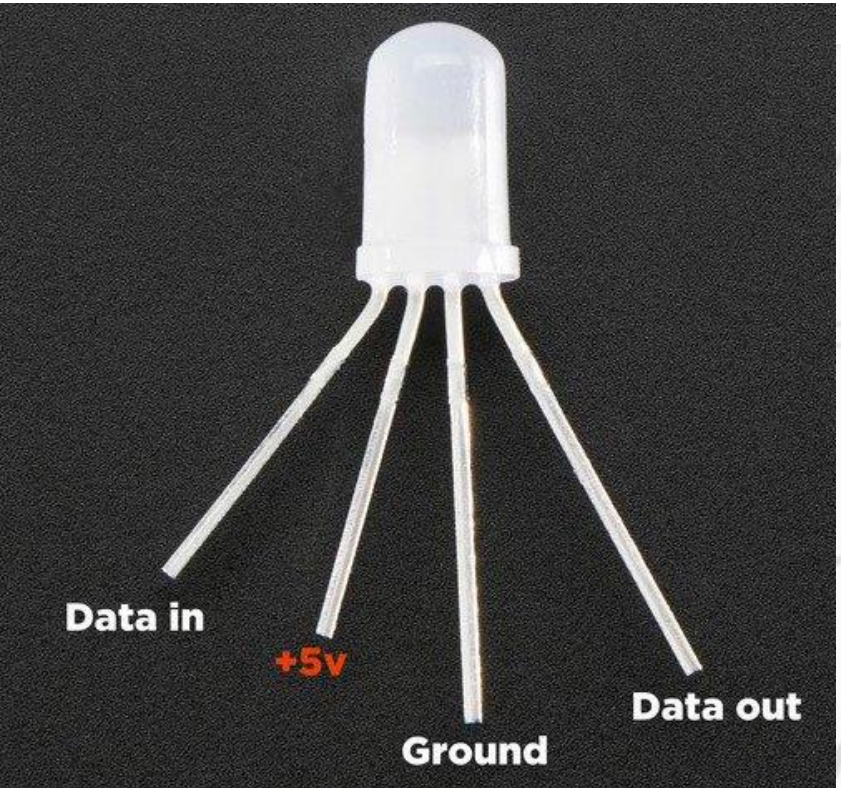




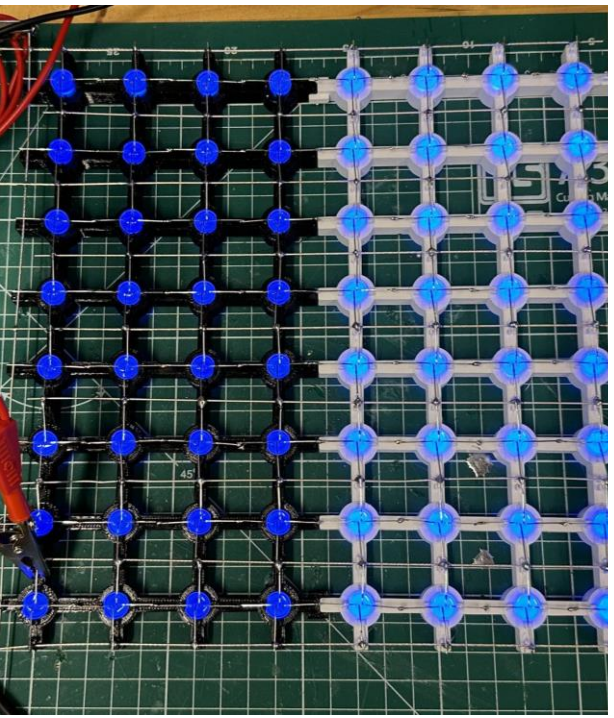
LED lights:

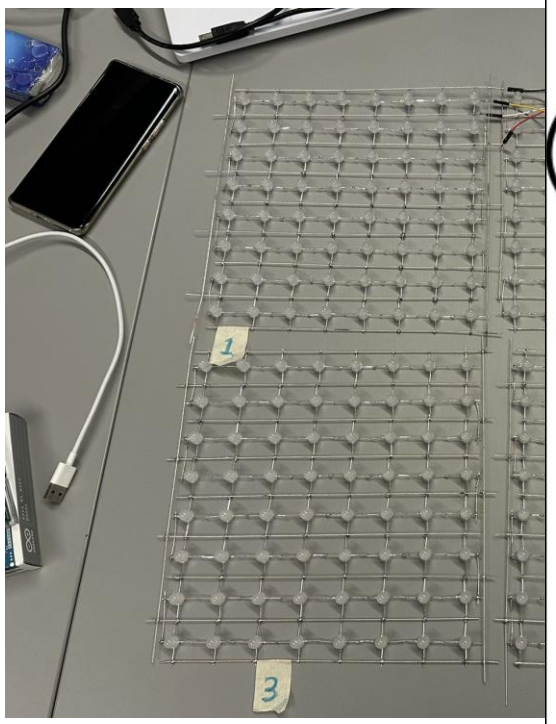
APA 106 RGB





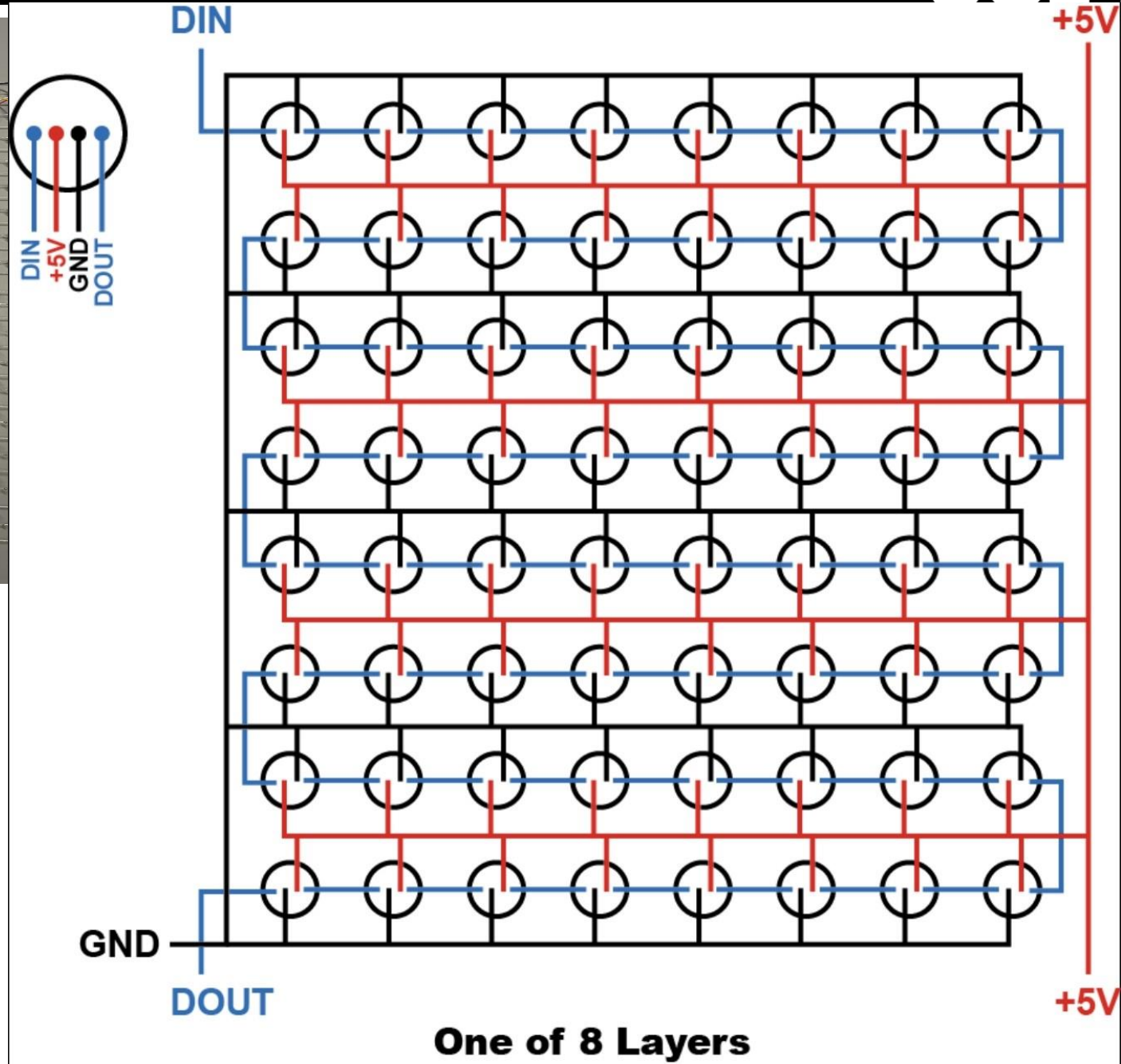
- Addressable RGB LED
- Built in controller IC and Register
- Can be connected in series
- Only three wires need to be connected





Production process

- 3D print a solder holder
- Soldering 512 LEDs into 8 matrices
- Build into cube
- Make and test animations



Temperature:

Sun Ball Animation

- **Color:** from blue (cool) to red (warm) to show temperature.
- **Speed:** slow for cool, fast for warm.

- **Connection: sun** as a natural, intuitive temperature source.

Humidity:

Droplet Accumulation

- **Layers of Accumulation:** Water droplets accumulate in layers, each representing a 10% increase in humidity.
- This animation simplifies indoor humidity assessment and enhances data interaction.

- **Connection:** **droplets** as a direct manifestation of humidity.

CO2 :

Wave Frequency

- **Color Coding:** Color shifts from green (normal) to red (above 1500ppm) for CO2 levels.
- **Frequency:** low for normal, high indicates excess CO2.

- **Connection:** **fluctuations** can symbolize changes in air fluidity and quality.

Why Display Numerical Data?

- Provides **precise** measurements for detailed understanding.
- Balances intuitive animations with accurate data for diverse preferences.

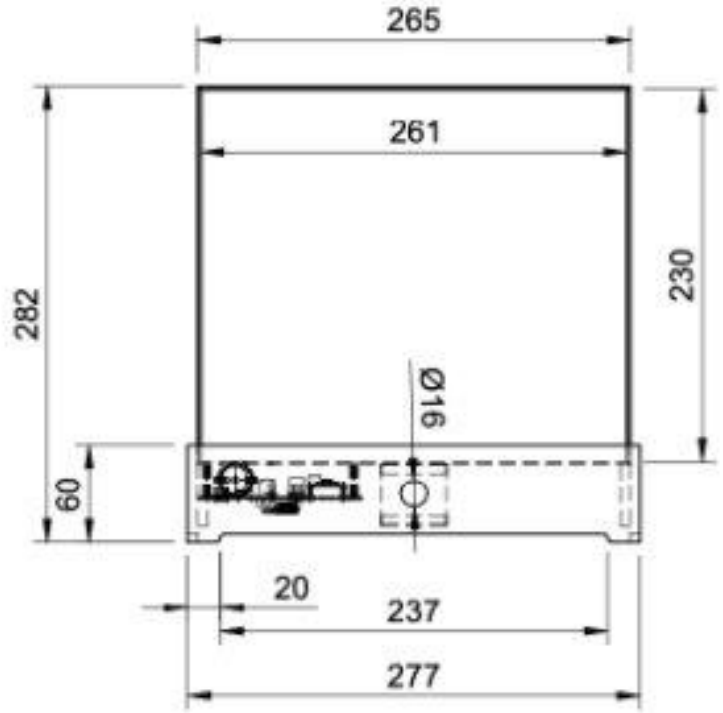
Advanced prototype

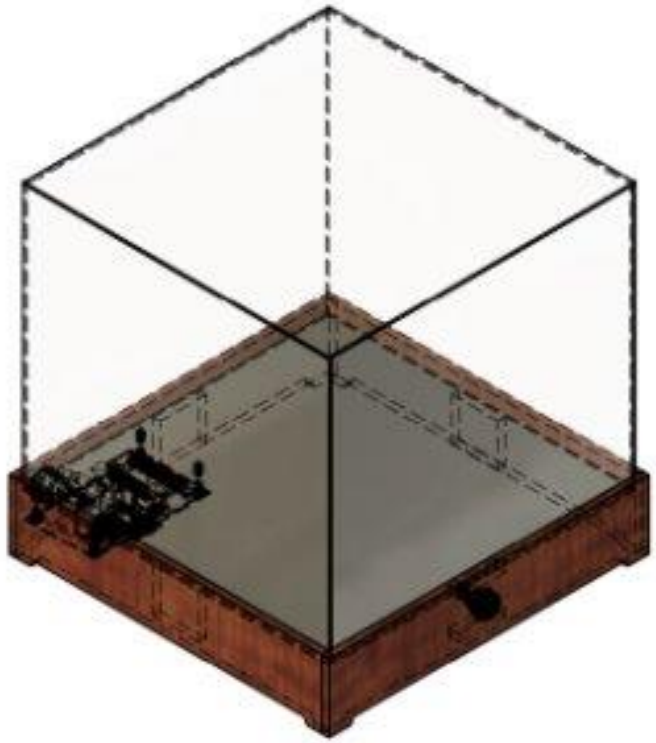
Enclosure

Case V1

Case V2

Advanced prototype

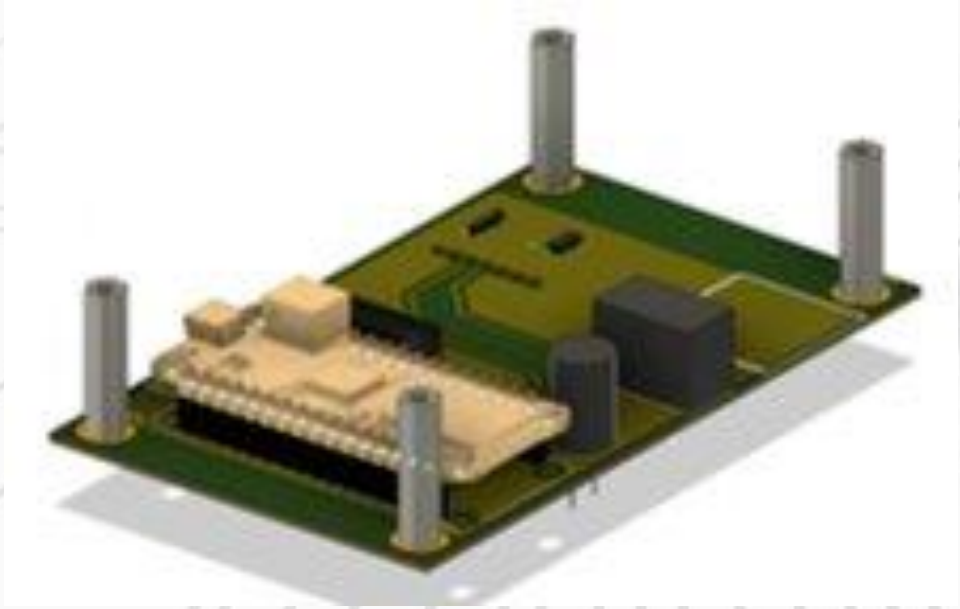


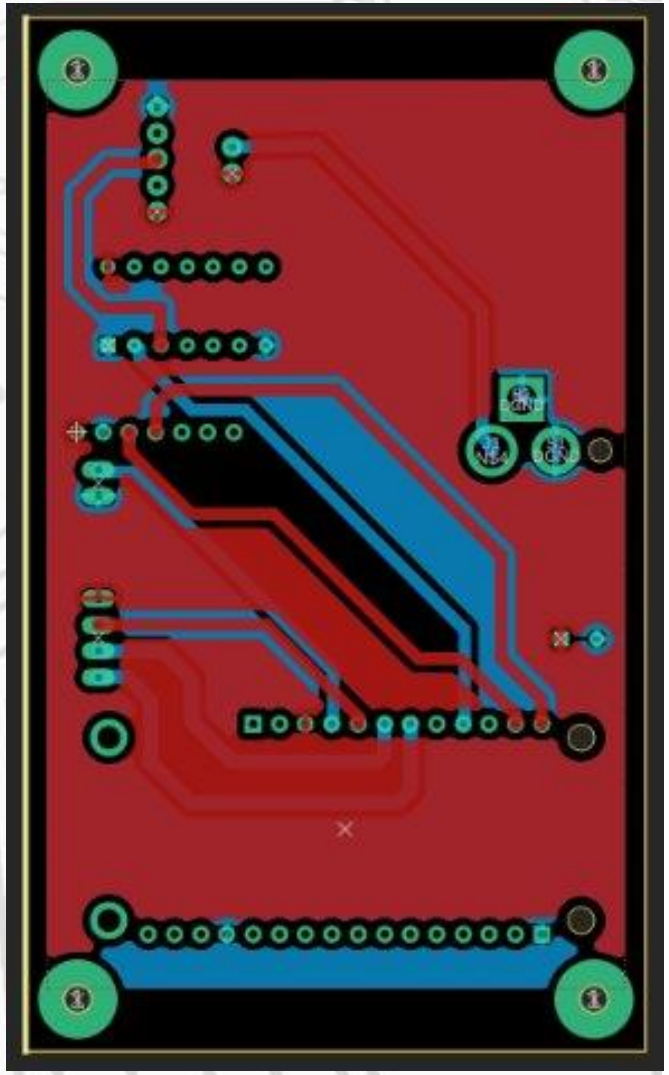


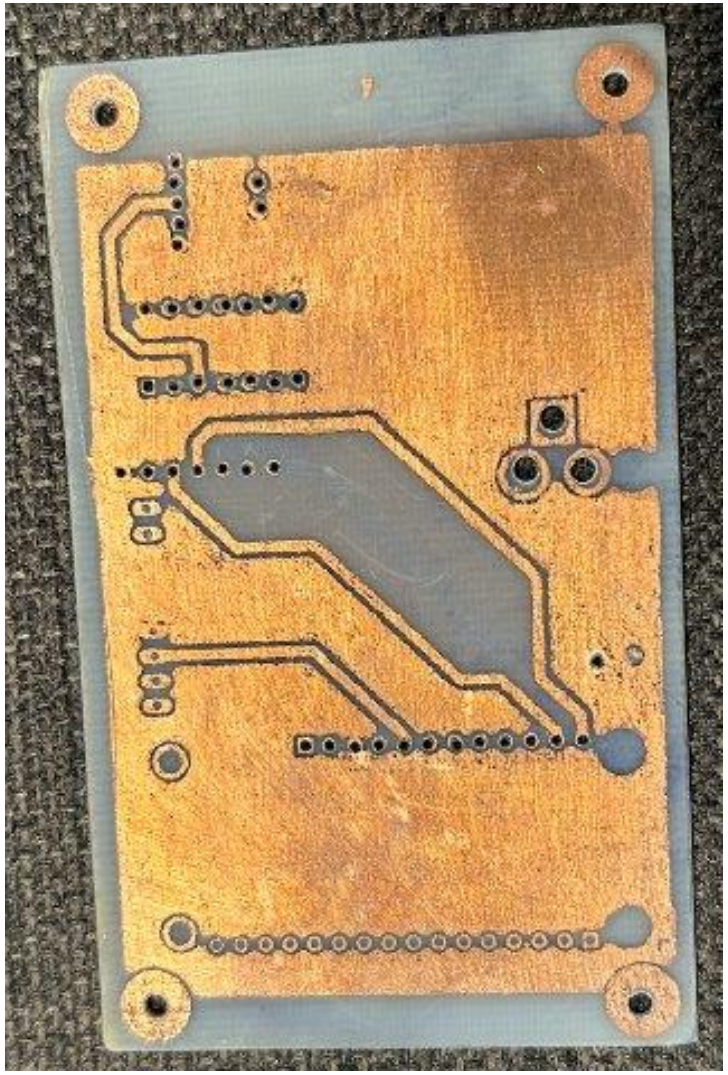
Dept.	Technical reference	Created by	Approved by
CASA		Satria Utama 17/03/24	
		Document type: Workshop drawing	Document status: Final Product
		Title: LED Cube	DWG No.
			Rev. 2.1 / Date of issue / Sheet 1/1

Advanced prototype

PCB

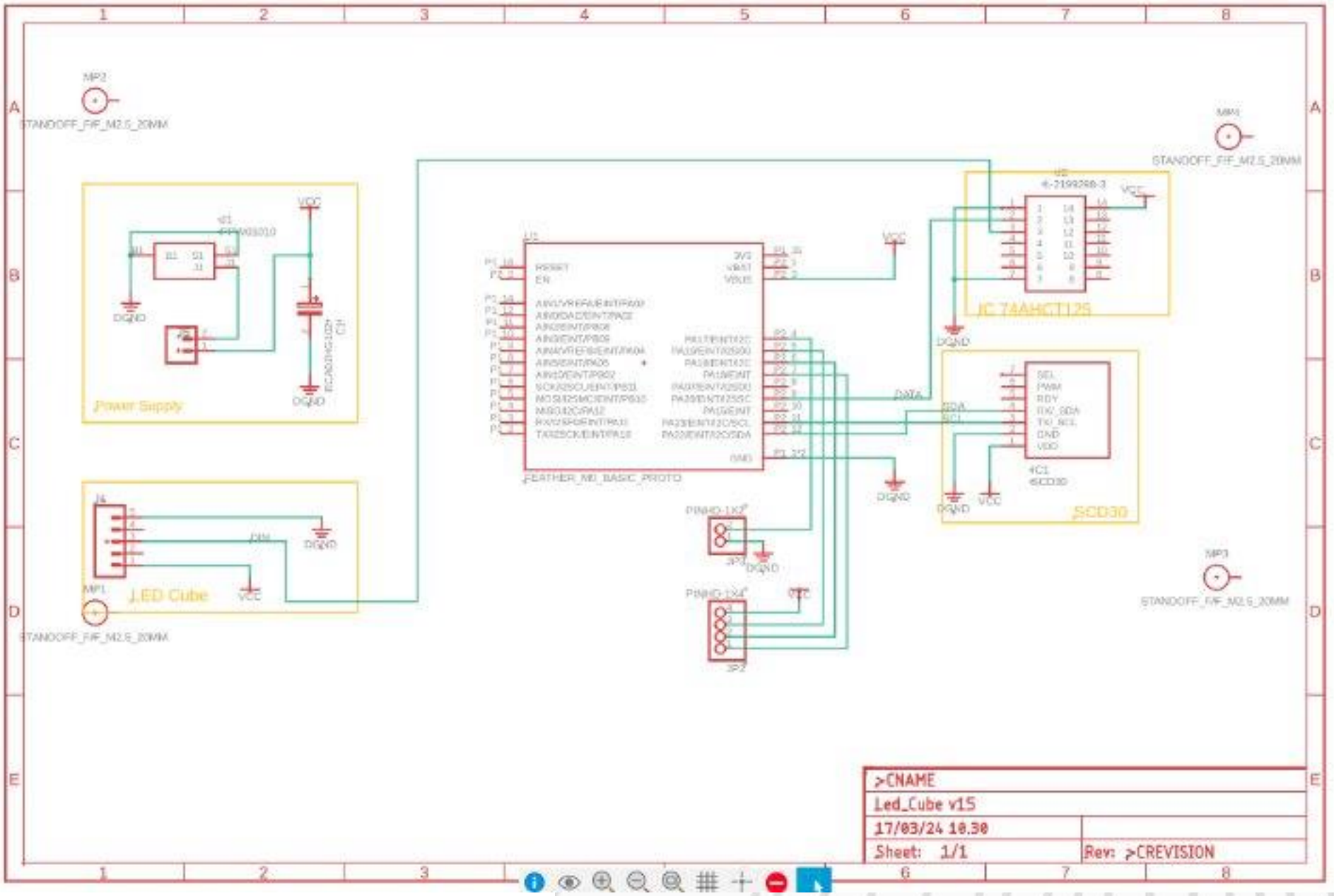






Advanced prototype

PCB



Who Can Benefit from Cube Matrix?

Broad Appeal:

- Suitable for homeowners, schools, and offices for easy indoor environment monitoring.

Educational Tool:

- Essential for teaching environmental science and raising awareness.

Health and Wellness:

- Beneficial for those focused on healthy indoor air quality and wellness.

Comparison with Existing Solutions

Conventional Tools:

- Complex, rely on numbers and graphs for data presentation.

Decorative LED Cubes:

- Mainly aesthetic, lacking functional depth.

Cube Matrix's Advantage:

- Offers a blend of functionality, simplicity, and engagement not found in current market offerings.

Sponsored
Seben 1200P W CO2 meter and monitor with traffic light, acoustic alarm, data logger for measuring air quality, relative humidity
21
£47.90
FREE delivery 22 - 26 Mar
Or fastest delivery Wednesday

Amazon's Choice
Amazon Smart Air Quality Monitor | Know your air, Works with Alexa
919
100+ bought in past month
£69.99
£15 off your first 3 Amazon Fresh orders
prime Same-Day & Overnight
FREE delivery Today by 22:00
Works with Alexa

+1 colour/pattern
Temtop Air Quality Detector, PM2.5 PM10 Particle Monitor Professional Laser Air Quality Sensor Meter Accurate Testing, P...
261
50+ bought in past month
£67.00 Was: £74.70
FREE delivery 21 - 22 Mar
Only 1 left in stock.

Temtop Air Quality Monitor PM2.5 Monitor AQI Meter Temperature Humidity Detector for Home Office or School Battery Powere...
267

SAF Aranet4 Home: Wireless Indoor Air Quality Monitor for Office or School (CO2, Temperature, Humidity and Mor...
1,098

Air Quality Mor
Multifunctional
Quality Detecto
Indoor Home, C
78

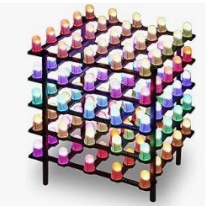
Conventional Tools

Decorative LED Cubes

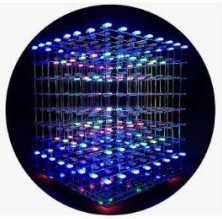
Sponsored
TEKLED Rotatable Cubes Outdoor LED Wall Light | Black 3000K Narrow Beam | Weather-Resistant IP54 Adjustable Outside Light | f...
Options: 2 sizes
£58.92
FREE delivery 21 - 22 Mar
Add to basket
Energy Efficiency Class: G

Mr.Go 4" LED Night Light Cube Lamp Color Changing Mood Light for Kid & Adult w/Remote, 16 RGB Colors, Dimmable, Rechargeable...
909
£24.99
prime Same-Day & Overnight
FREE delivery Today by 22:00
Add to basket
Energy Efficiency Class: G

Galaxy Projector Light for Bedroom,Ocean Wave LED Night Light Star Projector 16 Colors 30 Lighting Modes with Remote...
289
300+ bought in past month
£19.99
prime One-Day
FREE delivery Tomorrow
Or FREE delivery Today by 22:00 on orders over £20 of Prime Same-Day & Overnight item(s)
Add to basket
More buying choices
£15.83 (2 used & new offers)



Treedix Soldering Practice Project Kits, Individually Addressable 3D

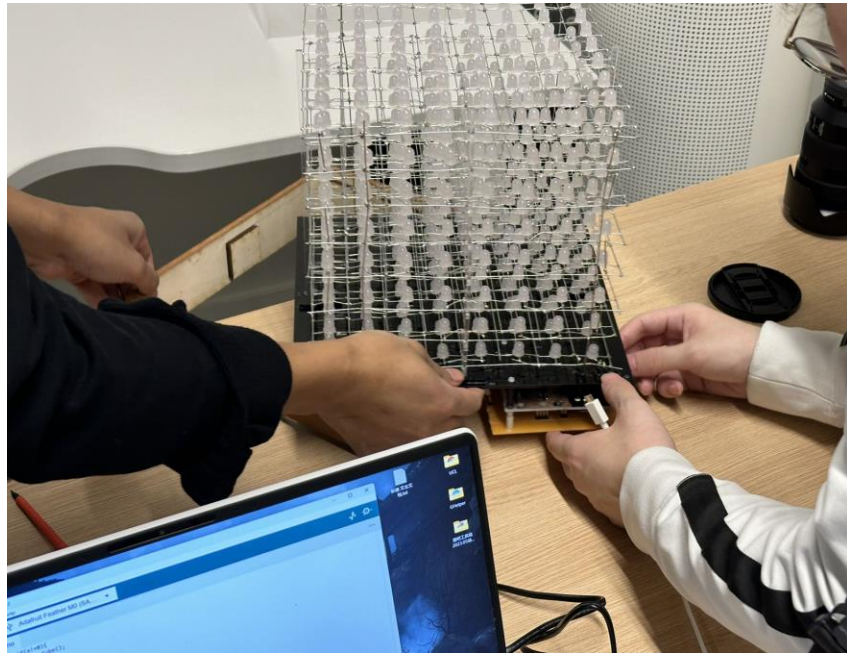
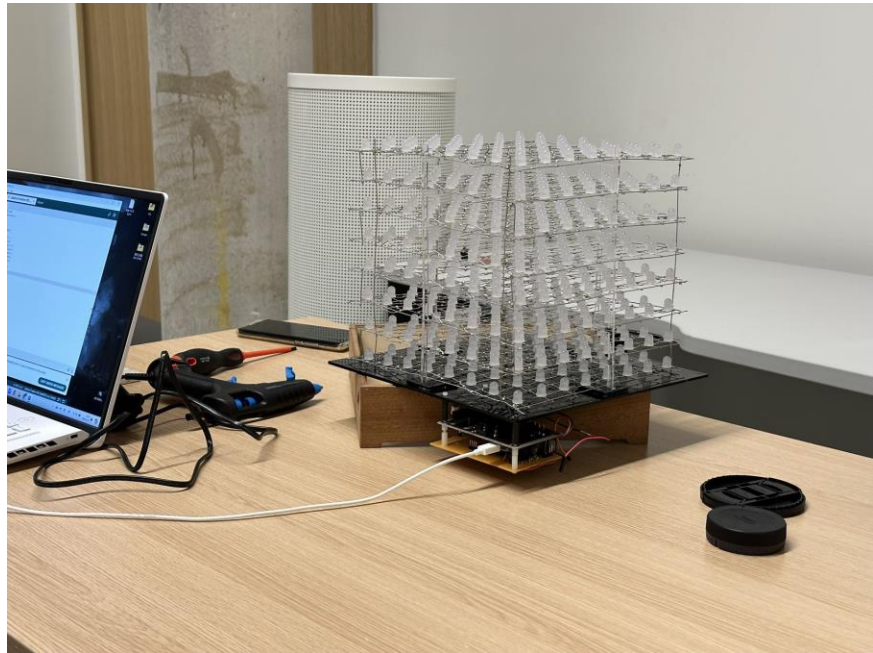


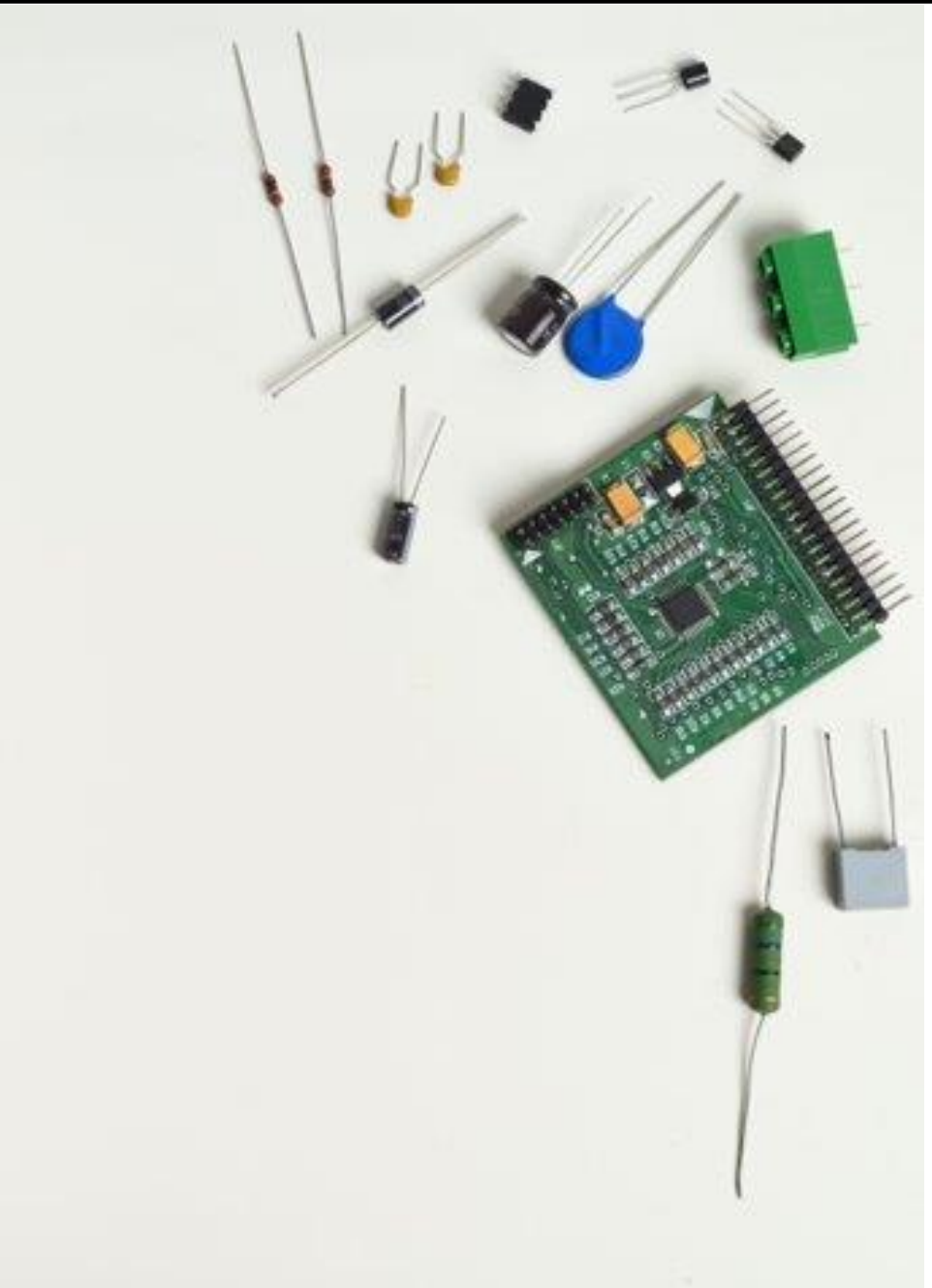
+3 colours/patterns
iCubeSmart 3D Led Cube Kit Diy

ACED Moon Lamp 2023 Upgrade with Timing 3D Printing Moon

Challenges and Limitations

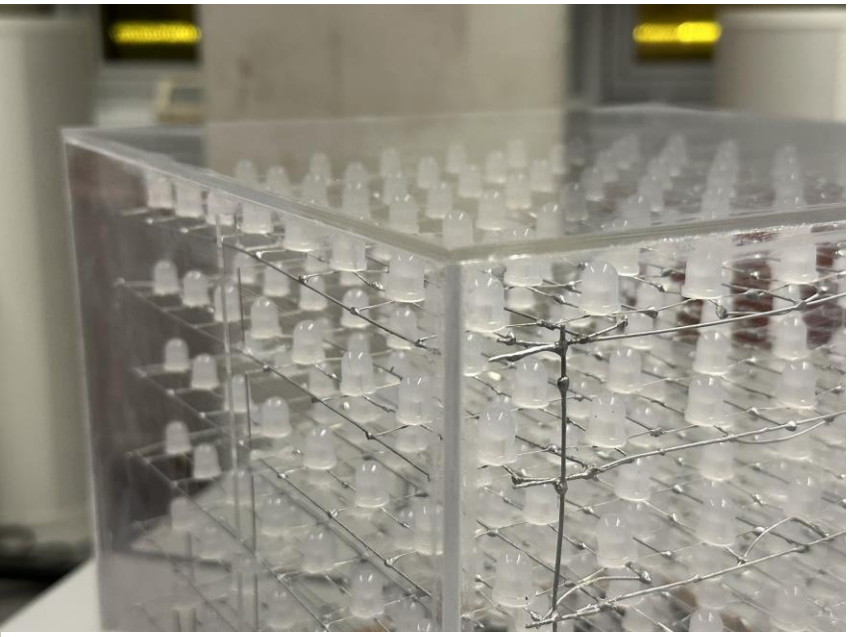
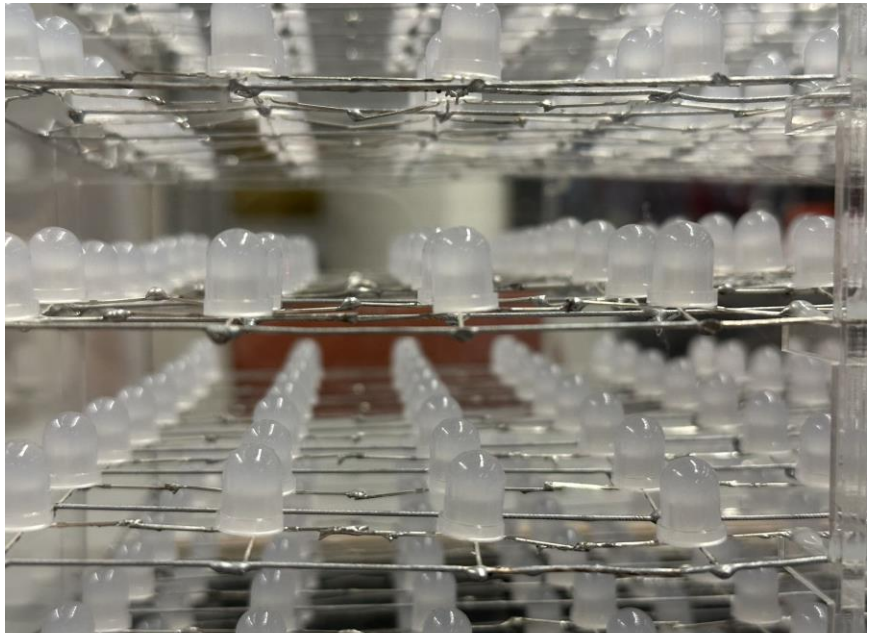
- **Core Challenge:** Merge temperature, humidity, CO2 into animations.
- **Design Challenges:** Address LED Cube's feasibility and coding.
- **Cost & Manufacturing:** Solve soldering errors and disconnections.
- **Maintenance Challenges:** Simplify maintenance and reduce damage risk.
- **PCB**



Future Improvement Measures

1. **Integration:** Refine algorithms for smoother animation data integration.
2. **Design:** Redesign Cube for simpler coding and better interaction.
3. **Manufacturing:** Upgrade to professional welding techniques and PCB.
4. **Maintenance:** Shift to modular design for straightforward updates and repairs.
5. **Data Points:** Add air quality indices for broader environmental tracking.



Thank!

Q&A Session.