UPTEKO

ÉCOLE NATIONALE D'INGÉNIEURS DE BREST

# DRONE FUNCTIONALITY DEVELOPMENT

ASSISTANT ENGINEERING INTERNSHIP

INTERNSHIP S8


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# SUMMARY





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# CONTEXT

# TRIP

# UPTEKO


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## UPTEKO

FOUNDED IN 2018

# UPTEKO

Mads Joergensen

Benjamin Mejnertz

Sebastian Duus

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# FIELD OF ACTIVITY

## WIND ENERGY

- wind-turbines inspections
- payload delivery
- aerial image acquisition

## OIL AND GAS

- oil spills detection
- gas leak detection

## OFFSHORE AND MARITIME

- charging station
- deployed on ship
- payload delivery

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# LÆRKE

- Fast Battery Replacement
- Customizable onboard computer
- Dust & Immersion proof

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# NEST

- Stabilized Landing Platform
- Contact-based Charging system
- Climate Control mechanism


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# ALBA

- lift up to 40Kg Payload
- X8 Motor frame
- fully autopilot controlled

# PROJECTS

# BLACK BOX

STM32 BLACK BOX

# OBJECTIVES

- reliable system
- independent running
- real time operating system
- save drone 3D orientations in SD Card

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# GIMBAL LOCK ISSUE

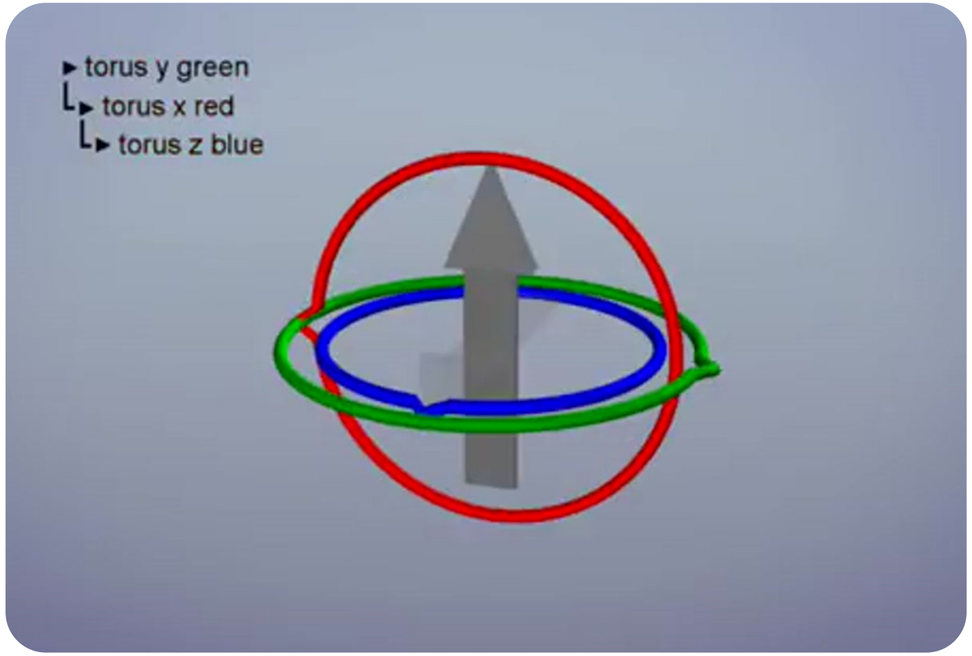


*Fig. - Gimbal lock explained*

3 components

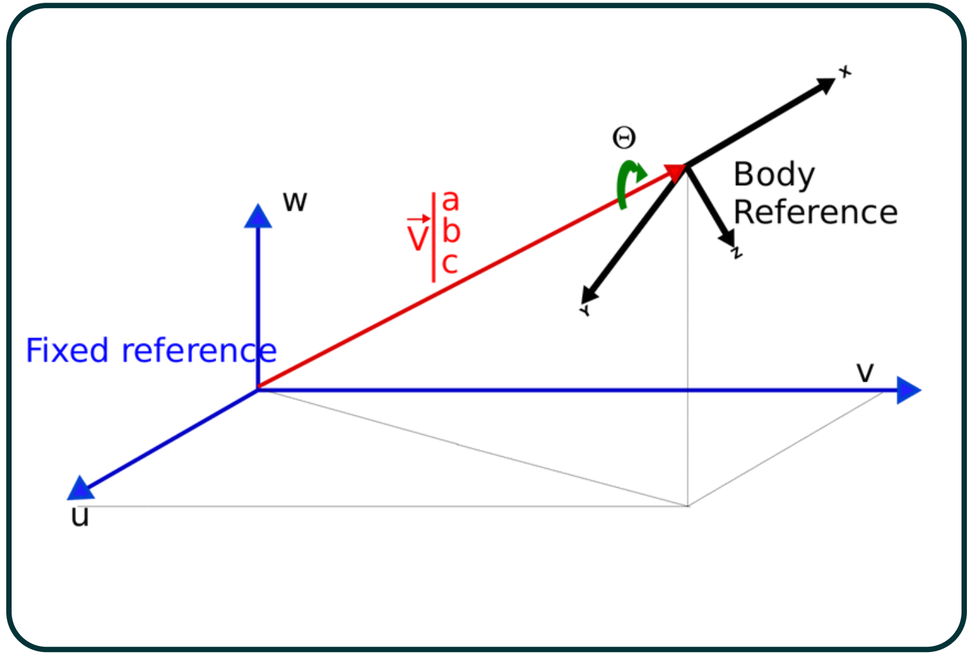


*Fig. - Quaternion reference*

4 components

# WHAT IS AN IMU ?

10 degrees Of Freedom

**I**nertial

**M**easurement

**U**nit

3 accelerations

3 angular velocities

3 direction of a magnetic field

1 pressure

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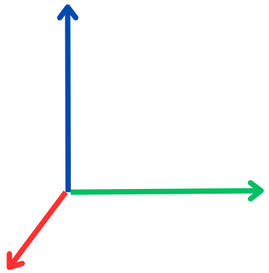
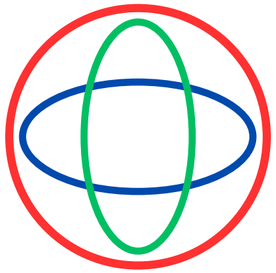
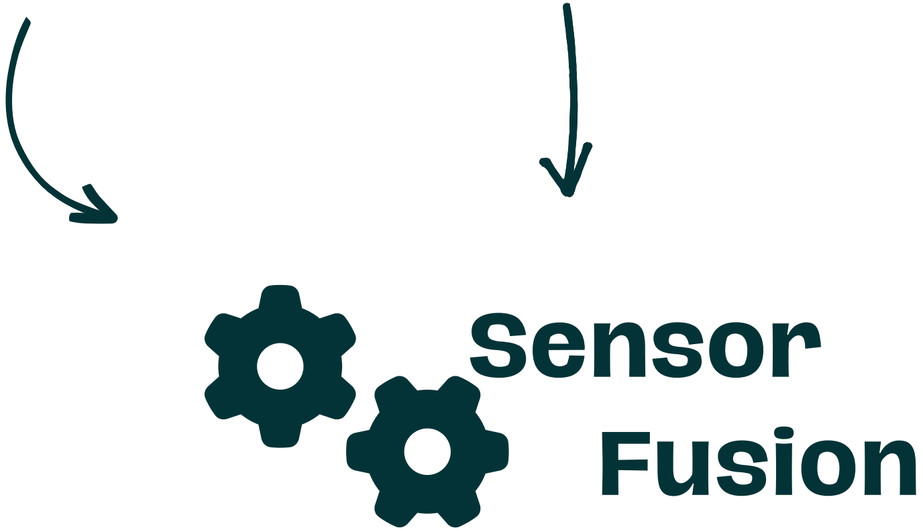


accelerometer



gyroscope

magnetometer




- sensitive to disturbances
- smoothly drift in time

precise and reliable data

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# MADGWICK FILTER

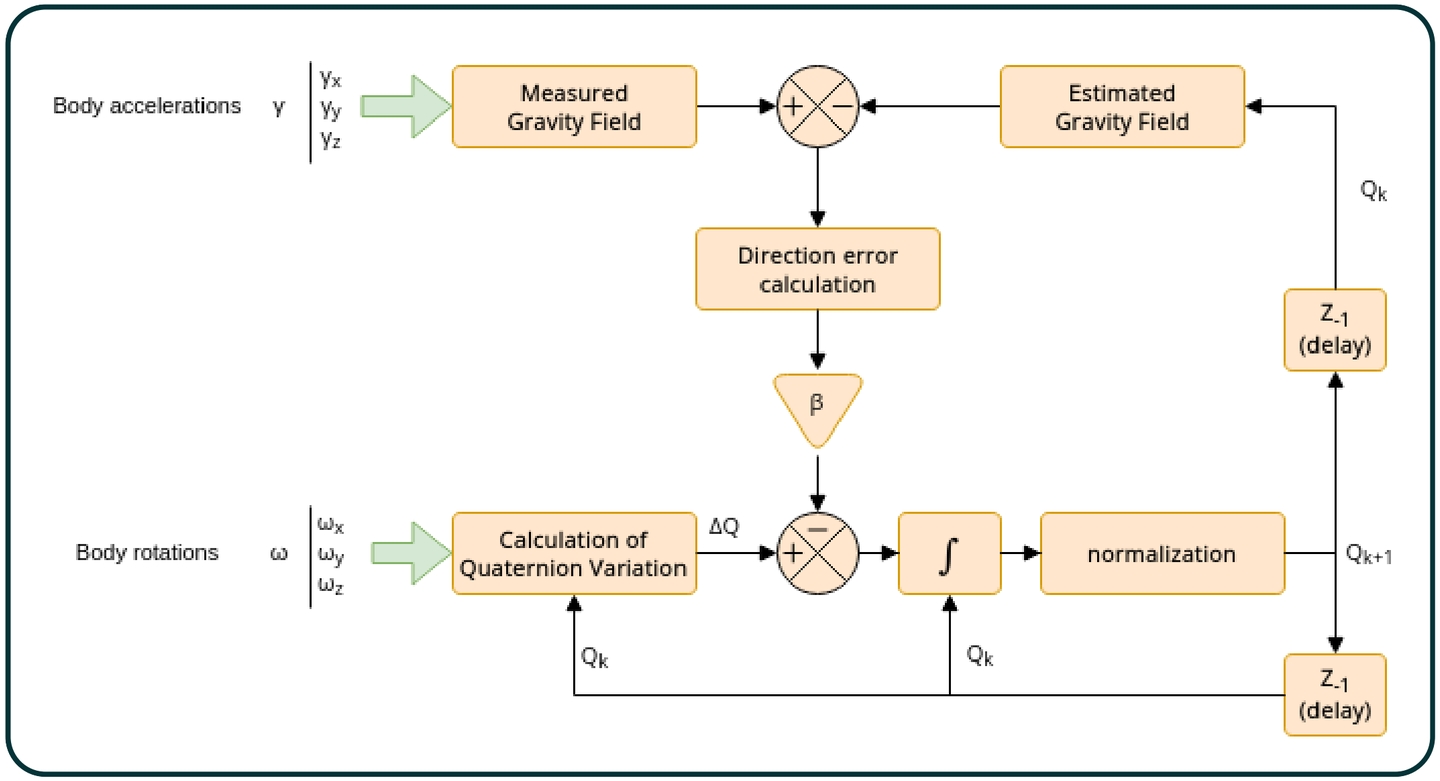


*Fig. - Madgwick filter schematic*

- comparison between estimated and measured gravity field
- reduce gyroscope error

open source

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# DEV KIT

STM32 CubeIDE

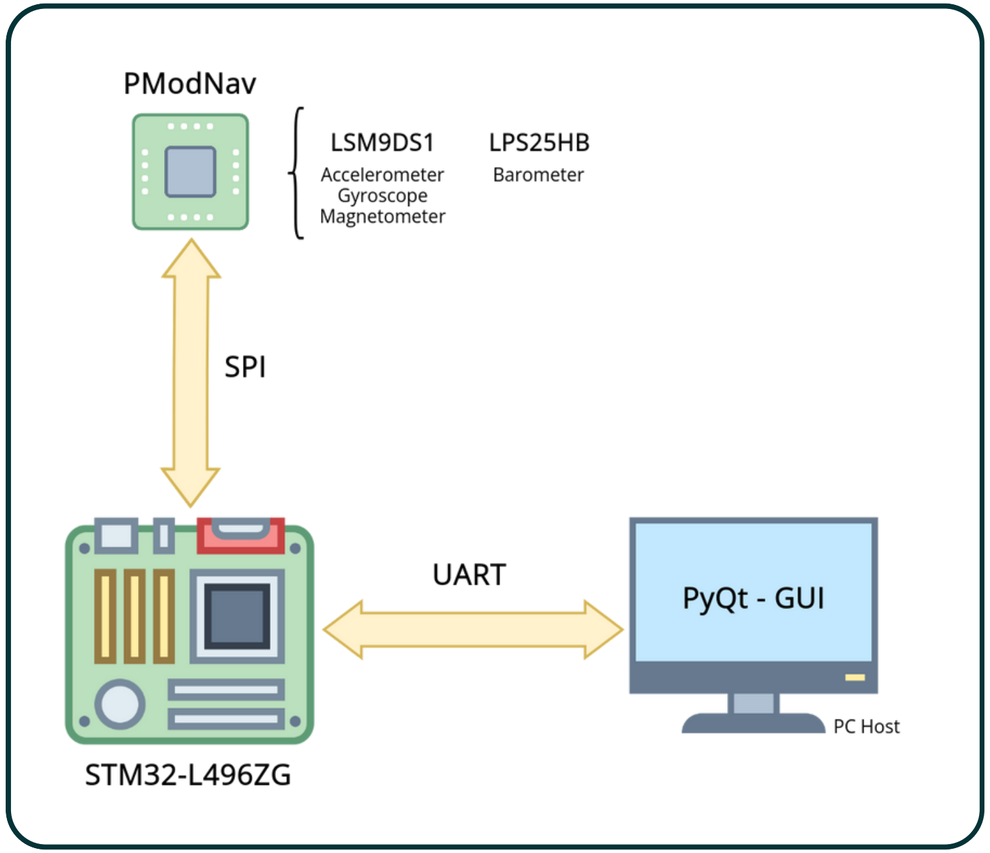


*Fig. - Project communication overview*

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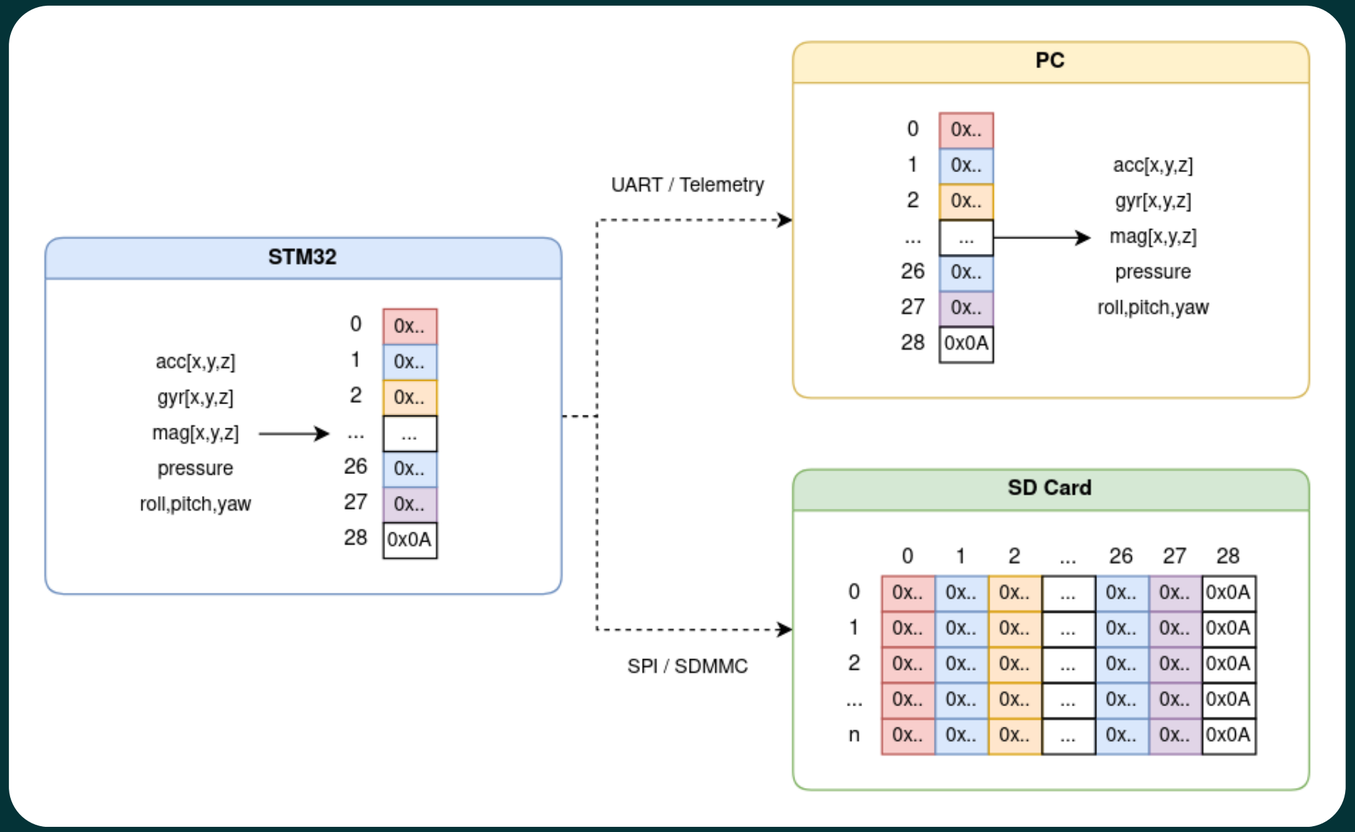
# SDCARD LOGGER

- optimized data frame
- fast communication
- no data loss



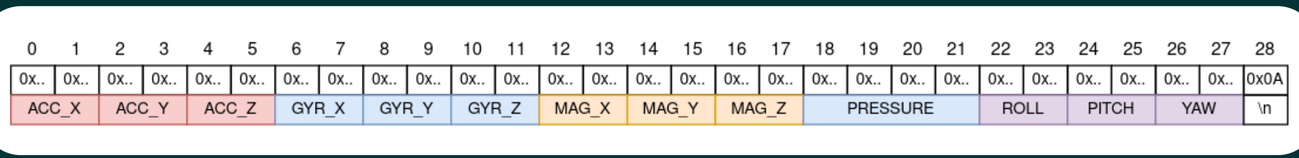




*Fig. - Frame and data store overview*

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# REAL TIME OPERATING SYSTEM

The Fast Task (IMU) run on interrupt and the slower task (Data log) is running when there is time left.

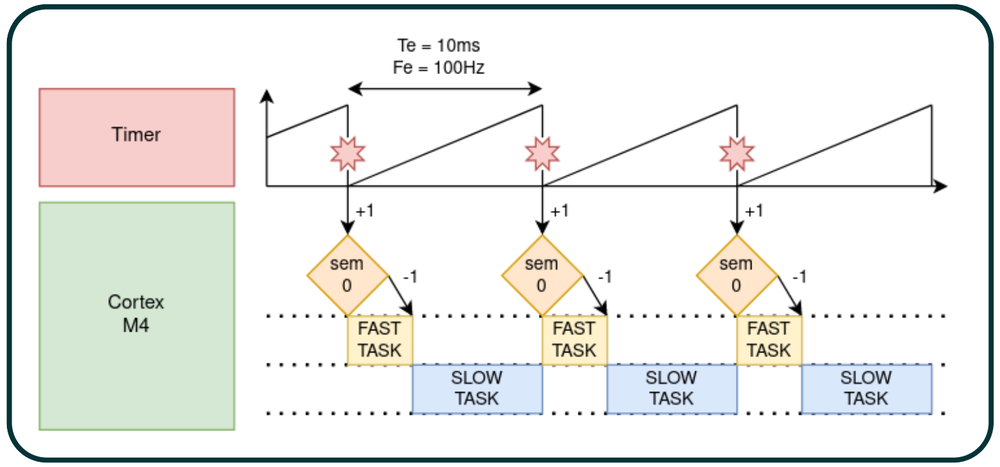


*Fig. - RTOS theorical chart*

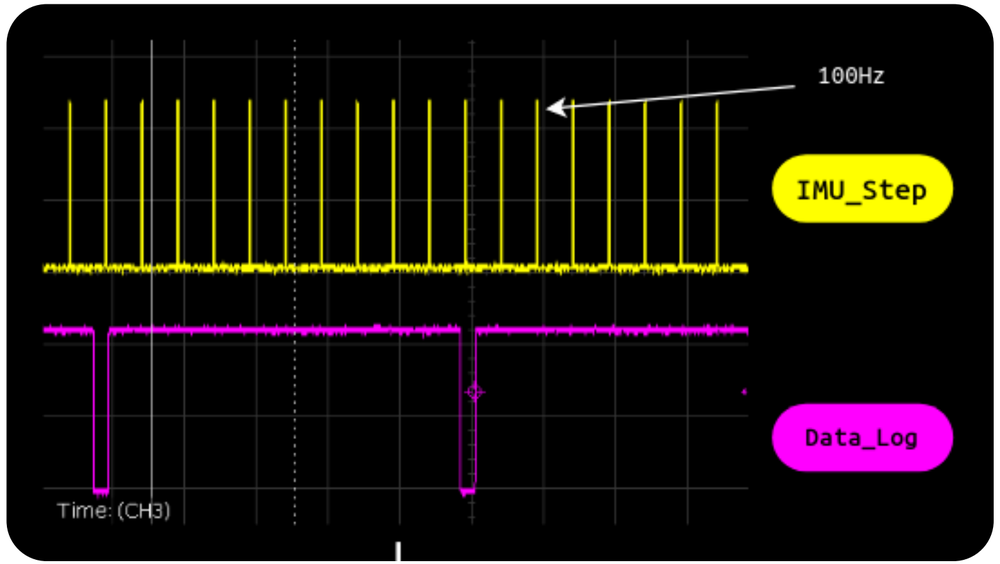


*Fig. - RTOS practical measure*

# GRAPHICAL USER INTERFACE

Easy configuration of :

- the port
- the baud rate
- the number of bits per frame
- the number of stop bits
- the parity
- the flow control

Real-time data acquisition

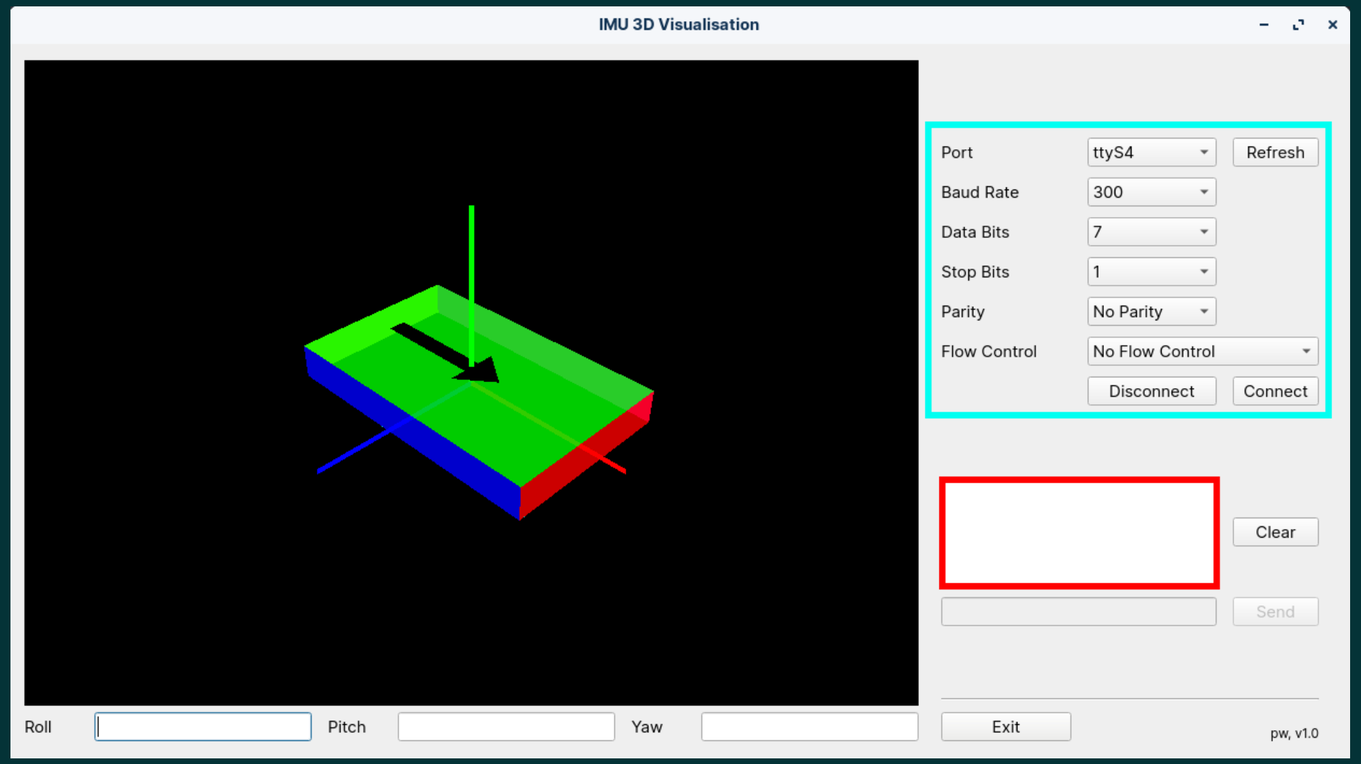


*Fig. - Python GUI window screenshot*

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# DOCUMENTATION

- clear feedback
- easy to maintain
- sharable

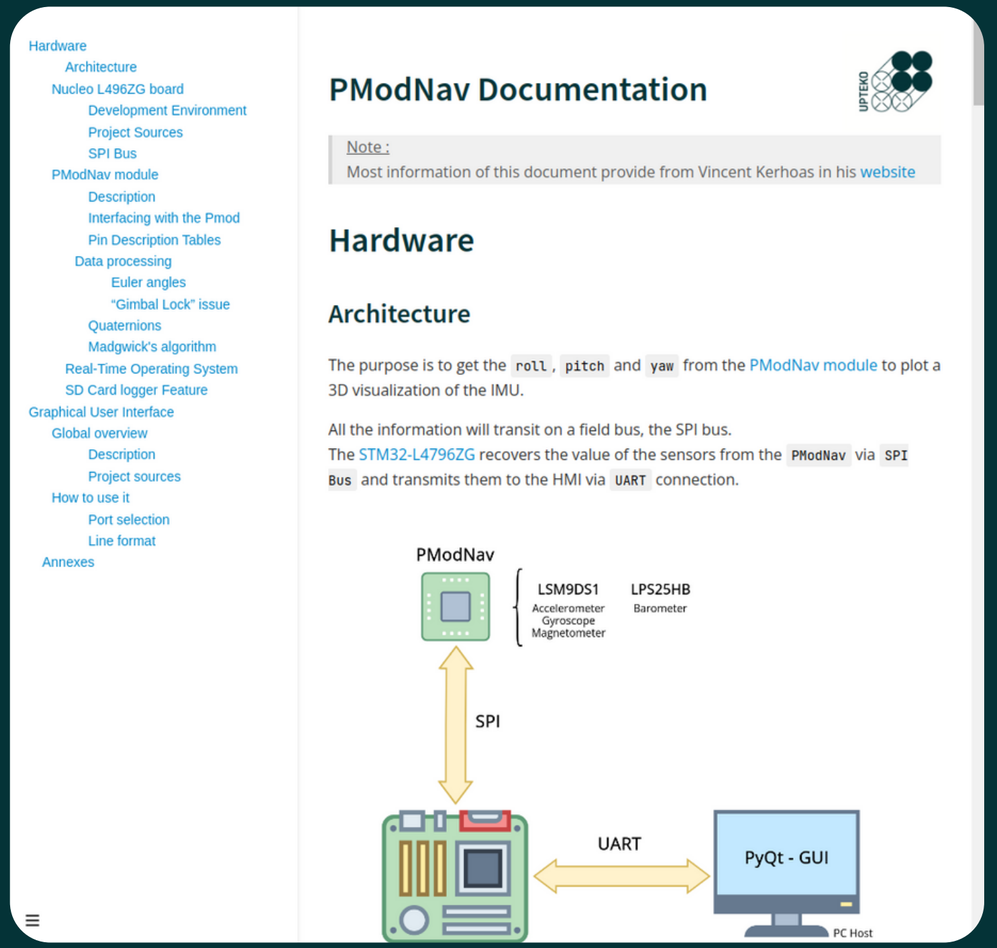
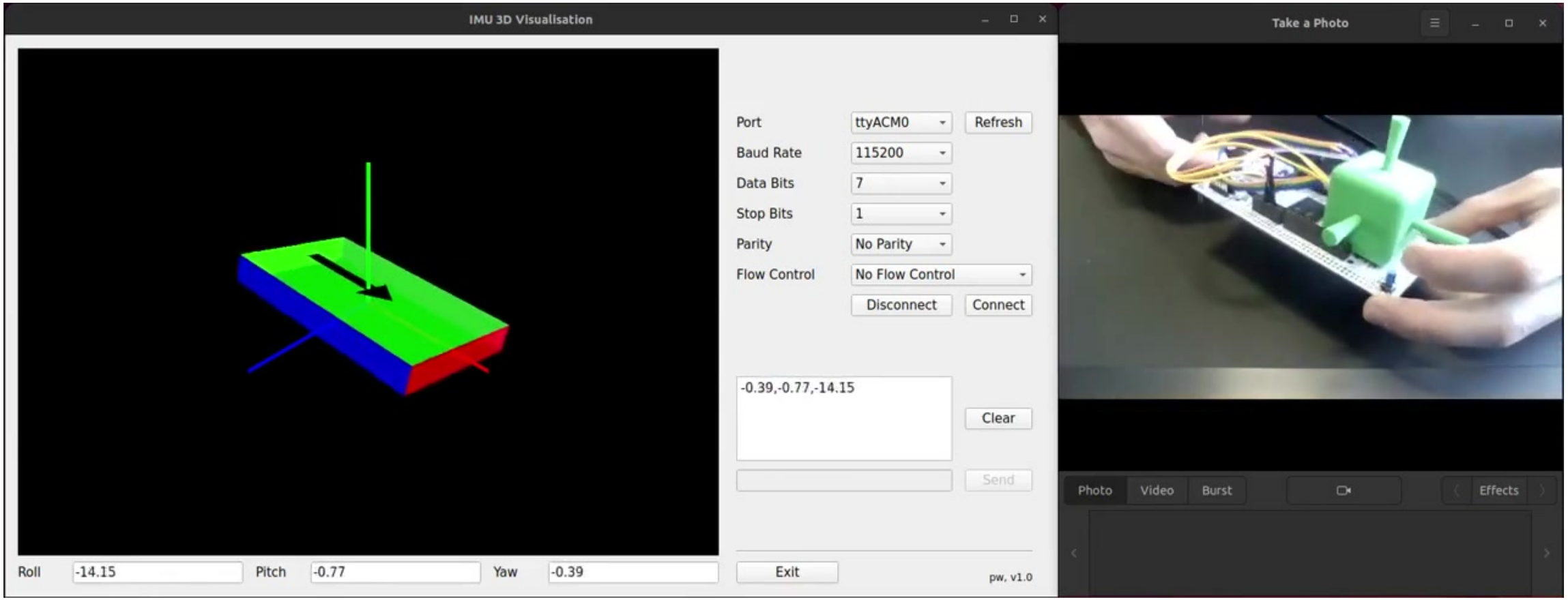



*Fig. - STM32 Black Box documentation*

# DEMO

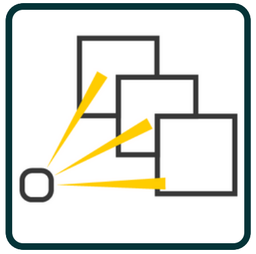

IMU 3D Visualisation
Port
ttyACM0
Refresh
Baud Rate
115200
Data Bits
7
Stop Bits
1
Parity
No Parity
Flow Control
No Flow Control
Disconnect
Connect
-0.39,-0.77,-14.15
Clear
Send
Roll
-14.15
Pitch
-0.77
Yaw
-0.39
Exit
pw, v1.0
Take a Photo
Photo
Video
Burst
Effects

# PROJECTS

# LOG VIEWER

# TERABEE TOWEREVO

- 360° coverage



- Laser technology

- precise measure
- long range

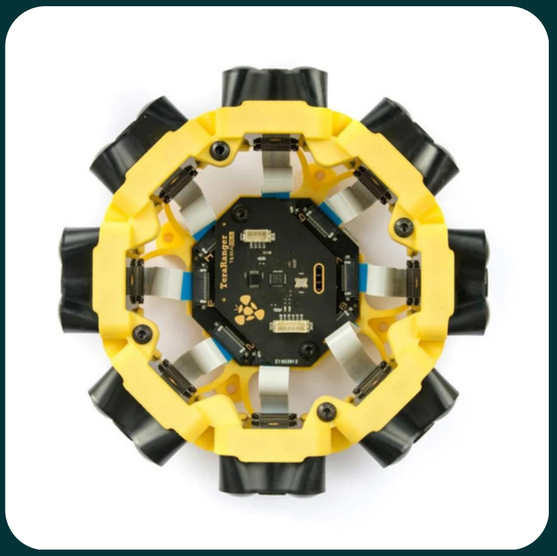


*Fig. - Terabee TowerEvo*

no zone detection
only directional

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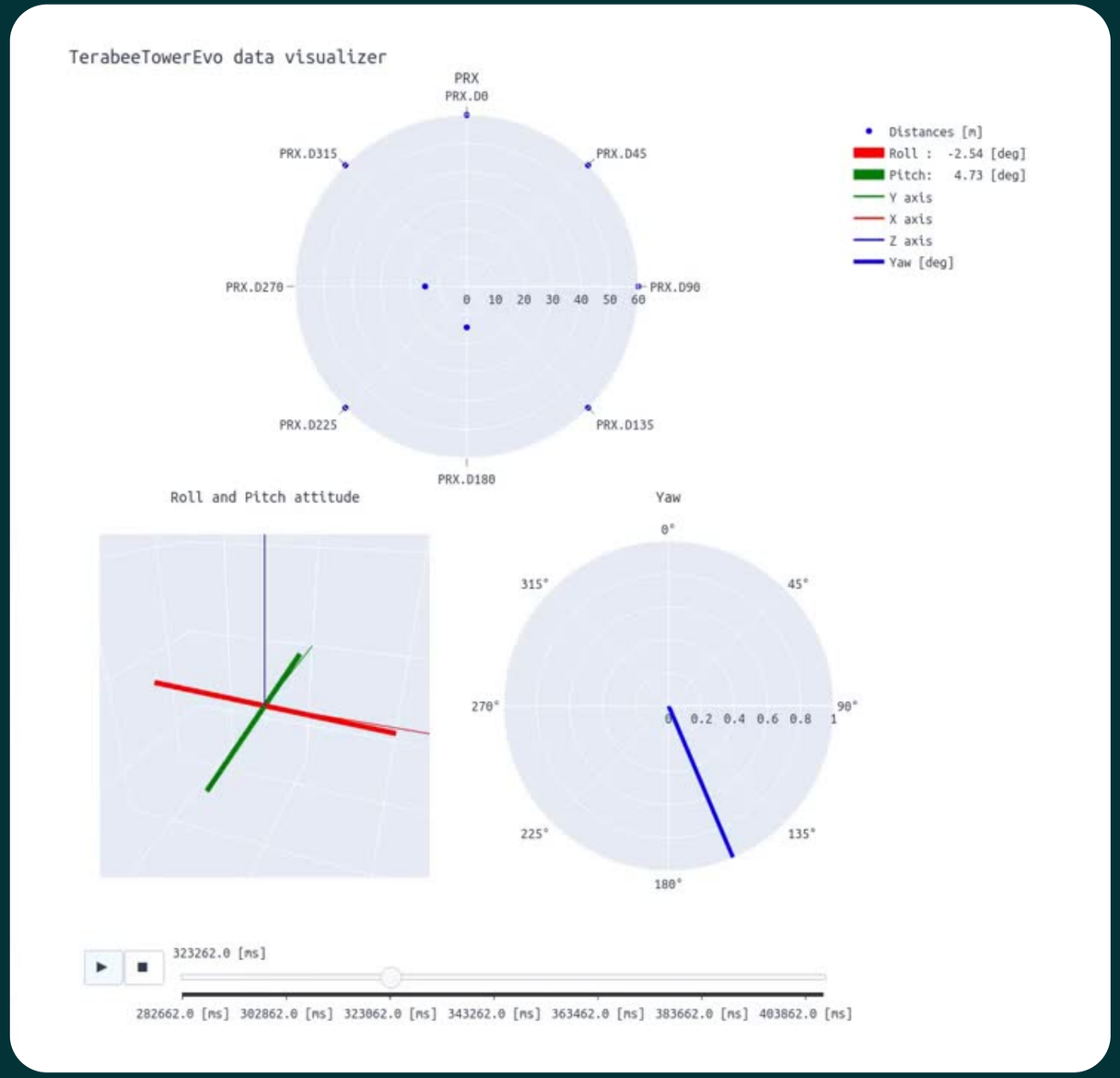
*Fig. - Drone installation*

# GRAPHICAL USER INTERFACE

- playable data
- 3D orientation
- 360 data plot

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# ORGANIZATION

## GANTT

# Organization - Gantt

# GANTT

- time based overview
- project details
- time consumming

| FILENAME | UPTEKO - Assistant Engineer Intership | COMPANY | Upteko Aps |
|---|---|---|---|
| NAME | Paul Walczak | DATE | 24/05/23 |

| | TASK | DURATION | STATUT | WEEK NUMBER 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | **STM32** | | | | | | | | | | | | | | | | holidays | | | | | | | company holidays | |
| **1.1** | **Terabee sensor communication** | 1 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 1.1.1 | UART communication | 1 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| **1.2** | **PModNav** | 7 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 1.2.1 | SPI communication | 1 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 1.2.2 | IMU parameters | 2 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 1.2.3 | Sensors calibration | 2 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 1.2.4 | AHRS algorithm implementation | 2 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 1.2.5 | Tests | 2 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 1.2.6 | Documentation | 1 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| **1.3** | **Python GUI** | 2 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 1.3.1 | Serial communication | 1 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 1.3.2 | QT Designer | 2 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 1.3.3 | OpenGL | 2 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 1.3.4 | Documentation | 1 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| **1.4** | **RTOS** | 5 | 83 % | | | | | | | | | | | | | | | | | | | | | | |
| 1.4.1 | RDF-868 configuration | 1 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 1.4.2 | FreeRTOS implementation | 4 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 1.4.3 | FreeRTOS & SD Card | 4 | 50 % | | | | | | | | | | | | | | | | | | | | | | |
| 1.4.4 | IMU merge | 2 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| **2** | **Collisions Avoidance SITL** | | | | | | | | | | | | | | | | | | | | | | | | |
| **2.1** | **Ardupilot collision avoidance built-in** | 3 | 64 % | | | | | | | | | | | | | | | | | | | | | | |
| 2.1.1 | Learn Gazebo environment | 2 | 80 % | | | | | | | | | | | | | | | | | | | | | | |
| 2.1.2 | Learn ROS1/2 environment | 2 | 75% | | | | | | | | | | | | | | | | | | | | | | |
| 2.1.3 | Ardupilot parameters | 2 | 50 % | | | | | | | | | | | | | | | | | | | | | | |
| 2.1.4 | Software-In-The-Loop | 2 | 50 % | | | | | | | | | | | | | | | | | | | | | | |
| **2.2** | **Collision Avoidance ROS2 Migration** | 3 | 65 % | | | | | | | | | | | | | | | | | | | | | | |
| 4.1 | Rewrite | 2 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 4.2 | 3D environment | 2 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 4.3 | Ardupilot environment | 1 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 4.4 | Debug | 2 | 25 % | | | | | | | | | | | | | | | | | | | | | | |
| 4.5 | Tests | 0 | 0 % | | | | | | | | | | | | | | | | | | | | | | |
| **3** | **Log Viewer** | | | | | | | | | | | | | | | | | | | | | | | | |
| **3.1** | **Python GUI** | 2 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 3.1.1 | Sensors tests | 1 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 3.1.2 | Drone integration | 1 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 3.1.3 | Drone flight | 1 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 3.1.4 | Python Plotly lib | 2 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| **5** | **Others** | | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 5.1 | Production line assembly | 1 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 5.2 | Drone disassembly | 1 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 5.3 | MiniPC comparisioin sheet | 1 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| **6** | **Internship Report** | | | | | | | | | | | | | | | | | | | | | | | | |
| **6.1** | **Internship Report** | 10 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 6.2 | Writing | 9 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 6.3 | Latex | 8 | 100 % | | | | | | | | | | | | | | | | | | | | | | |
| 6.4 | Reading | 2 | 100 % | | | | | | | | | | | | | | | | | | | | | | |

*Fig. - Gantt diagram*

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# CONCLUSION

Thanks to my colleagues !

Thanks to my roommates !

learn new technologies (ROS2, Gazebo ...)

Confirm my desire to work in robotics

I worked a bit alone

# TAK ! / THANK YOU !

Let’s talk !

PAUL WALCZAK

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