

# Dynamic Lighting Arena for swarm robotics

## IRIDIA - CoDe

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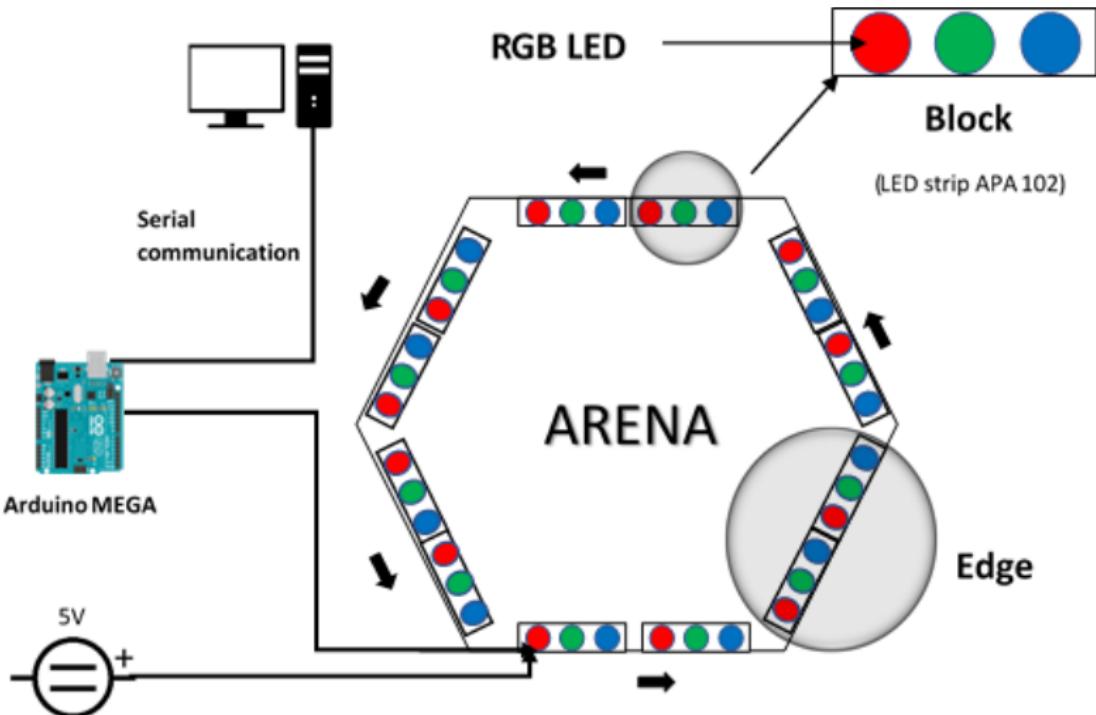
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# Dynamic Lighting Arena

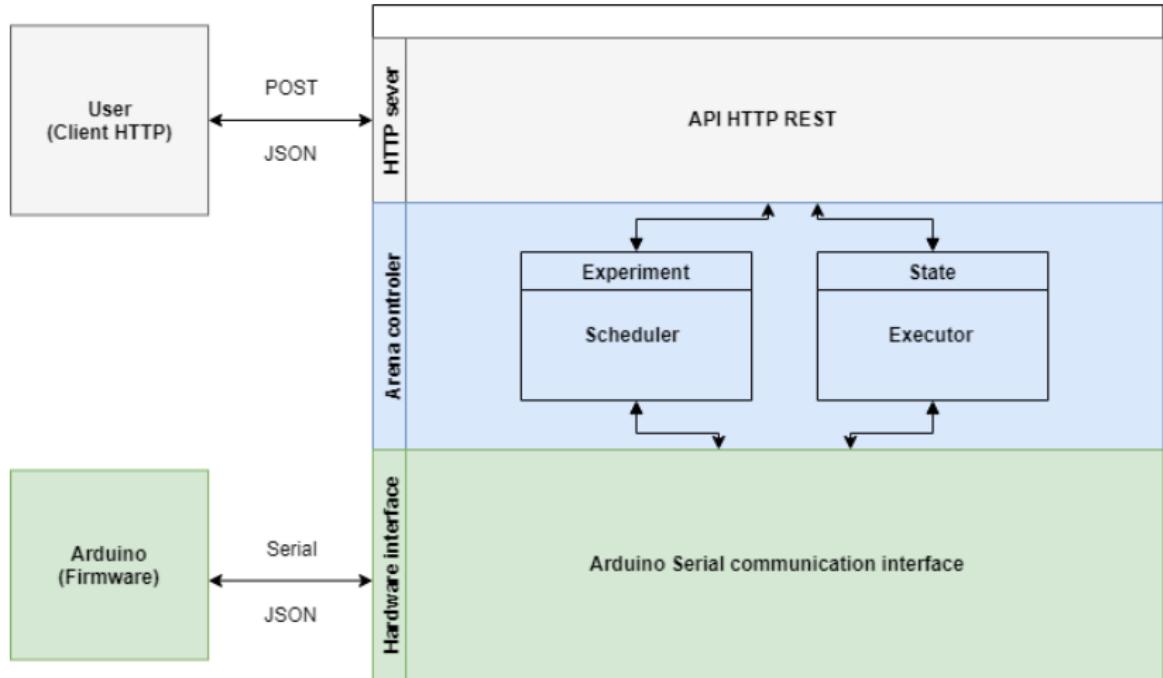
# Objectives

- Develop a **modular**, **flexible** and **dynamic** system for displaying colored signals in the walls that delimit the work space in experiments with swarms robots.

# Hardware architecture



# Software architecture



# Language (Arena)

Formally an **Arena** is an 8-tuple:

$$A = (ne, nb, nl, br, c, E, B, L) \quad (1)$$

- ne** : Number of edges. where  $ne \in \mathbb{Z}, ne > 0$
- nb** : Number of blocks per edge. where  $nb \in \mathbb{Z}, nb \geq ne$
- nl** : Number of LEDs per block. where  $nl \in \mathbb{Z}, nl \geq nb$
- br** : Arena brightness. where  $ne \in \mathbb{Z}, 0 \leq br \leq 100$
- c** : Component Color. where  $c \in C = \{\text{red, green, blue, yellow, none, omit}\}$

**Edge** is defined as an array of 4-tuples elements:

$$E = [(i_1, c_1, B_1, L_1), \dots, (i_{ne}, c_{ne}, B_{ne}, L_{ne})] \mid \varepsilon \quad (2)$$

- i** : Component index. where  $i \in I = \{(start, stop, step), (start, stop), (start)\}, start, stop, step \in \mathbb{Z}$
- $\varepsilon$**  : Empty set.

# Language (Arena)

$$A = (ne, nb, nl, br, c, E, B, L) \quad (1)$$

$$E = [(i_1, c_1, B_1, L_1), \dots, (i_{ne}, c_{ne}, B_{ne}, L_{ne})] \mid \varepsilon \quad (2)$$

**Block** is defined as an array of 3-tuples elements:

$$B = [(i_1, c_1, L_1), \dots, (i_{ne*nb}, c_{ne*nb}, L_{ne*nb})] \mid \varepsilon \quad (3)$$

**LED** is defined as an array of 2-tuples elements:

$$L = [(i_1, c_1), \dots, (i_{ne*nb*nl}, c_{ne*nb*nl})] \mid \varepsilon \quad (4)$$

# Language (Experiment)

Formally an **Experiment** is a 4-tuple:

$$EX = (tt, r, cl, S) \quad (5)$$

**tt** : Total time, in seconds, of the experiment if  $r = True$

**r** : Repeating Boolean flag. where  $r \in True, False$

if True the states repeats until the tt is finished.

**cl** : Clean Boolean flag where  $cl \in True, False$

if True clean the arena at the end of the experiment.

**States** is defined as an array of 2-tuples elements:

$$S = [(dt_1, A_1), \dots, (dt_n, A_n)] \quad (6)$$

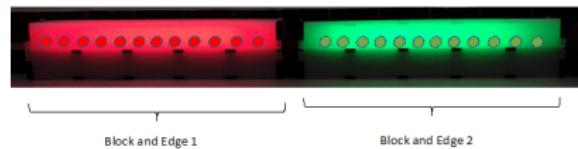
**dt** : Duration of a state in seconds.

**A** : Any valid arena configuration.

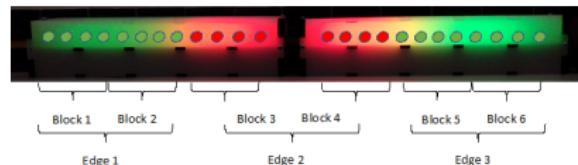
## Modular and flexible

$$A = (ne, nb, nl, br, c, E, B, L) \quad (1)$$

$$A_1 = (2, 1, 12, 100, \text{none}, E[(1, \text{red}, \varepsilon, \varepsilon), (2, \text{green}, \varepsilon, \varepsilon)], \varepsilon, \varepsilon) \quad (7)$$



$$A_2 = (3, 2, 4, 100, \text{green}, E[(2, \text{red}, \varepsilon, \varepsilon)], \varepsilon, \varepsilon) \quad (8)$$



# Conclusions

- I found that a critical aspect defining a **language** is the **expressiveness** that the language has to bring to the users, Thus the key aspect for the developing was the frequent meetings with the IRIDIA's team.
- I also found that to build the system variety of **tools** were available, however I had to discard some of them, **selecting the ones that better fits to the objectives of this project.**