Technical file

The holographic fan

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Illustration table

Introduction

A holographic propeller operates based on the retinal persistence of the human eye: a blade equipped with LEDs rotates at high speed, and the LEDs light up at specific angles. The synchronization between the rotation speed and the LED blinking frequency deceives the human eye, creating the impression of a static image floating in the air.

The students developed the project entirely from scratch. They imagined the product, identified the challenges, and proposed innovative solutions. They handled every stage, from designing and manufacturing the rotating blade to building the base structure and developing the image processing software.

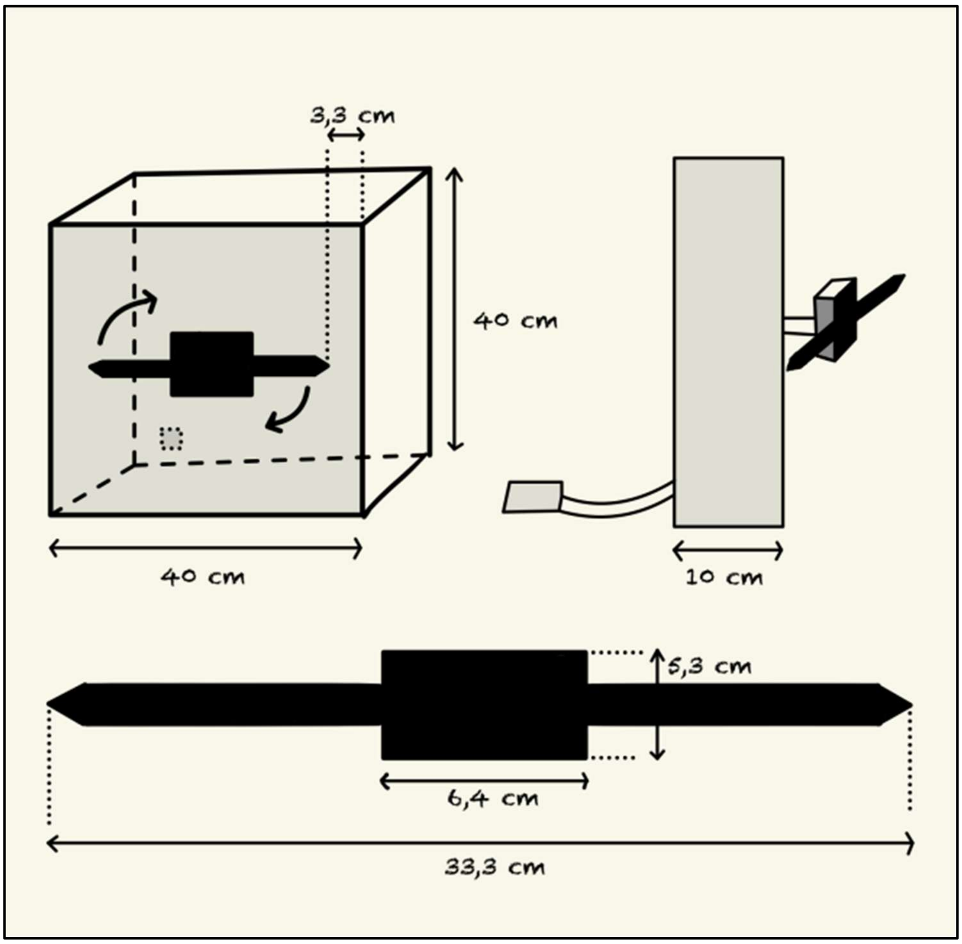

Figure 1-Stylized view of the fan, Source : Mustafa TOPBAS

The final product is designed to allow users to install the software which formats the image and displays it through the propeller.

Particular attention was given to the following high added value features that characterize this propeller:

1. **Initialization** – Determines the starting position of one blade to ensure a stable and correctly aligned image.
2. **Image Display** – Enables precise control of LED color and timing to display a clear and accurate image on the rotating blade.
3. **Accessibility and Educational Use** – Operated via a user-friendly application designed to make the system easy to control and to explain its underlying functioning, making it ideal for educational purposes.

The goal of this project is to be used by the Physical Engineering and Embedded Systems program during open house events, showcasing the practical and technical skills acquired by students throughout their training.

1- Functional synoptic diagram of the project

1-1 Use case

The use case presented in *Figure 2*, and created on Capella (for more detail, find the original document at https://github.com/cedric-da-cruz/HoloFan), describes the way different actors interact with the system of the fan. Blocks 1 and 3 are the different actors and block 2 is the fan. The darker inside blocks are the main functions of each block.

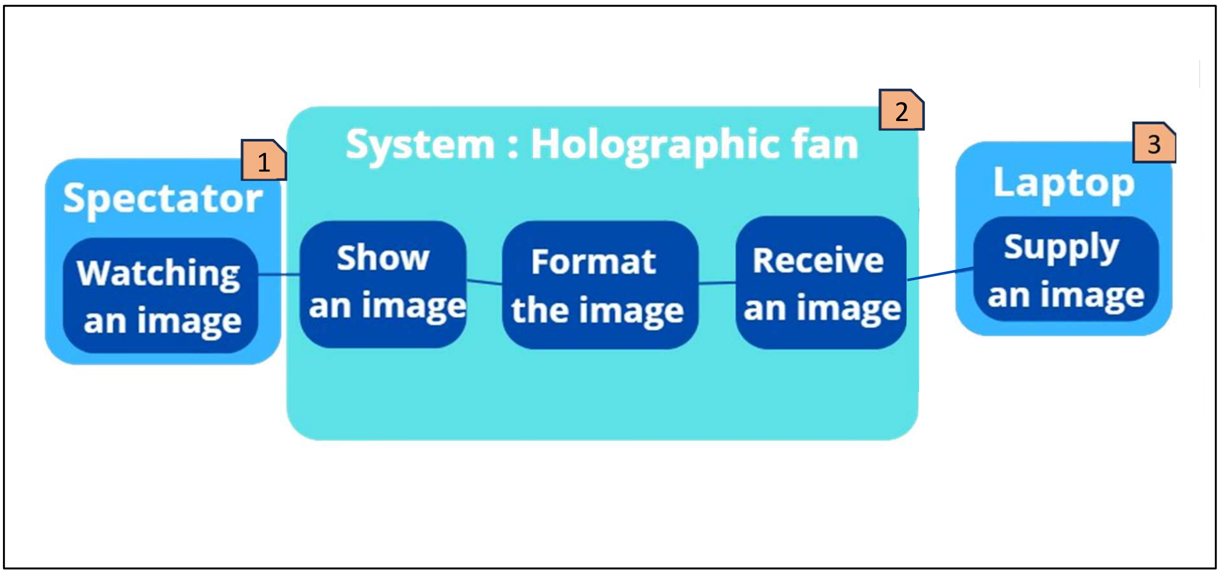

Figure 2-Use case of the project, Source: Axel LEROY

1-2 Fast diagram

The purpose of the FAST diagram shown in figures 3, 4 and 5 is to review the main functions found during the product life-cycle analysis, to draw up a specification table.

The life cycle corresponds to the various stages in the manufacture of the object, from design to disposal.

This table structures the project by identifying the main functions, then progressively breaking them down. Each line corresponds to a main function, and the more you read to the right, the more detailed the function becomes until it reaches measurable or testable elements. The columns associate requirements or technical solutions with each function. This organization makes it possible to clarify objectives, plan the design and visualize interactions between functions without prioritizing their performance.

Main function	Sub Function 1	Sub Function 2	Sub Function 3	Sub Function 4
Easily transportable				
	Be compact			
	Be lightweight			
	Resist impacts			
Be divisible into several parts				
	Design a modular structure			
		Avoid numerous connections		
		Limit the number of modules		
Easily mountable				
	Be quick to assemble			
		Have a limited number of assembly steps		
		Require little assembly time		
	Require minimal tools			
Rotate to display an image				
	Rotate the fan			
		Rotate the LED strip		
			Rotate the LED strip simultaneously	
			Rotate the LED strip quickly	
			Have a sufficient number of LED strips	
			Have the required power to rotate the LED strips	
	Light up the LEDs			
		Light up the LEDs at the right moment		
			Identify the position of the LEDs	
				Light up the LEDs according to angular position
		Display without being disturbed by surrounding light		
			Ensure sufficient brightness	
		Have a sufficient number of LEDs		

Figure 3-FAST diagram (part1), Source : Abigaïl BROCHARD

Main function	Sub Function 1	Sub Function 2
Import an image from the user's device		
	Access user files	
		Restrict selection to predefined formats
Process the imported image		
	Automatically resize	
	Adjust quality	
	Preview image	
Export the image to the fan		
	Connect software to fan	
		Connect quicky
		Maintain a stable connection
		Be close to the fan
	Export the image to the fan quickly	
Be intuitive to use		
	Easily access features	
		Require minimal scrolling to access main features
	Guide the user	
		Display the process (instructions) on the home screen

Figure 4-FAST diagram (part2), Source: Abigaïl BROCHARD

Main function	Sub Function 1	Sub Function 2
Ensure rotation stability		
	Limit vibrations	
		Distribute weight evenly on the base
	Reduce wind resistance	
Power supply		
	Prevent the user from coming into contact with the fan during operation	
		Maintain a minimum distance from the user
	Protect the user's eyes	
		Do not exceed a luminance threshold
Power electrically		
	Provide sufficient voltage	
	Adapt power to components	
Facilitate recycling at end-of-life		
	Use recyclable materials	
	Make system components accessible	

Figure 5-FAST diagram (part3), Source: Abigaïl BROCHARD

1-3 Specification table and conformity test

The purpose of the specification table shown in figures 6,7 and 8 is to establish criteria that we can test. Those criteria are established upon the subfunction found with the FAST diagram. The final product is later tested with those criteria to verify its conformity to the specifications table.

It's read left to right, the first column being the main function on which is based the criteria. Then there are the criteria, and they're wished value (If a value can be used). After it the tolerance around those values depends on the importance of the function. And lastly, the conformity tests which will be used to check the conformity of the product.

Main function	Criteria	Value	Tolerance	Conformity
Easily transportable				
	Volume	< 500x150x600 mm	+ 20mm	Measure
	Weight	< 5 kg	+1kg	Weigh
	Force	10 N	+/-1	Apply pressure
Be divisible into several parts				
	Number of connections	<10	+2	Count
	Number of modules	<5	+1	Count
Easily mountable				
	Number of steps	<5	+1	Count
	Time	<5min	+30s	Clock the time
	Type/Nb of tools	<=1	+1	Count
Rotate to display an image				
	Simultaneous	x	x	
	Rotation speed	>700RPM	-50RPM	Datasheet/by using the angular sensor
	Number of LED strip	>=2	-1	Count
	Electrical power	>24W	+/-1W	Measurer using a multimeter
	angular position	x	+/- 1°	Datasheet
	Luminance	>1200cd/m2	-100cd/m2	Simulation on Tracepro
	number of LEDs per blade	>=180	+/-1	Count
Import an image from the user's device				
	Image formats	png, jpg, jpeg .gif	x	Test with each predefined format

Figure 6-Specification table (part1), Source: Cédric DA CRUZ

Process the imported image				
	Dimensions	1:1	x	Use an image with a different ratio and check the adaptation
	Number of pixels	>[512x512]	-10	Calculate from rotation speed and flashing speed/Compare real image and display image
	Visible image	x	x	Do you see the image on the app/site
Export the image to the fan				
	Connection time	<10 s	+2 s	Clock the time
	Bandwidth	> 2Mbps	-0,1 Mbps	Calculate from export time and send file size
	Distance	<10 m	+ 1 m	Try at the maximum distance requested and beyond until the cutoff
	Export time	<10 s	+2 s	Clock the time
Be intuitive to use				
	Number of scrolls	<= 1	+1	Count
	Guided use	x	x	Give the app to newbies and ask what they think of it
	Clear interface	x	x	Give the app to newbies and ask what they think of it
Ensure rotation stability				
	Weight distribution	x	x	
	Wind resistance	x	x	Blow on it and check if it spins
Power supply				
	Distance	>10 cm	-2 cm	Try to touch the fan when it is operating and see if you can touch it
	Luminance	<1500 cd/m2	+100 cd/m2	Using a luminance meter
Power electrically				
	Voltage	>12 V	-0,5 V	Use a voltmeter
	Electrical power	x	+/- 1 W	
Facilitate recycling at end-of-life				
	Recyclability of materials	x	x	Check recyclability of materials, avoid composite materials
	Accessibily of components	x	x	Check the accessibility of the different components individually

Figure 7- Specification table (part2), Source: Cédric DA CRUZ

2- System architecture and scenario

2-1 System architecture

The system architecture shows the main components used for the system, their behaviors and their relationship with each other.

A simplified overall view of the architectural system made with Capella is presented in *Figure 4*. The original document can be found on the web at https://github.com/cedric-da-cruz/HoloFan. The system is composed of seven elements: the power supply (block1); the motor (block 3); the fan/blades (block 4); the microcontroller (block 5); the Bluetooth module (block 6); the angular sensor (block 7); the application (block 9). Blocks 2 and 8 are the actors/users that interact with the system. This system architecture is followed by a scenario to make it clearer.

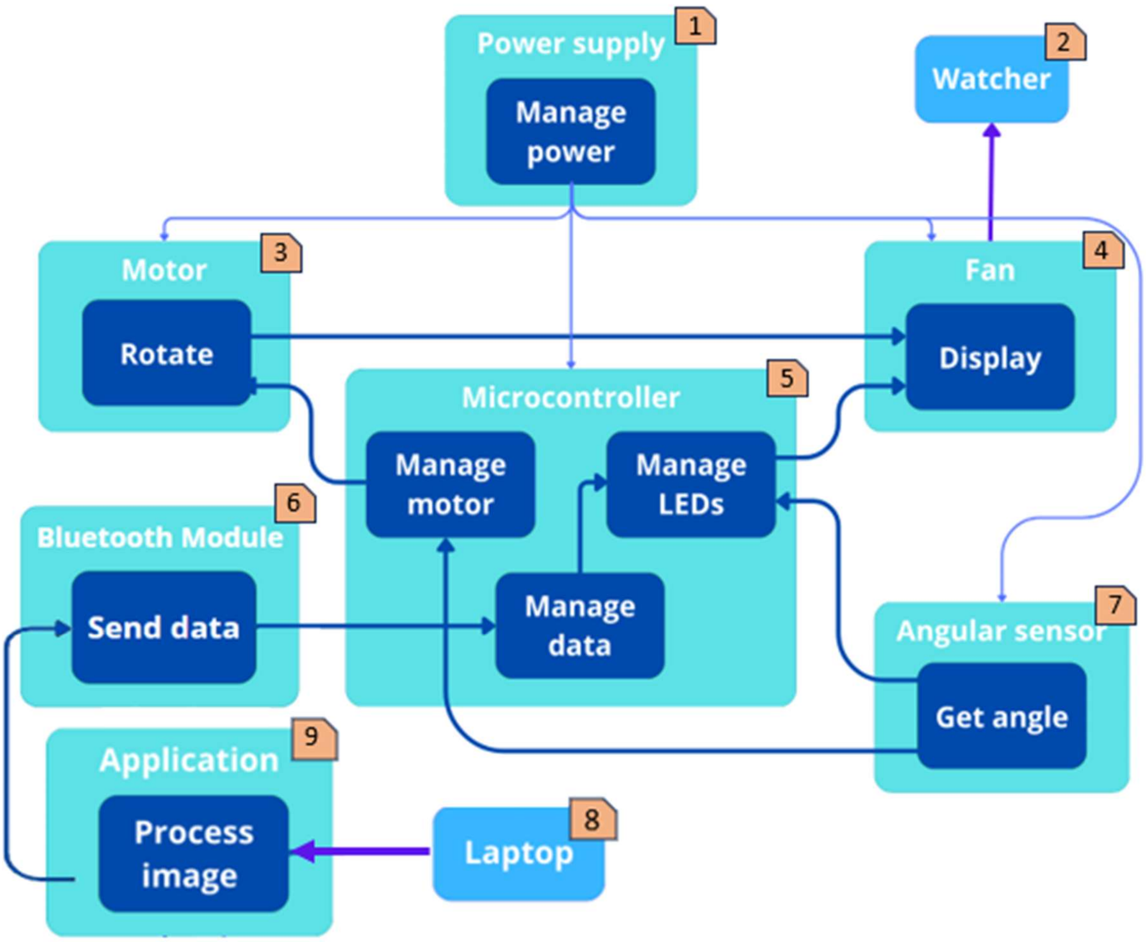

Figure 8-Global view of the system architecture, Source: Axel LEROY

2-2 Scenario

First, an actor will use the application to format the image and to send its data to the Bluetooth module, that transfers it to the microcontroller. The microcontroller will, in an array, for each pixel (LED), for each angle, associate the right color. This is the application and data management. Then, the motor has to start and reach its cruise velocity. The angular sensor will be able to measure the speed of the blade and will make sure that the cruise velocity is reached and stable. This is the motor management. Finally, the fan will be rotating and for each angle measured by the angular sensor, the LEDs will light up with the right colors according to the array created in the data management. This is the fan, angular sensor and LEDs management.

To understand in more detail how the fan works, refer to the next chapter.

3- Functional set

This section will present, in order, the different components of the system that enable the product to function: the motor, the PCB (including how it is powered through the motor-PCB connection, its purpose, and the components it contains), the LEDs, the angular sensor, Arduino, and Bluetooth module, the image processing and display (explaining how the image is received and formatted — resolution and size specifications, conversion of RGB data and pixel positions from Cartesian to polar coordinates, and data transmission), and finally, the enclosure.

3-1 Power supply

Solutions were identified and implemented for this part of the project. The system is powered by sector. Energy transmission between the rotating and fixed parts is achieved using inductions coils.

General system power supply view

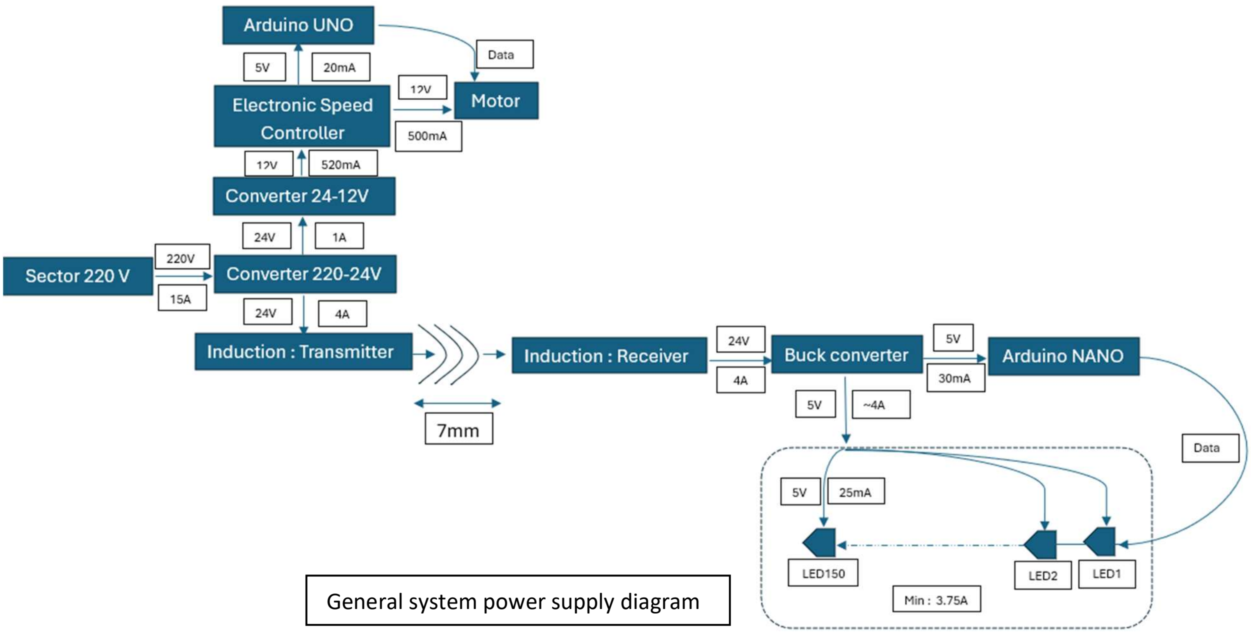

Figure 9--General system power supply view, Source: Mustafa TOPBAS

This diagram describes the power supply for each system component. It is read from left to right. The sector represents the power source. It arrives at an adapter that gives us 5 A. This current is then divided between the system components. The induction component delivers 100W. At a distance of 7mm, the power transmitted is not reduced, tests have proven this. A buck converter is a power supply circuit that steps down a higher input voltage to a lower output voltage with high efficiency. The leds are powered in parallel, which limits the use of amperes, while the data is routed in series.

3-2 Motor & Motor management

A A2212/15T 930KV brushless motor is used with a 30A ESC (Electronic Speed Controller), images of the components are shown below on figures 10 and 11.

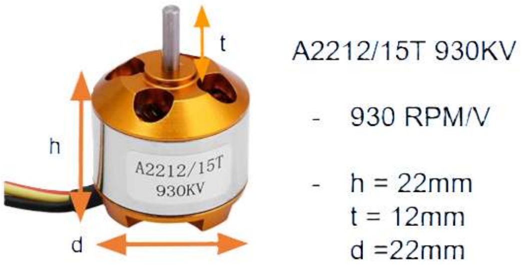

Figure 10-Picture of the motor, Source: Cédric DA CRUZ

It's a tri-phased motor which spins by alternatively changing the magnetic force of the motor's coils. This model is a cylinder, 22mm high and with a 12mm radius. It has 15 turns per magnetic poles and can generate a speed of 930 RPM / Volts. It will be powered at 12 Volts by the ESC which equate to a maximum speed of 11 160 RPM.

Figure 11-Picture of the ESC, Source: amazon.com

The 30A ESC will transform a PWM impulsion received by a microprocessor into a tri-phased signal to regulate the spinning speed, which means the motor will turn at a percentage of the max speed. The mean speed of rotation is 1600 RPM. The ESC can be powered between 2 and 12 Volts. The width of the PWM impulsions is determined by a data signal sent by an Arduino card connected to the ESC.

As a mean to verify the specs of the motor(without a load), its power consumption was plotted as a function of the spinning speed, see figure 12.

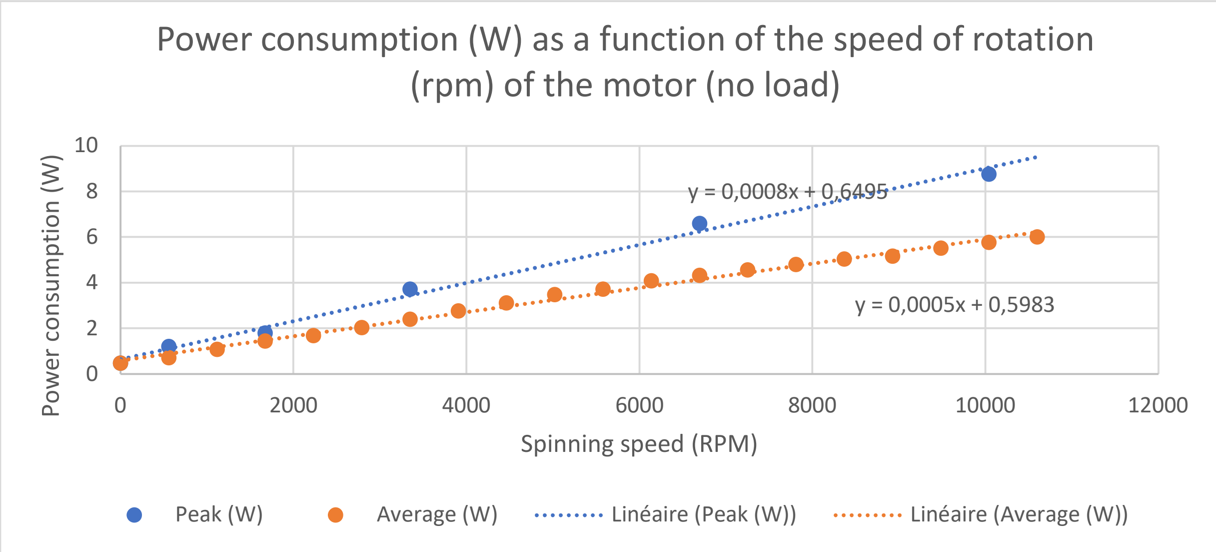

Figure 12-Graphic of power consumption, Source: Cédric DA CRUZ

An Arduino code is used to initialize the motor and then make it spins. The PWM width is of 1063 which equate to 700RPM. The code is available on the web at https://github.com/cedric-da-cruz/HoloFan.

A test was conducted to establish the ratio between the width of the PWM impulsion and the spinning speed.

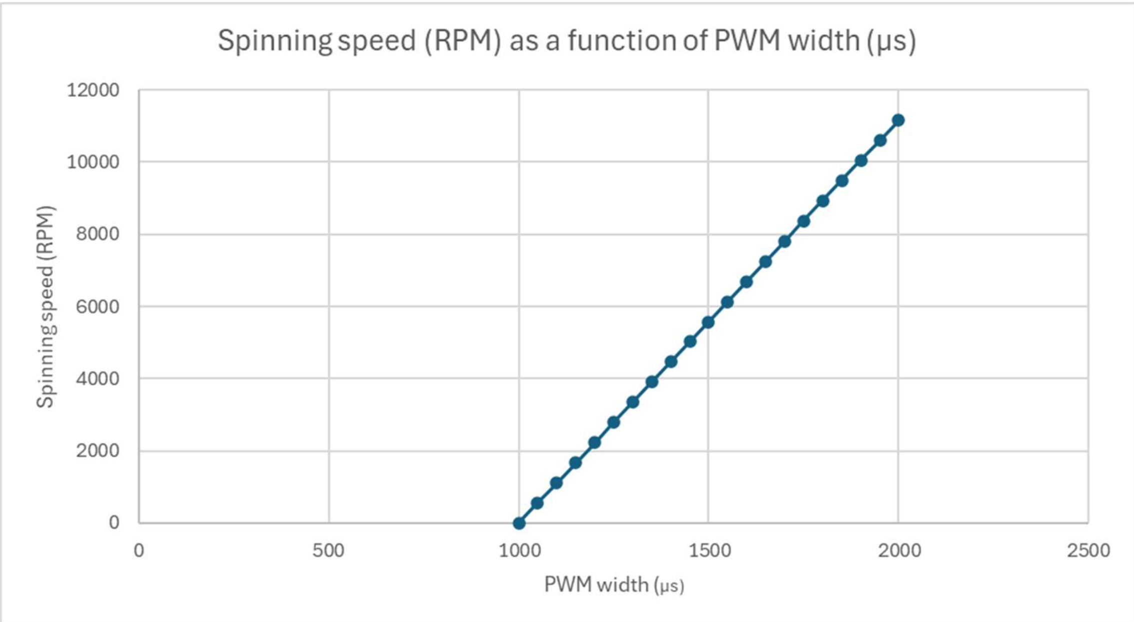

Figure 13-Plot of spinning speed to PWM width Source : Cédric DA CRUZ

3-3 PCB electrical diagram and PCB

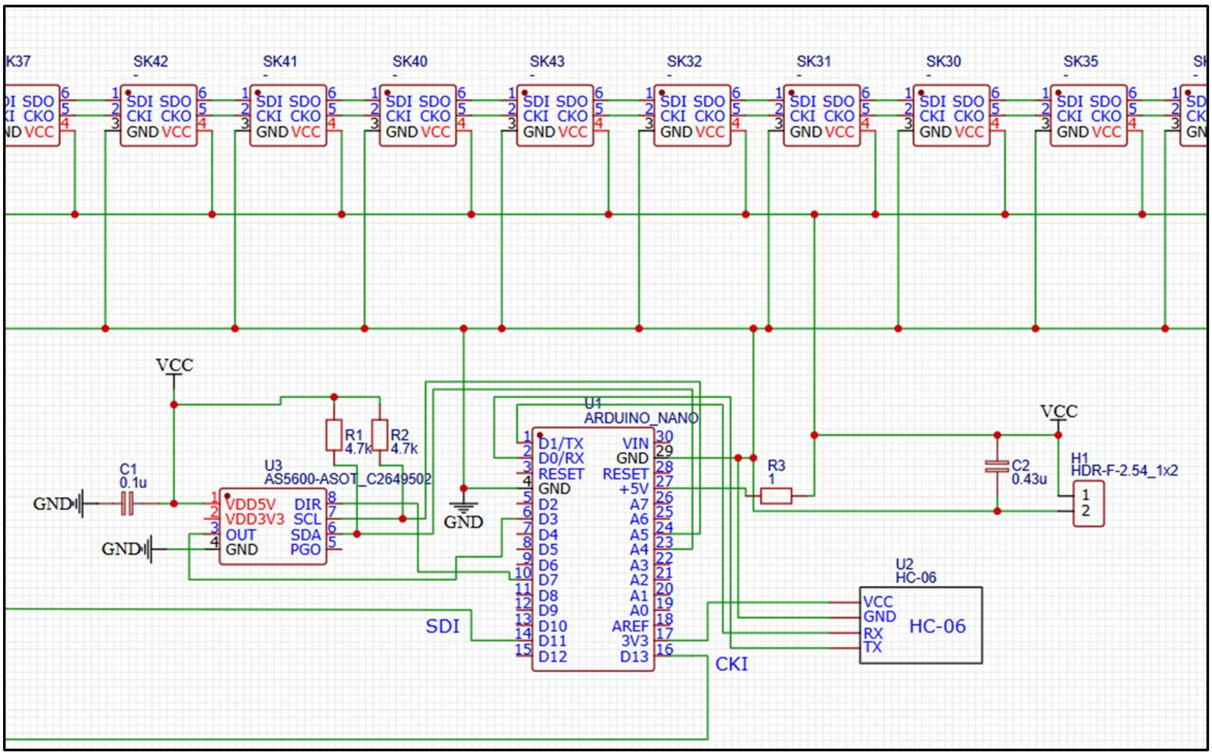

Figure 14-Extract from the blade electrical diagram, Source: Abigaïl BROCHARD & Mustafa TOPBAS

There are 50 LEDs aligned and connected to each other. They are powered in parallel, while the data flows in series. The microcontroller in the center is an Arduino Nano, which controls the components on the PCB. These include the angular sensor (U3), the Bluetooth module (U2), and the various LEDs. Power is supplied through H1, which is a HDR F 2.54_1x2 — a 2-pin female connector with a 2.54 mm pitch, used for simple electrical connections between PCBs or modules. The angular sensor operates either in PWM or I²C mode; in this case, I²C was chosen because it is significantly faster according to the product's datasheet. The schematic was completed with pull-up resistors for the angular sensor and various capacitors to regulate voltage and reduce noise on the PCB. The PCB was made once the electrical diagram had been checked.

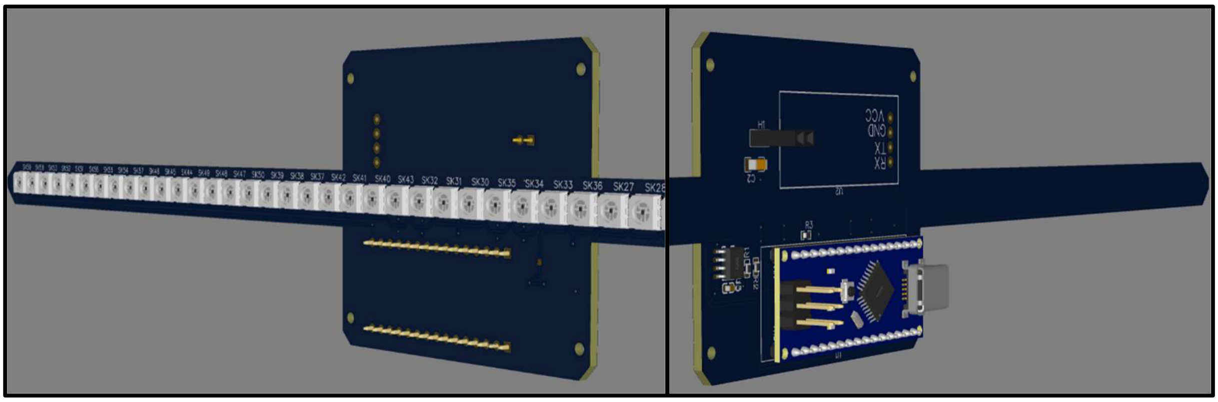

Figure 15-Front and rear screenshots of the 3D PCB view, Source: Mustafa TOPBAS

The PCB was also designed using EasyEDA. The LEDs were placed on one side, while the components were positioned on the other. This layout was necessary to maintain a continuous line of LEDs. A ground plane was added on the LED side to avoid using additional ground wires, which would have been very difficult due to overlapping with the power lines. Moreover, the ground plane offers several advantages, such as reducing electrical noise, improving signal integrity, and simplifying the grounding of components. Holes have been drilled to fix the PCB to a 3D box, which in turn will be linked to the running motor, and this box will contain components such as the buck that we can't fit on the PCB.

Figure 16-PCB sizing, Source : Mustafa Topbas

The PCB's width is too large for the equipment available at Polytech's Fab Lab. Indeed, when it approaches 30cm, manufacturing at Polytech begins to become tricky. The PCB was therefore manufactured by a subcontractor: JLCPCB.

3-4 LEDs

SK9822 are individually addressable 5x5 mm RGB LEDs, optimized for use with a fast two-wire SPI protocol (Data In and Clock In). Each LED incorporates a control circuit that enables precise control of color and luminous intensity, thanks to a 32-bit frame structure consisting of one control byte and three bytes for the red, green and blue channels. They operate at 5V ± 0.2V and consume up to 60 mA each at full white light. Their maximum communication frequency is up to 30 MHz, making them particularly suitable for applications requiring high refresh rates and smooth display, such as high-definition LED panels or dynamic lighting effects. SK9822s also feature internal brightness modulation via PWM, enabling more precise color rendering, even at low intensity. Their operating temperature ranges from -20°C to +70°C, guaranteeing robustness in a variety of environmental conditions. Stable even at high speeds, they remain reliable for complex assemblies with many LEDs in series.

Figure 16 is a table summarizing the various SK9822 data.

Criterias	SK9822
Communication protocol	SPI: 2 wires (Data In + Clock In)
Max communication frequency	Up to 30 MHz
Frame structure	32 bits: 1 control byte (0b111xxxxx) + 3 bytes RGB
Power supply voltage	5.0 V ± 0.2 V
Max current per LED	RGB max (3 × 20 mA) = 60 mA per LED
Brightness (RGB white @ 100%)	~550–650 mcd
Operating temperature	-20°C to +70°C
Signal latency per LED	~0.4 µs per LED at 30 MHz (slightly faster)
Power consumption at 150 LEDs	150 × 60 mA = 45 W max (at 100% white)
Logic input voltage	Data/Clock HIGH ≥ 3.3V
High-speed stability	Very stable, but slight flicker may appear above 20 MHz

Figure 17-Summary table of SK9822 LED data, Source Abigaïl BROCHARD

3-5 Angular captor, Arduino and Bluetooth module

The angular sensor determines the position of each LED so that they can be lit in the right color. The AS5600 is a non-contact magnetic angular position sensor, designed to accurately measure a 360° angle of rotation, without a mechanical stop. It operates on magnetic fields generated by a small magnet placed in front of it, which eliminates wear and extends system life. The sensor delivers 12-bit resolution, 4096 distinct positions over a complete revolution, ensuring very fine angle measurement. It communicates via a standard I^2C interface but also offers an analog output in PWM or voltage format, depending on configuration. Powered from 3.3V to 5V, the AS5600 is extremely flexible to adapt to different microcontrollers. Its low power consumption, stable operation over a wide temperature range (-40°C to +125°C) and ability to be programmed to adjust start angle or rotation range make it an ideal choice for applications requiring reliable angle feedback, such as electric motors, joysticks, or precision robotic systems.

Figure 17 is a table summarizing the various AS5600 data.

Criterias	AS5600
Measurement type	Non-contact angular position
Measurement range	0° to 360° (without mechanical stop
Resolution	12 bits (4096 steps per revolution)
Communication interface	I^2C
Supply voltage	3.3V to 5V
Power consumption at 150 LEDs	~1. 5 mA in typical operation
Operating temperature	40°C to +125°C
Programmability	Yes (angle range, direction, etc.)
Latency	Typically 1-2 ms
Magnetic field sensitivity	Recommended magnet: 4 mT to 8 mT at 0.5 mm

Figure 18-Summary table of AS5600 data, Source Abigaïl BROCHARD

The Arduino Nano is a compact development board, based mainly on the ATmega328P microcontroller, ideal for embedded projects where space is limited. It has most of the features of an Arduino Uno but is much smaller (only 45x18 mm) and can be plugged directly into breadboards. The Arduino Nano operates at a voltage of 5V (or 3.3V, depending on the version) and offers 14 digital pins

(6 of which can be used for PWM) and 8 analog inputs. It also features a UART, I²C and SPI serial interface, making it highly versatile for controlling sensors, motors or communication modules. Programmed via a USB mini-B port, it features a bootloader for easy code upload without the need for an external programmer. Thanks to its low power consumption, ease of integration and extensive ecosystem, the Arduino Nano is particularly well suited to rapid prototyping projects, connected objects or lightweight embedded systems requiring simple, reliable control.

In figure 18 is a table summarizing the various Arduino nano data.

Criterias	Arduino nano
Microcontroller	ATmega328P
Operating voltage	5V or 3.3V
Digital pins	14 (including 6 PWM)
Analog inputs	8
Available interfaces	UART / I^{2}C / SPI
Flash memory	32 KB
Clock frequency	16 MHz
Programming port	USB mini-B

Figure 19-Summary table of Arduino nano data, Source Abigaïl BROCHARD

The Bluetooth model will receive the colors that each LED should have according to their positions, and with the Arduino nano, the LEDs will be lit according to the position detected by the angular sensor.

The Bluetooth module is a HC-06. Its specifications can be found in *Figure …*

HC-06	
Bluetooth version	Bluetooth 2.0
Range	10m
Frequency	2,4 GHz
Max data transfer rate	2,1 Mb/s
Communication protocol	UART
Power supply	5V
Dimensions	16X37mm
Max data transfer rate	5V

Figure 20-HC-06 specifications, Source Axel LEROY

It is soldered to PCB and connected directly to the Arduino.

3-6 Image processing and display

The application will get the image from the laptop and process it so that the Bluetooth module and the Arduino can read the data correctly. The application also allows the user to zoom in and out of the image and move it around, while reducing pixelization by using interpolation. The diagram, *figure 20* shows a scenario of using the application.

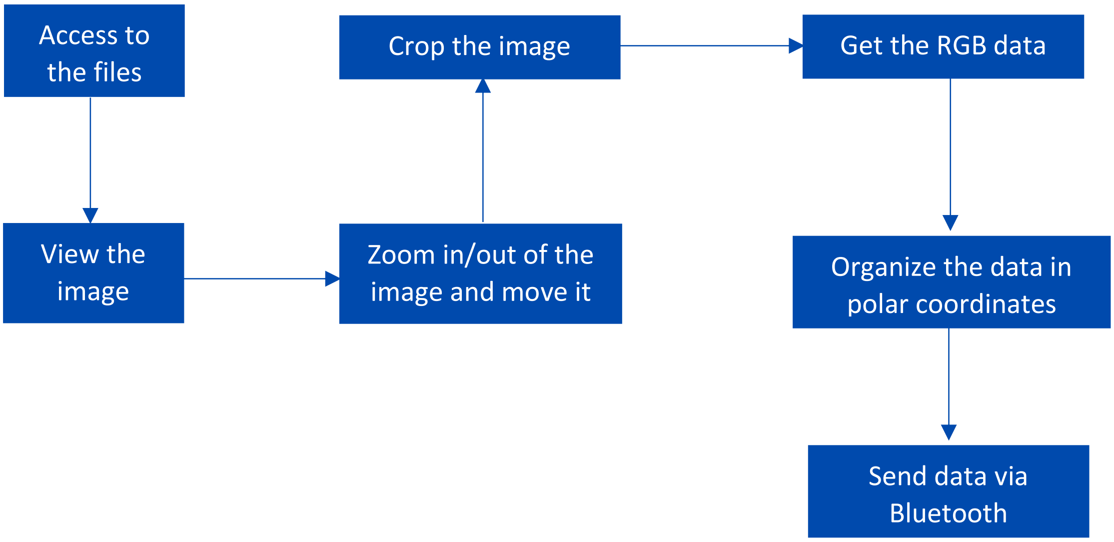

Figure 21-Scenario using the application, Source: Axel LEROY

3-7 Mechanical structure

Two mechanical structures were fabricated, a support for the motor and a case for the PCB:

- The support, schematics shown figure 21, is a box made of reprocessed wood. Its dimensions are 40*40*10 cm, for a weight of 4kg. It maintains the motor stable, and it also stocks the electrical components that power the system.

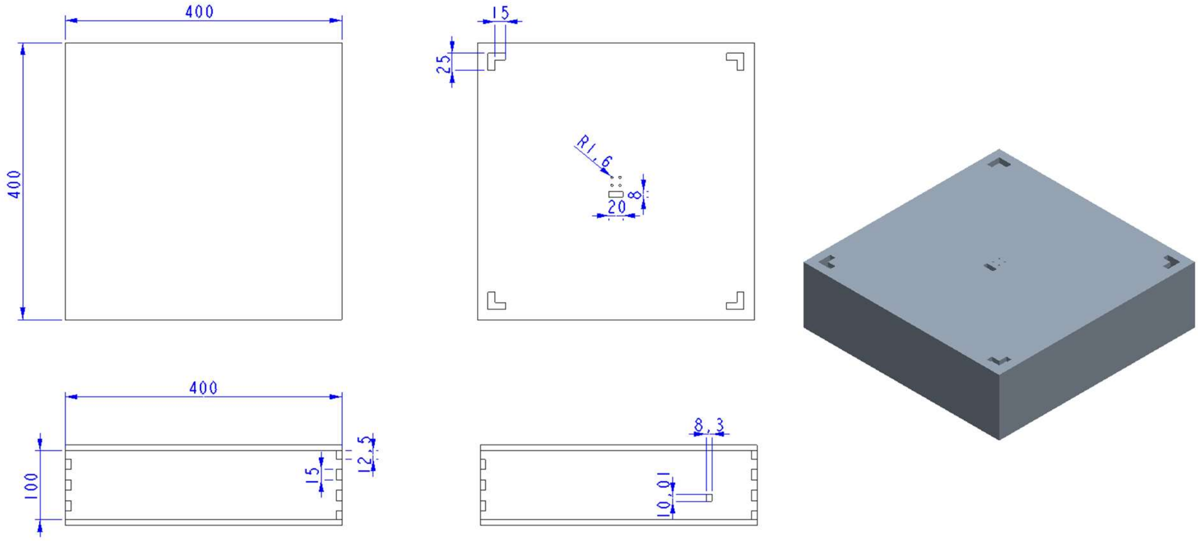

Figure 22-Box schematic, Source: Cédric DA CRUZ

- The case for the PCB, schematics shown figure 22, is a 3D printed box made of PLA plastics. Its dimensions are 10,5*10,5*5,5 cm. It holds the electrical circuit that converts the energy received by the induction coils from AC to 5V – 4A.

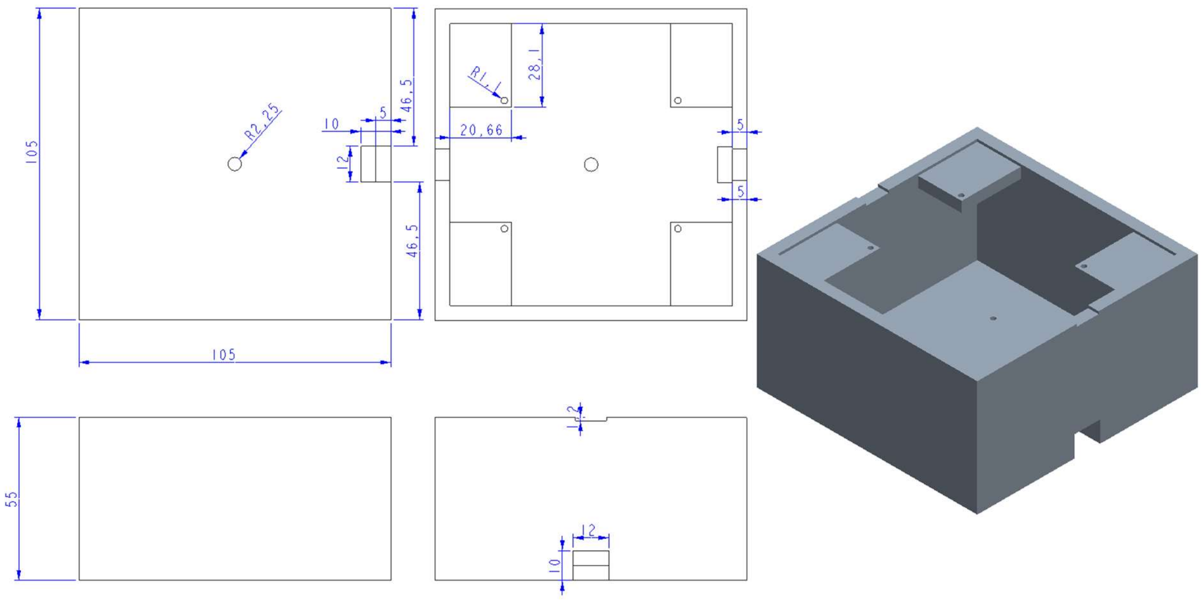

Figure 23- Case schematic, Source: Cédric DA CRUZ

4- Risk analysis

For the project to reach it's end we need to reduce the chance of a problems arising. To do so a risk matrix, see figure 23 will be used to calculate the risk score of identified risk. Then depending on their score solution will be suggested to reduce its risk

	Catastrophic (5)	Considerable (4)	Medium (3)	Low (2)	Negligible (1)
Certain (5)	25	20	15	10	5
Probable (4)	20	16	12	8	4
Occasional (3)	15	12	9	6	3
Rare (2)	10	8	6	4	2
Unlikely (1)	5	4	3	2	1

Figure 24-Risk table, Source Cédric DA CRUZ

Here is an example with the first identified risk, which doesn't exist anymore, of the risk table seen figure 24:

The probability of us not receiving the package of products sent by HOLO3DLED was probable (4), but the lack of it wouldn't impact on the project dramatically since it was by luck that a company accepted to send us materials. So, its impact is negligeable (1), with both its impact and probability we use the matrix to find the risk score, which here is 4.

Identified Risk	Probability of occurring	Impact on the project	Risk score	Proposed solution to reduce the risk
~~HOLO3DLED company that does not send the promised package~~	~~Probable~~	~~Negligible~~	~~4~~	~~Not be dependent on the study of a functional fan~~
Injury caused by the fan while spinning	Unlikely	Catastrophic	5	Make the fan untouchable during its rotation
Application/Site unable to handle traffic	Rare	Catastrophic	10	Make the app/site independent of traffic
Too high ambient light (indoors)	Rare	Medium	6	Ensure a brightness equivalent to the indoor lighting standard
Fan that flies away	Rare	Catastrophic	10	Ensure sufficient weight of the base
Blades that detach	Rare	Catastrophic	10	Keep the blades fixed and prevent unscrewing via vibration
Fan that pitches	Occasional	Considerable	12	Light fan/Stable Base (Big Block?) and Stable Axis of Rotation
System Short Circuit	Occasional	Considerable	12	Spare part and test point (circuit breaker?)
No compatibility with any system (IOS, Android, Windows, etc)	Probable	Medium	12	Used a Cross-System Programming Tool
Image processing problem	Rare	Considerable	8	Pre-Display Confirmation Step/ Simple Image
Fan connection problem	Unlikely	Catastrophic	5	Keeping the distance reduced as possible and without obstacle

Figure 25-Risk criteria, Source: Cédric DA CRUZ

Table of Appendices

A - All useful sources

Engine & Engine management

Controlling a Brushless Motor (Arduino Tutorial):
https://arduino.blaisepascal.fr/controler-un-moteur-brushless/

Brushless Motor Control - Video 1:
https://youtu.be/xiRyQOrpP0E

Brushless Motor Control - Video 2:
https://youtu.be/Be50YbIuTuc

Main Types of Electric Motors (ST Solutions):
https://stsolutions.ch/principaux-types-moteurs-electriques/

Introduction to Electric Motors (Educational Resource):
https://eric-walschaerts.canoprof.fr/eleve/LES_MOTEURS/LES_MOTEURS_ELECTRIQUES/

Different Types of Electric Motors (Conceptek):
https://conceptek.net/fr/techniques-de-base/conception/machines-et-composants/quels-sont-les-diff%C3%A9rents-types-de-moteurs-%C3%A9lectriques

5 Common Types of Electric Motors (Electricity & Magnetism):
https://www.electricity-magnetism.org/fr/5-types-de-moteurs-electriques-les-plus-communs/

How a Propeller Works (3Demotion Blog):
https://interactive.3demotion.net/blog-helice/#:~:text=Son%20principe%20est%20simple,ne%20voit%20pas%20l'h%C3%A9lice

Technical Data Sheet for MLHHx (Matel):
https://matel.com/wp-content/uploads/fiches_techniques/MLHHx

Helipix - Holographic Display Technology:
https://www.plv-hologramme.fr/helipix

LED management & angular sensor

https://files.seeedstudio.com/wiki/Grove-12-bit-Magnetic-Rotary-Position-Sensor-AS5600/res/Magnetic%20Rotary%20Position%20Sensor%20AS5600%20Datasheet.pdf

https://docs.rs-online.com/9968/A700000006824964.pdf

https://www.mouser.com/datasheet/2/737/APA102_2020_SMD_LED-2487271.pdf?srsltid=AfmBOoohDNiSU36U6w5PKeeTQEbeQk5pGfmWQD-KM6JJ3rQY8_dBXoU6

Application and data

https://www.youtube.com/watch?v=Hh279ES_FNQ&list=PLdo4fOcmZ0oUBAdL2NwBpDs32zwGqb9DY

ImageCropper.Maui 1.2.3 on NuGet - Libraries.io - security & maintenance data for open source software

Votre Arduino communique avec le module HC-06 • AranaCorp

Getting RGB array from image in C# - Stack Overflow

Implementation of the Bluetooth Connectivity Using .NET MAUI

https://youtu.be/mMByPw8_TMw?list=PL-oGQIjmlO23SJ3Pim42ImNGW4ci2xcoX

Power supply and fan

Wireless power: https://fr.aliexpress.com/item/1005005868915972.html?gps-id=pcDetailTopMore-OtherSeller&_t=gps-id:pcDetailTopMoreOtherSeller,scm-url:1007.40050.354490.0,pvid:9b95278e-16db-49e4-8ef6-105118be24d8,tpp_buckets:668%232846%238112%231997

Sector power adapter: https://fr.aliexpress.com/item/1005005763465796.html?pdp_ext_f=%7B%22order%22%3A%224247%22%2C%22eval%22%3A%221%22%7D

Buck converter: https://fr.aliexpress.com/item/1005004153906058.html?pdp_ext_f=%7B%22order%22%3A%2271%22%2C%22eval%22%3A%221%22%7D

Converter : https://fr.aliexpress.com/item/1005005639066185.html?pdp_ext_f=%7B%22order%22%3A%22930%22%2C%22eval%22%3A%221%22%7D

B – Software

DSEE Labs Software for PC & Phone: Link

Visual Studio 2022: Link

Arduino IDE: Link ; Libraries: AccelStepper (1.64), SoftwareSerial (1.0)

C - CSR approach

The CSR (Corporate Social Responsibility) approach was integrated from the earliest design phases of the project. The aim was to consider the three fundamental dimensions: economic, social and environmental. Although the electronic nature of the device implies the use of critical materials, concrete efforts have been made to limit its impact at every stage of its life cycle.

1. Environmental dimension

From an ecological point of view, several actions have been implemented to design a more environmentally friendly system. Our two main objectives were to select materials with the least environmental impact, and to optimize product lifespan.

1.1 Selection of materials with low environmental impact:

Particular attention has been paid to the choice of materials. For example:

- Use of recycled wood and plastic from the school's FABLAB for the structure.
- Use of a mains-powered battery, to avoid the use of disposable batteries.
- The system has been divided into several modules, making it easy to repair, reuse or partially replace in the event of failure.

1.2 Optimized product lifespan:

The choice of durable materials and modular assembly allow for extended use. Wherever possible, components are selected from suppliers who respect ethical practices (responsible sourcing of materials, decent working conditions).

1.3 To go further

We also have overtaking targets, but they're still important to us.

- Reduction in the quantity of materials
- Reduce the environmental impact of the use phase
- Optimization of the end of life of the system

System disassembly has been designed to facilitate material sorting and improve recyclability. The aim is to enable responsible treatment of the device once it has been taken out of use.

1.3.1 Materials used (non-exhaustive list) :

- PLA (support)
- Polycarbonate (protective panel)
- Copper (wires, PCB)
- Silicon (electronic components)
- Polyepoxide resin (printed circuit board)
- Stainless steel (motor)

1.3.4 Areas for improvement

Areas for improvement have been identified to take the approach further:

- Reduction in the quantity of materials used, through optimization of printed parts.
- Reduced environmental impact during use (e.g. optimized power consumption).
- Better recovery of components at end-of-life (simplified dismantling, recycling documentation).

2. Social dimension

The project is also part of a social dynamic. It was conceived as an educational and promotional tool for the school. It allows us to showcase our students' know-how and to arouse the interest of a wide audience in science and technology, particularly at events such as open days and demonstrations.

It's also a good way of attracting young people to technology, showing them how you can use many different areas of science to achieve something tangible.

3. Economic dimension

From an economic point of view, the main objective was to design a system that was accessible, both in terms of manufacturing cost and component availability. The choice of standard materials, which are readily available and 3D printable, means that the system can be easily reproduced, making it easier to disseminate and appropriate for other teams or institutions wishing to reproduce the experiment.

It's also interesting to be able to imagine a marketing follow-up to the project, with the idea of being able to create it in kit form, so that children, teenagers or even adults can try to reproduce the project behind it.

D - Distribution of work

First semester:

	Mustafa	Axel	Cédric	Abigail
Tasks completed				
Use case	25	25	25	25
Life cycle	25	25	25	25
FAST diagram	25	25	25	25
Specifications table	25	25	25	25
Risks table	5	5	90	0
Corporate social responsibility	5	5	0	90
Capella	30	65	5	0
Application + Image data manager	0	100	0	0
Engine + Engine management	0	0	100	0
Led management + angular sensor	0	10	0	90
Power Supply + Fan	80	0	20	0
Gantt	100	0	0	0
Analysis of received propellers	20	0	80	0
Report and slides	40	20	20	20
Prototype	35	45	20	0
Task distribution table	95	0	5	0

Figure 26-Task allocation table (part1), Source: Mustafa Topbas

Second semester:

	Mustafa	Axel	Cédric	Abigail
Tasks completed				
Electrical Schematic for PCB	40	0	0	60
Power Electrical Schematic	70	0	30	0
Building the Base	0	0	85	15
PCB Design	90	5	5	0
LED Soldering	80	0	0	20
Component Soldering	25	0	0	75
PCB Housing Creation	0	0	100	0
Component Testing	10	0	90	0
Building the Base	5	0	95	0
CSR	0	0	0	100
CANVA Business Model	33	33	0	33
Report and Slides	25	25	25	25
GitHub	20	0	80	0
Component Ordering	0	0	10	90
Software Program	0	100	0	0
Task distribution table	55	15	15	15

Figure 27-Task allocation table (part2), Source: Mustafa Topbas

E - Self-assessment of skills acquired/strengthened and CV

FICHE COMPETENCES / C.V.

BROCHARD Abigaïl

INGENIEUR en « éclairagisme »

Description du poste/métier envisagé :

J'aimerais pouvoir travailler dans le domaine de l'éclairagisme dans les domaines de la colorimétrie, de l'éclairage public ou en laboratoire. J'aimerais travailler en enteprise pour pouvoir devenir cheffe de projet finir ma carrière dans la formation.

Projets, stages et mobilité intern. réalisés :

- 2021 – Stage de 3 mois dans le cadre d'un BTS TPIL (Techniques Physiques pour l'Industrie ou le Laboratoire) dans le laboratoire ICMN au CNRS d'Orléans.
  - Création d'un dispositif de lévitation acoustique
  - Création d'une boîte pour étude d'échantillons à humidité et température contrôlées
- 2022 – Projet de seconde année de BTS intitulé : "Est-il possible d'associer une station météorologique et un dispositif de récolte du miel ?"
  - Partie Informatique Arduino sur l'affichage des données sur une application, une macro Excel et un afficheur RGB
- 2023 – Stage au laboratoire ICMN au CNRS d'Orléans dans le cadre d'une 3e année d'école d'ingénieur en Génie Physique et Système Embarqués à Polytech Orléans
  - Etude de l'eau « activée »

Soft-Skills :

Rigueur	●●●○○○
Curiosité	●●●●●○
Créativité	●●●●●○
Adaptabilité	●●●○○○
Autonomie	●●●●○○
Coopératif	●●●●●○

Langues :

TOEIC	775
Anglais	●●●●○○
Allemand	●○○○○○
Français	●●●●●○

Compétences

Techniques :

Acquises :
- Word et Powerpoint
- Soudure
- Arduino basique
- QT

A conforter :
- C ++ et python
- STM8
- COMSOL

Méthodologiques :

Acquises :
- Gestion de projet
- Travail d'équipe
- Aisance oral

A conforter :
- Gestion du temps et des priorités
- Patience

Théoriques :

Acquises :
- Bases de l'électricité
- Base de l'optique
- Colorimétrie
- Etude d'un laser

A conforter :
- Physique des matériaux
- Laplace

Figure 28-Self-assessment of skills acquired, Source: Abigaïl BROCHARD

Spécialité Génie Physique et Systèmes Embarqués — Polytech Orléans

FICHE COMPETENCES / C.V.

TOPBAS Mustafa

INGENIEUR en « GPSE »

Description du poste/métier envisagé :

Ingénieur en SE dans une grande entreprise pendant
5 voire 10 ans puis création d'entreprise de production.

Projets, stages et mobilité intern. réalisés :

- 2024-2025 (9 mois) Projet hélice holographique (Chef de projet)
- 2024 (1,5 mois) Entreprise manufacturière de pièce industrielle en Turquie
- 2024 (3 mois) Projet luminaire – réalisation de cartes (parties intelligence)
- 2023 (1 mois) Projet début d'année Fablab – Réalisation du support pour l'escalier de Chambord du Fablab
- 2023 (1/2 mois) Projet de fin d'année de Peip – Démonter et comprendre laser
- 2022 (4 mois) Projet robot – réalisation d'un robot à roues

Soft-Skills :

Rigueur	●●●●●○
Curiosité	●●●●○○
Créativité	●●●●○○
Adaptabilité	●●●●●○
Autonomie	●●●●○○
Coopératif	●●●●●●

Langues :

TOEIC	880
Anglais	●●●●○○
Turc	●●●●●○
Français	●●●●●●

Compétences

Techniques :

Acquises :

- Réalisation de soudures
- Lecture de datasheet
- Réalisation de PCB

A conforter :

- Réalisation de cartes électroniques
- Utilisation découpeur laser
- Utiliser les outils d'une salle blanche

Méthodologiques :

Acquises :

- Faire/suivre un CDC
- Identifier un cas d'usage
- Rédaction de compte rendu
- Présentation orale
- Rétroplanning
- Choix des composants
- Schéma fonctionnel

A conforter :

- Faire une fiche technique
- Capella

Théoriques :

Acquises :

- Langage : C++
- Physique du transistor
- Physique du plasma
- Protocoles de communication I2C, UART, SPI
- Maths/physique niveau 4A GPSE

A conforter :

- Langage : C, python
- Filtrage

Date de mise à jour 06/07/17

École polytechnique
de l'université d'Orléans
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des écoles d'ingénieurs
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Figure 29-Self-assessment of skills acquired, Source: Mustafa Topbas

FICHE COMPETENCES / C.V.

DA CRUZ Cédric

INGENIEUR en Génie Physique et Système Embarqué

Description du poste/métier envisagé :

Ingénieur SE dans une entreprise qui se focalise dans la robotique, l'électronique ou l'informatique pendant au moins 5 ans

Projets, stages et mobilité intern. réalisés :

- 2022 (4 mois) Projet de réalisation et programmation d'un robot
- 2023(1/2 mois) Fragmentation d'un LASER et exposition
- 2023 (1 mois) Projet de conception d'un solveur de Rubik's Cube
- 2024 (4 mois) Projet de réalisation d'un luminaire

Soft-Skills :

Rigueur	●●●●○○
Curiosité	●●●●○○
Créativité	●●●○○○
Adaptabilité	●●●○○○
Autonomie	●●●●●○
Coopératif	●●●●○○

Langues :

TOEIC	925
Anglais	●●●●●○
Français	●●●●●○

Compétences

Techniques :

Acquises :

- Réalisation de soudures
- Suite Microsoft

A conforter :

- CAO
- Schéma électronique
- Conception de carte
- Outils de salle blanche

Méthodologiques :

Acquises :

- Cahier des charges
- Compte rendue
- Présentation oral/Exposition / Explication

A conforter :

- Retroplanning
- CAPELLA

Théoriques :

Acquises :

- Langage C++
- Résolution d'équations différentielles
- Types de moteur électrique et fonctionnement

A conforter :

- Langage C/C#/Qt/Python
- Filtrage (Analogique et Numérique)
- Optique géométrique & ondulatoire

Figure 30-Self-assessment of skills acquired, Source: Cédric DA CRUZ

FICHE COMPETENCES / C.V.

LEROY Axel
INGENIEUR en GPSE

Description du poste/métier envisagé :

Je souhaiterai travailler dans les systèmes embarqués, dans une entreprise stable afin de pouvoir y faire carrière. L'industrie de l'armement me plaît tout particulièrement.

Projets, stages et mobilité intern. réalisés :

- 2022, 2023, 2024 (6 mois) CDD agent municipal
- 2022 (4 mois) Projet robot de Peip 1
- 2023 (2 semaines) Projet informatique de Peip 2
- 2023 (1 mois) Projet Fablab début d'année : réalisation d'un support pour l'escalier de Chambord imprimé au Fablab
- 2024 (4 mois) Projet 3A
- 2024 (en cours) Projet personnel : conception et fabrication d'une table de lancement pyrotechnique
- 2024-2025 (en cours) Projet 4A

Soft-Skills :

Rigueur	●●●●●○
Curiosité	●●●●○○
Créativité	●●●○○○
Adaptabilité	●●●●●○
Autonomie	●●●●●○
Coopératif	●●●●○○

Langues :

TOEIC	980
Anglais	●●●●●○
Français	●●●●●●

Compétences

Techniques :

Acquises :

- Réalisation de soudures
- CAO (creo, Proteus 8, TracePro)
- Utilisation de découpeuse laser
- Réalisation d'une POC
- Lecture de datasheet

A conforter :

- Réalisation de cicruits imprimés à partir de composants simples
- Utilisation d'imprimante 3D
- Utilisation de matériel salle blanche
- Utilisation de Capella

Méthodologiques :

Acquises :

- Faire et suivre un CDC
- Conceptions de rapports aux normes universitaires
- Présentation orale
- Choix de composants adaptés

A conforter :

- Réalisation de fiches techniques
- Réalisation d'un rétroplanning
- Utilisation de la méthode Arcadia

Théoriques :

Acquises :

- Langages informatique (C, C++, html, php, C#)
- Bases en mathématiques et pyhsiques
- Physique du transistor

A conforter :

- Langages informatique (python, SQL, QT, CSS, XAML)
- Filtrage

Figure 31-Self-assessment of skills acquired, Source: Axel LEROY