Technical Specifications

Team 1 - Rubik's Art Project

Table of contents

I. Introduction

A. Team members

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B. Project

The project imagined by ALGOSUP is to create a fresco[1] using Rubik's cubes[2]. We have designed an image for a pixel art[3] representation at the entrance of ALGOSUP's building to promote the school and decorate the room where Rubik's art will be displayed.

II. Solution

The school has supplied us with a stock of Rubik's cubes for constructing the fresco in a pixel art style. Indeed, we need to use cubes consisting of 3x3x3 squares each with 6 colors available: White, Red, Blue, Yellow, Green, and Orange.

Once the fresco has been selected by the jury, each group is responsible for building a part of it using their methods.

Fresco :

Fresco of the team 1.

Next, we will need to utilize the countless combinations of colors on the cubes to reproduce each area of the fresco.

To achieve this, we have implemented an algorithm that automatically calculates how to rotate the Rubik's and provides us with a step-by-step solution. We make each face manually.

To present the fresco, we propose two different installation options :
- showcase, which doesn't need to fix Rubik's on the wall
- frame with a polycarbonate sheet, which needs to fix the sheet on the wall and Rubik's on the sheet
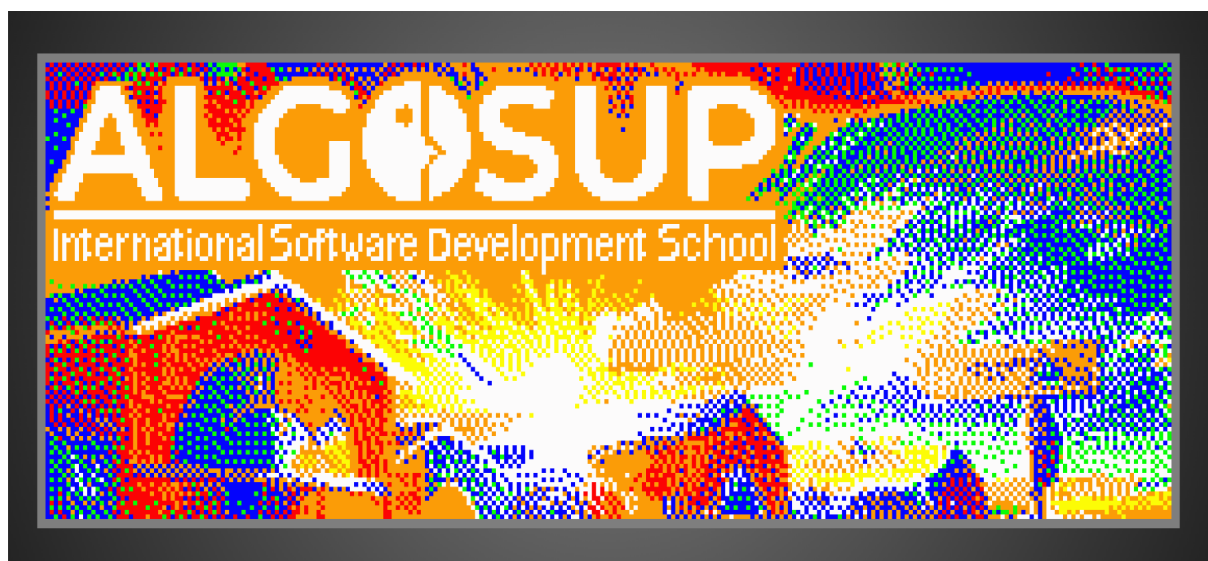
III. Application

A. Technologies

The application is implemented using the main web technologies, HTML, CSS, and JavaScript. Currently, it's running on the personal server of one of the team members.

B. Software architecture

Initially, an overview of the chosen fresco is provided. From this overview, you can select any Rubik's cube that comprises the fresco.
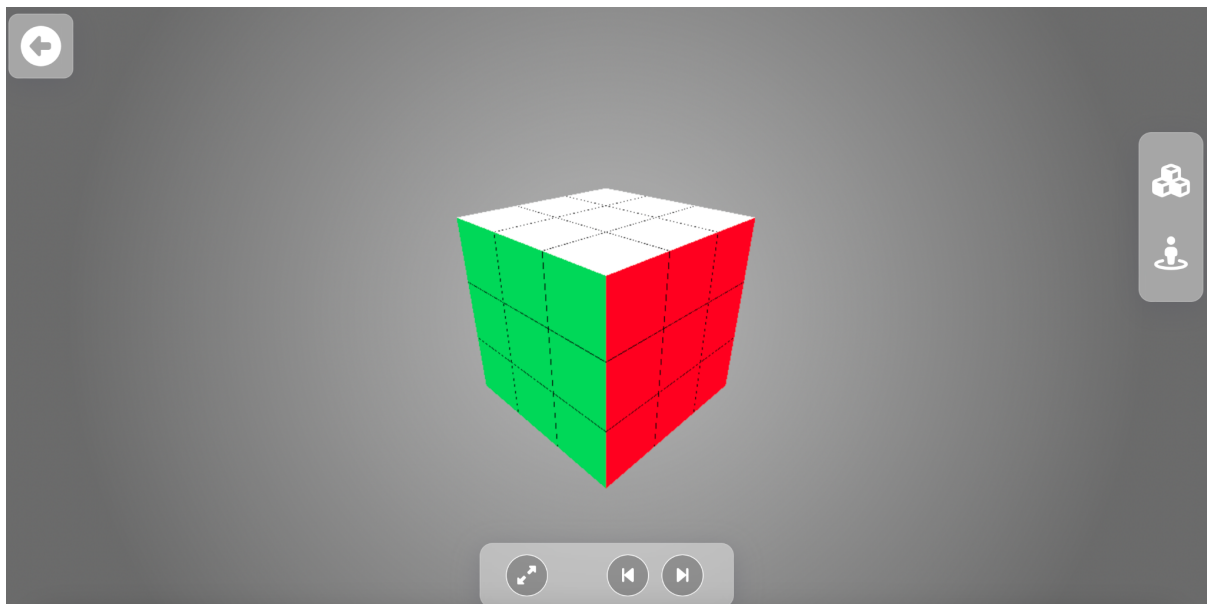

Home page of our solution.

You can hover your cursor over each Rubik's cube to see it more clearly. After clicking on the Rubik's cube you want, you will be redirected to a web page that displays only the Rubik's cube you have selected.

Result when you hover a Rubik's cube.

Result after you've clicked on a Rubik's cube.

Next, click the expansion button at the bottom to reveal all rotations needed to craft the desired face.

Here is the bottom menu bar, to see all the interactions you can have with the Rubik's Cube.

Once your menu is expanded you will see the menu that is above, following is the description of all the components:

1. Shrink Icon: The leftmost button minimizes the menu for a cleaner interface.
2. Trash Icon: The second button resets the Rubik's Cube to its initial state.
3. Left Arrow Icon: Located next to the Trash button, this button undoes the last move.
4. Algorithm Rectangle: The central section contains algorithms for Rubik's Cube patterns.
5. Right Arrow icon: The fourth button performs a single rotation step by step.
6. Double Right Arrow icon: The rightmost button executes a series of rotations in succession.

Team I - Rubik's Art Project

| Characters	Movement
F	Rotation of the Front Face.
B	Rotation of the Back Face.
L	Rotation of the Left Face.
R	Rotation of the Right Face.
U	Rotation of the Top Face.
D	Rotation of the Bottom Face.
x	Rotation of the entire Cube on the X axis.
y	Rotation of the entire Cube on the Y axis.
z	Rotation of the entire Cube on the Z axis.
'	This parameter indicates that the rotation is counter-clockwise.
2	This parameter indicates that the rotation is doubled.

table of letter signification

So in a nutshell, " **z' B' R' L B U' D2 R' L** " means to rotate the **entire Cube counterclockwise** on the **Z axis**, followed by a **counterclockwise** rotation of the **Back** Face, then a **counterclockwise** rotation of the **Right** Face, a **clockwise** rotation of the **Left** Face, a **clockwise** rotation of the **Back** Face, a **counterclockwise** rotation of the **Top** Face, **two rotations** of the **Bottom** Face, and finally, a **counterclockwise** rotation of the **Right** Face and a **clockwise** rotation of the **Left** Face.

We also have 2 two toggle switches on the right of the Rubik's Cube.
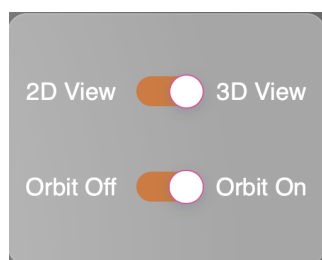
Here is the right menu bar, to control the view.

One is to select the view between 2D and 3D view. The other one is the orbit to move the Rubik's Cube on the right or left and zoom in and out.
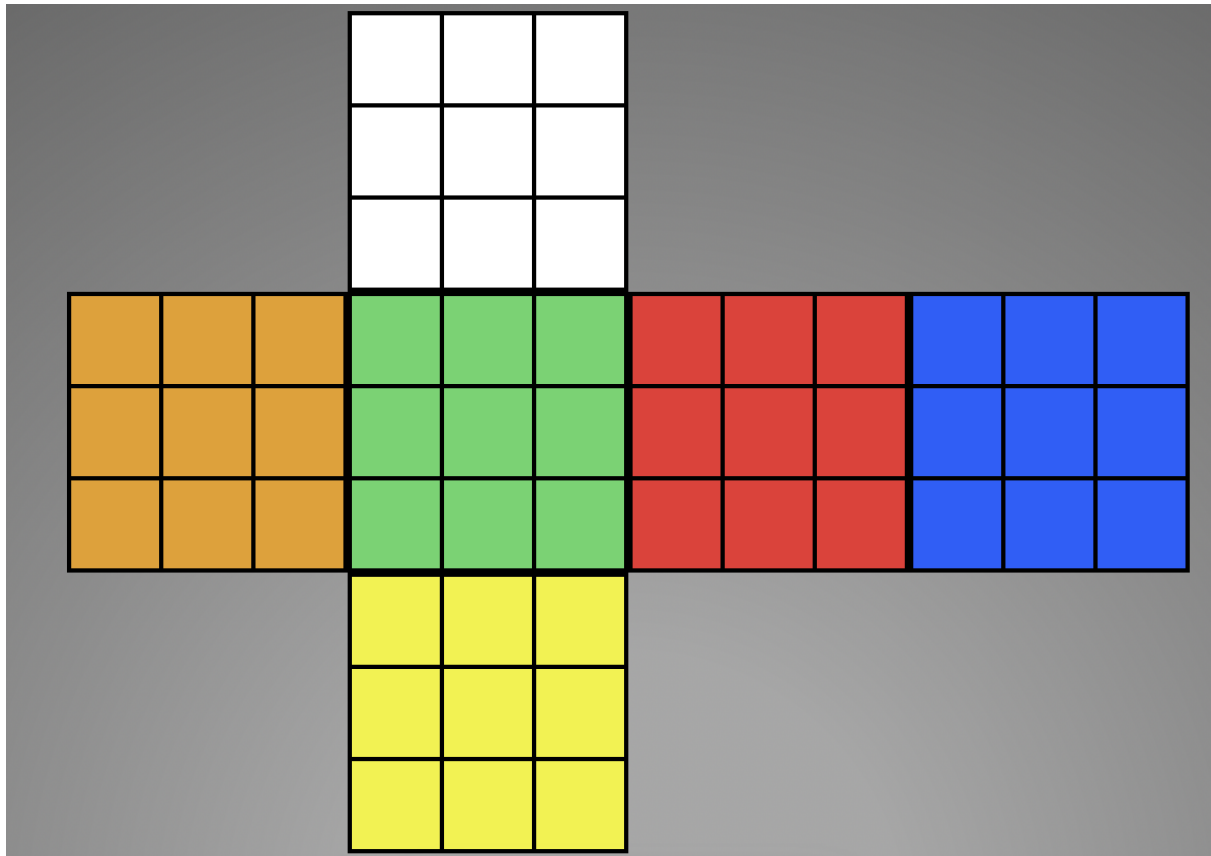
2D View of a Rubik's Cube in our solution.

Finally, we have an arrow to return to the overview to select another Rubik's Cube in the fresco.

Arrow on the top left to go back to the overview.

Team I - Rubik's Art Project

C. Technical constraints

Coding conventions:

Variable names:

All variable names will be written on snake_case.

```
let target_rotation_x = 0;
let target_rotation_y = 0;
let target_rotation_z = 0;
```

Comments:

To comment on a function the comment will be above the function to explain it.

```
//convert color names to hexadecimal values
function getColorHex(colorName) {
    switch (colorName) {
        case "red":
            return 0xed3030; // Red color in hexadecimal
        case "green":
            return 0x58d568; // Green color in hexadecimal
        case "blue":
            return 0x1c5ffe; // Blue color in hexadecimal
```

To explain a variable the comment will be next to the definition of the variable.

```
controls.target.set(0, 0, 0);
controls.enablePan = true; // Disable panning (i.e. right click + drag)
controls.enableZoom = true; // Disable zooming
controls.enableRotate = true; // Disable rotation
controls.enabled = true; // Disable controls altogether
```
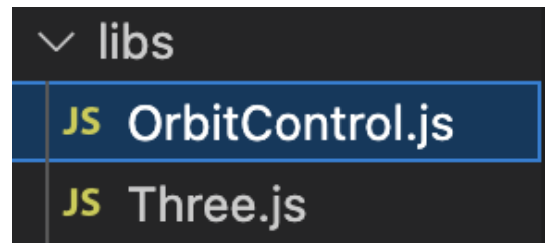
Function names:

All function names will be written on camelCase.

```
function animateStep() {
    const current_time = performance.now();
    const elapsed = current_time - start_time;
```
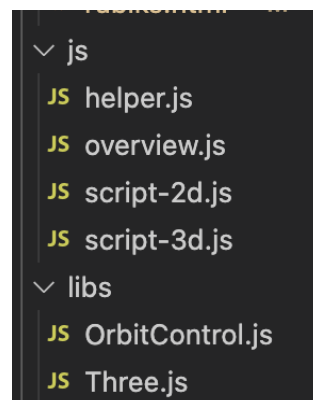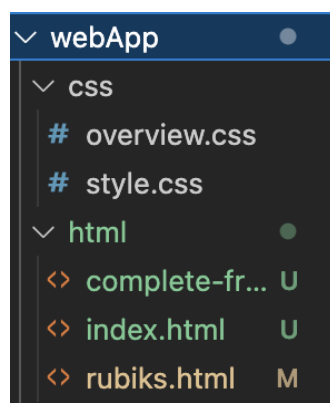
File names: all file names will be written on kebab-case.
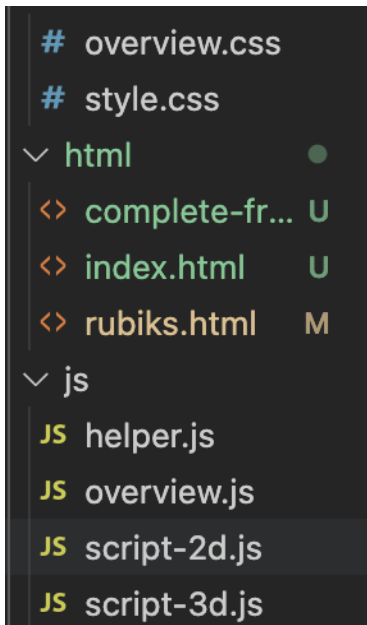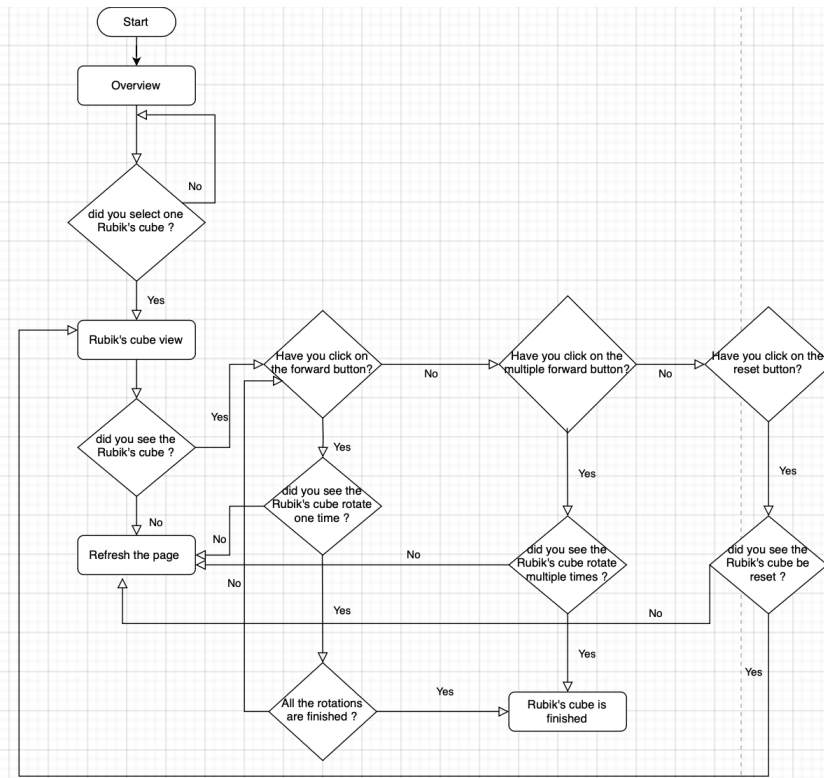

Library names: all libraries names will be written on PascalCase.

File architecture: All CSS files will be in the "css" folder, all HTML files will be in the "html" folder and all JS files will be in the "js" folder.

D. Flowchart diagram

E. Accessibility

Here is the link to the GitHub repository of our project:
https://github.com/robin-debry/rubiksProject

Here is the link to see the demo:
http://www.pierre-gorin.fr/Rubiks-Art/

IV. Showcase *presentation installation n°1*

The showcase is composed of a wooden[(4)] frame and a plexiglass[(5)] window.

The frame is made up of 6 wooden planks. 2 planks measuring 248 centimeters in width, 6 centimeters in depth and 2 centimeters in thickness each, from the base platform. They are positioned just above the sockets and fixed from below using screws and squares (3 per plank).

Additionally, there is 1 plank on each side, measuring 188 centimeters in width, running from the sides of the platform to the ceiling and fixed from the inside of the frame. The last two planks of the same size as the platform will make the top of the frame.

The window is made up of 5 panels of plexiglass measuring 188 by 100 centimeters placed vertically next to each other and screwed to the wooden frame.

Showcase cost:

MATERIAL	LINK	UNIT PRICE	DELIVERY PRICE <2 weeks	QUANTITY	TOTAL
wood 248x6x2	Brutdetable company	39.70€	6€/plank	6	274.20€
plexiglass 188x100x0.3	plexiglass-sur-mesure	71.70€	free	5	358.50€
screws/ brackets	Amazon		free		12.50€
glue	Amazon	4€	free	5	20€
					TOTAL
					667.20€ incl

Cost to build a showcase.
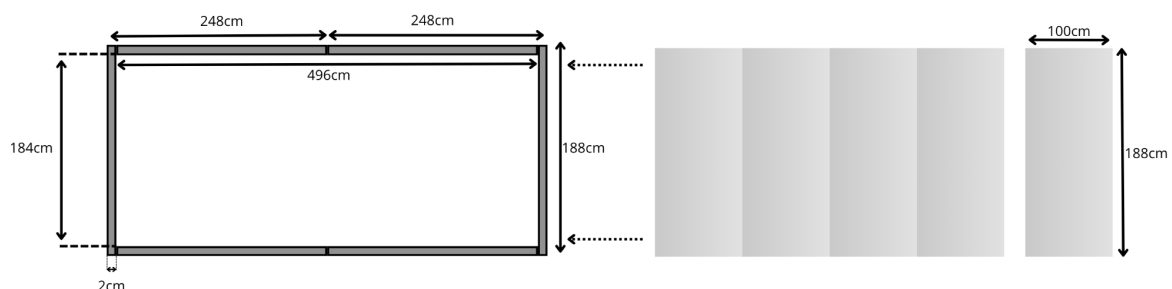
Sketch of the showcase.

V. Frame/sheet *presentation installation n°2*

The frame is made up of 4 wooden planks. 1 plank measuring 188 centimeters width, 6 centimeters depth and 2 centimeters thickness will create 1 side of the frame and another plank with the same criteria for the other side. The top of the frame has 2 planks of 248 centimeters width.

The Planks are fixed from below using screws and squares (3 per plank) from the inside of the frame.

For the background of the installation, we propose to put 4 polycarbonate[6] sheets (300 centimeters width and 98 centimeters height) which will be fixed to the wall and on which it will be possible to tape the Rubik's.

Frame/sheet cost:

MATERIAL	LINK	UNIT PRICE	DELIVERY PRICE <2 weeks	QUANTITY	TOTAL
wood 248x6x2	Brutdetable company	39.70€	6€/plank	4	182.80€
polycarbonate sheet l:98 L:300	Leroy Merlin	29.95€	36.90€	4	156.70€
screws/ brackets	Amazon		free		12.50€
double-sided tape	Amazon	6.45€	free	2	12.90€
				TOTAL	
					364.80€ incl
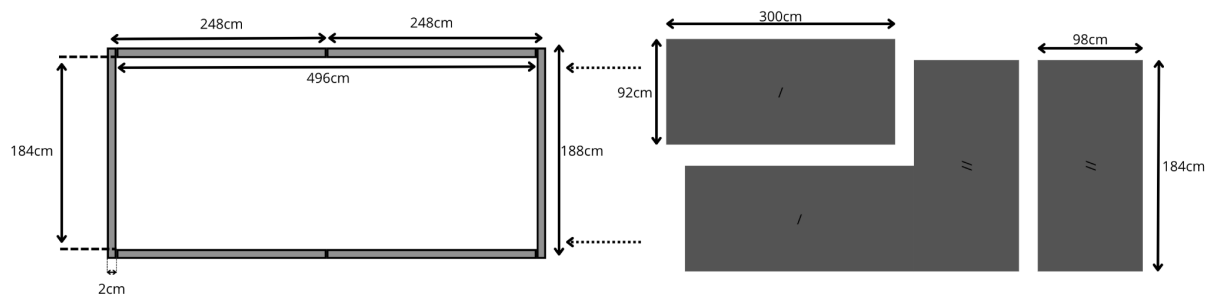
Sketch of the frame/sheet.

VI. Quality Control

A. Quality Control Objectives

To ensure that the Rubik's Art Project achieves the desired outcomes and meets ALGOSUP's expectations, a comprehensive quality control (QC) plan is essential. The primary objectives of the QC process are:

1) Ensure that the fresco accurately represents the intended pixel art image.
2) Verify the correct application and function of the software developed.
3) Confirm the durability and safety of the installations.
4) Foster coordination and communication among the 8 teams.
5) Address errors efficiently and promptly.

Team I - Rubik's Art Project

B. Team Coordination

Given that multiple teams are involved in the project, coordinated quality control is crucial. Steps for effective coordination include:

- **Centralized Communication:** Establish a centralized platform for communication where teams can raise concerns, provide updates, and request resources.
- **Regular Check-ins:** Schedule periodic check-ins where teams showcase their progress and receive feedback.
- **Shared Documentation:** Maintain shared documentation that logs errors, corrections, and observations for all teams to access and learn from.

C. Evaluation Criteria

To maintain consistency across all teams, standardized evaluation criteria should be adopted. Some of the key criteria include:

- **Accuracy:** The orientation and color scheme of the Rubik's cubes should align with the design specifications.
- **Software Performance:** The application should be user-friendly, provide accurate instructions, and have minimal bugs or errors.
- **Installation Durability:** Whether using the showcase or the frame with polycarbonate sheets, the installation should be sturdy, and with all components securely fixed.

D. Error Management and Corrections

Despite best efforts, errors may occur. To manage them effectively:

- **Error Logging:** Create a system where teams can log any errors or deviations they encounter.
- **Prioritization:** Classify errors based on their severity and impact on the project. Address critical issues first.
- **Correction Teams:** Designate members from each team to be part of a correction team, responsible for addressing and rectifying errors.

E. Documentation and Reporting

Maintain a comprehensive record of the QC process. This should include:

- **Daily Reports:** A summary of the day's work, including any errors encountered and how they were addressed.
- **Weekly Summaries:** A consolidated report of the week's progress, challenges, and learnings.
- **Final QC Report:** To conclude the project, compile a final report outlining the QC process, results, and recommendations for future projects.

VII. Further considerations

A. Cost estimation

1. Software

The application has been implemented without paid resources and it's not hosted by a server. There is no cost for the software side.

2. Hardware

We don't have a device to rotate Rubik's Cubes and the application only needs a computer. There is no cost for the hardware side.

3. Material

We have 2 different solutions to present and highlight the fresco. You have the choice between the showcase (667€) and the frame with polycarbonate sheet (364€). you can refer to the previous price table (IV and V categories) to decide which installation you want.

4. Time & Human

To create the fresco, the 8 teams, each composed of 6 or 7 members (49 students in total), have been assigned a section with approximately 370 Rubik's cubes to create the image, so between 52 and 62 Rubik's per person.
We estimate that each team requires between 9 and 10 hours to complete their portion of the mural, assuming an average of 90 seconds per Rubik's.
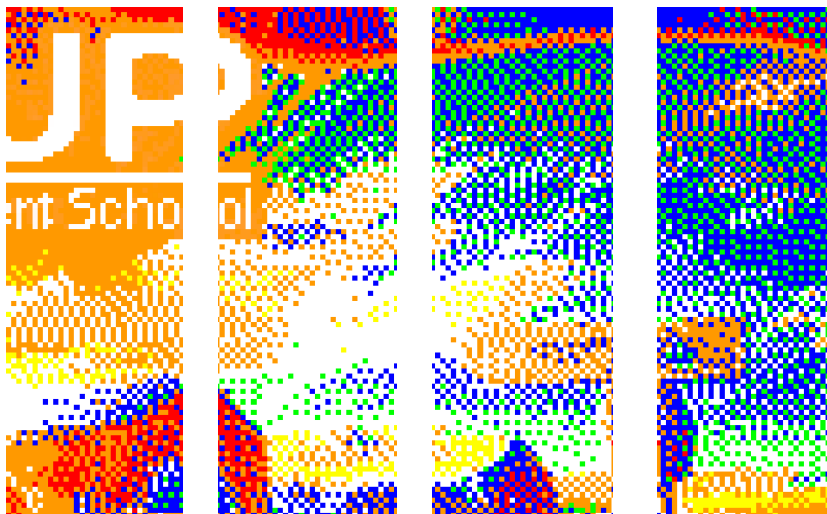
B. Distribution of the fresco
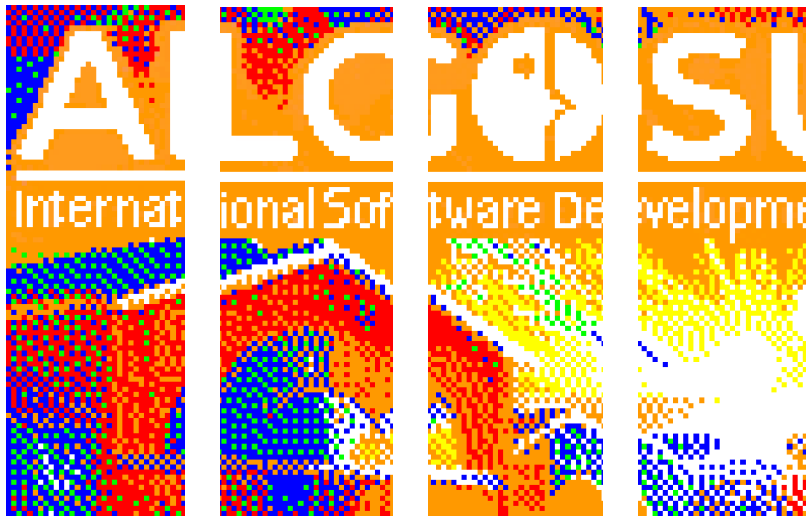
Team 1   Team 2   Team 3   Team 4

team 5   team 6   team 7   team 8

Glossary

1: Fresco

A Fresco is a wall painting generally applied with watercolor.

sources: [Cambridge Dictionary](#)

2: Rubik's Cubes

The Rubik's Cube is a puzzle invented by Ernő Rubik in 1974, and which quickly spread across the planet in the 1980s. It's a geometric puzzle that generally takes the form of a cube made up of nine small independent faces on each side of different colors (blue, white, red, yellow, green, orange), which can be moved on all sides of the large cube using rotations. A system of axes, whose mechanism has been patented by its author, is hidden in the center of the cube.

sources: [Wikipedia](#)

3: Pixel art

Pixel art is the plastic representation of the pixel. In other words, a square, colored surface has an elementary component.

sources: [Wikipedia](#)

4: Wood

Hard material constitutes the trunk, branches and roots of large plants.
The wood is a solid material that is aesthetic and low-maintenance, but very heavy.

sources: [Cambridge Dictionary](#)

5: Plexiglass

It's a transparent hard plastic imitating glass which is also called polymethyl methacrylate.
The disadvantage of plexiglass is that it yellows over time and has a slight reflection.

sources: [Cambridge Dictionary](#)

6: Polycarbonate

This macromolecular compound which the chain is formed by the regular repetitions of organic carbonate functions. It's strong, light and inexpensive.

sources: [Reverso](#)