# KESTREL SYSTEMS

KONGSBERG

USN Universitetet i Sørøst-Norge

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Social Media
Website

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Prototyping

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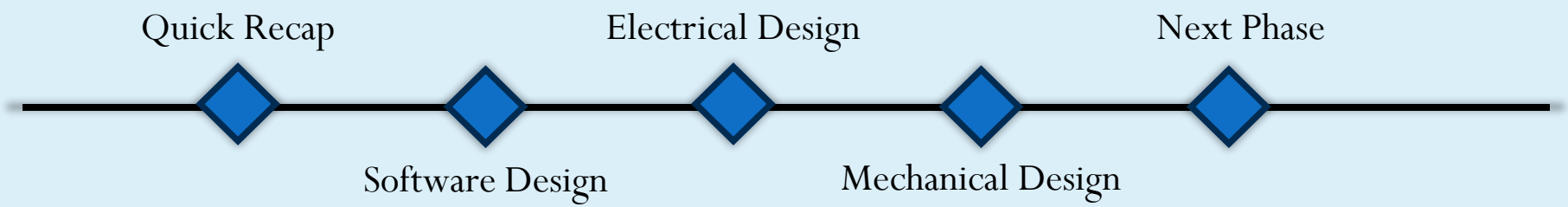
Computer Engineer

Project Economy
Software Development

**Kristian E. Myren**
Electrical Engineer

Circuit Designer

# Presentation Timeline



# Quick Recap

# Kongsberg Defence & Aerospace

- DMS – Missile and Space
- Local Hawk

Quick Recap
System Design

# Task Description

Develop a system to improve the response time and preparedness of emergency responders through autonomous drone technology.

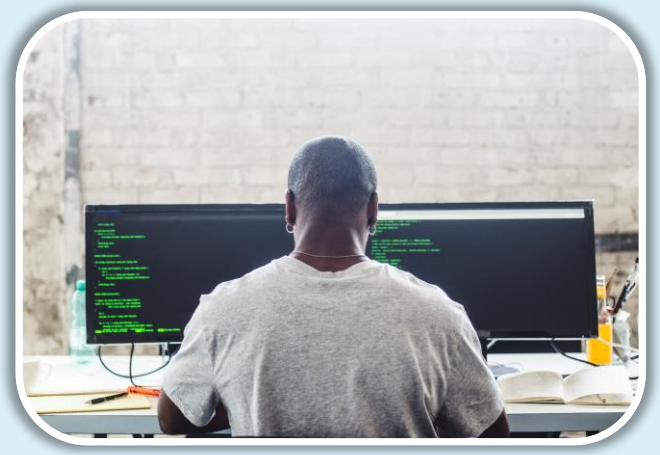
Quick Recap

System Design

# Task Description

Drone

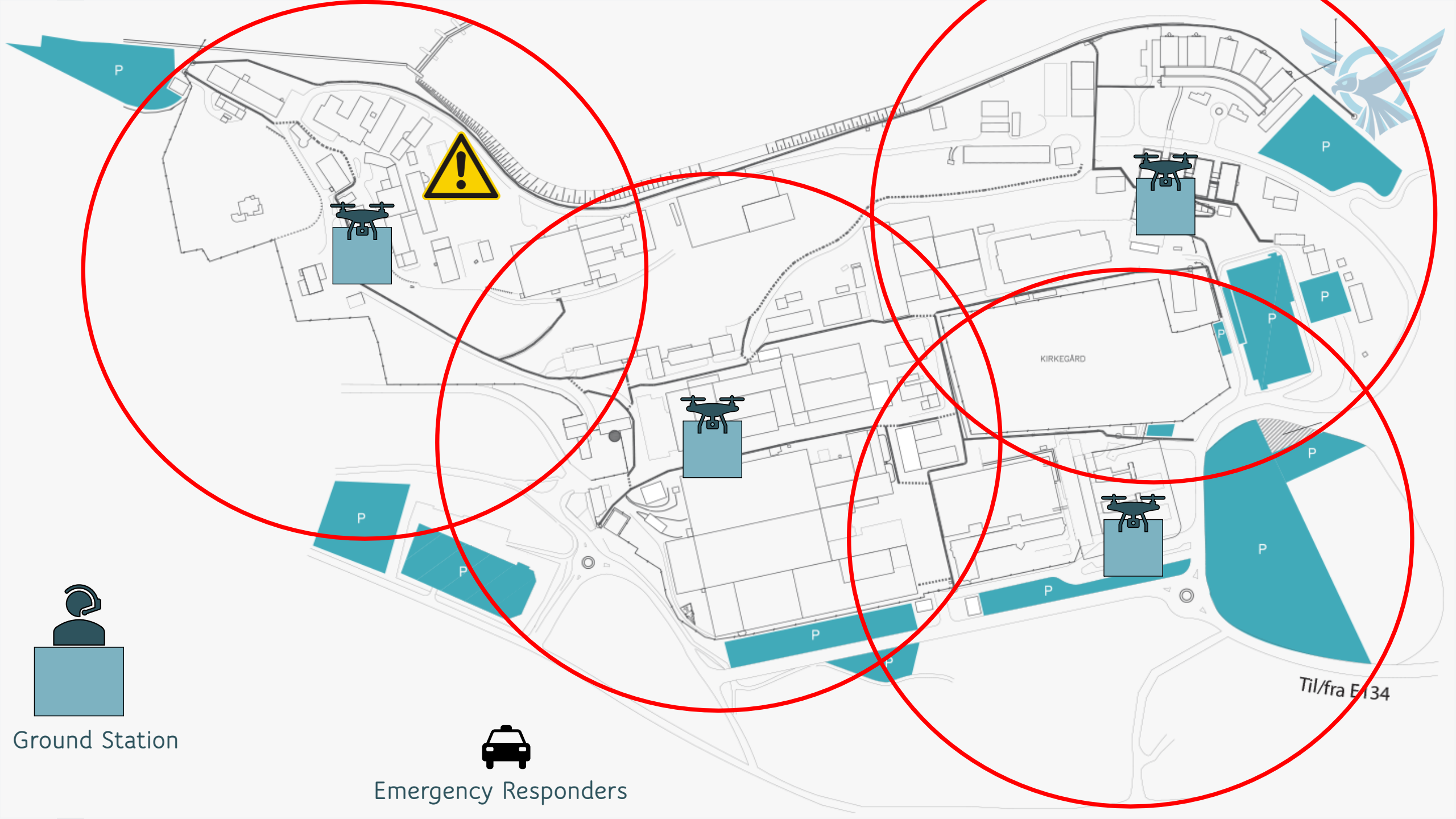
Dispenser



Ground Station

Quick Recap

System Design


P
KIRKEGÅRD
Til/fra E134
Ground Station
Emergency Responders

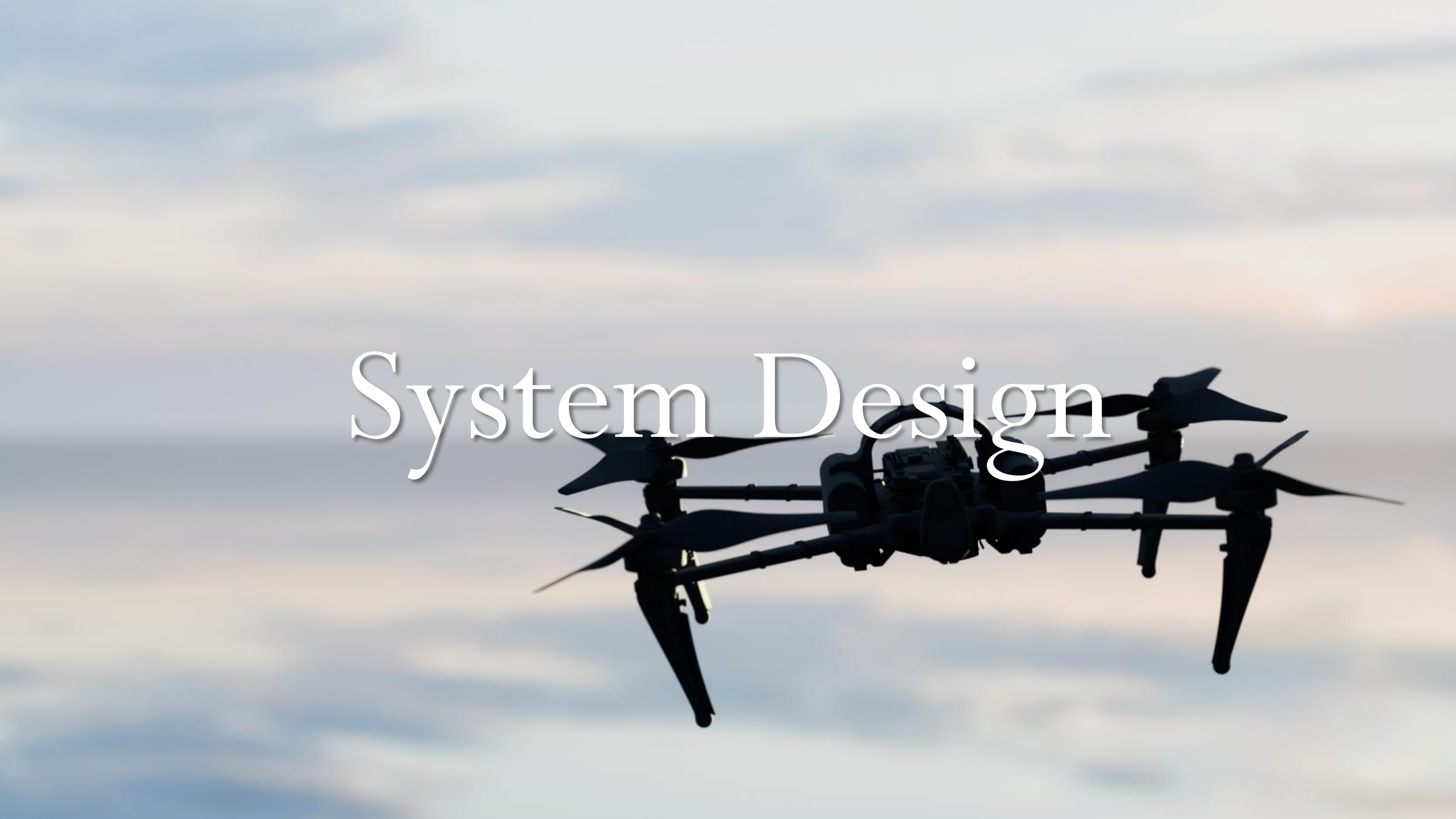
# Requirements

| Task Description | Requirement | Rationale | Success Criteria | Verification Method | Priority | Status |
|---|---|---|---|---|---|---|
| **1**<br>The system should be able to dispatch drones that autonomously move to specific locations in their vicinity | **R1.1**<br>The drone shall be able to autonomously navigate to a specific GPS location given by the ground station | The drone has to be able to move to its location autonomously to be able to survey the situation | The drone can reach its destination autonomously using GPS signals | **T1.1**<br>The drone will be given a GPS location by the ground station and the drone must navigate to this position successfully | A | Not Started |
| | **R1.2**<br>The response time for the drone to be in the air from the alert should not exceed 30 seconds | To facilitate a quick response to various situations the drone must be in the air quickly | The drone can launch within 30 seconds of the alert | **T1.2**<br>The drone will be given an alert and a timer will start to confirm the time it takes to get the drone in the air | A | Not Started |
| | **R1.3**<br>The drone should utilize AI to detect different objects | Utilizing AI will increase the drones' autonomy and adaptability | The AI is able to detect different objects successfully | **T1.3**<br>The drone will have multiple objects placed within its field of view to verify the correct detection | C | Not Started |
| | **R1.4**<br>The system should have the option to simulate take-off and landing of the drone after the dispenser has been opened | To mitigate risk concerning GPS problems the system needs to be able to simulate the drone flight | The system sends a signal to the simulator after the dispenser is opened to start the simulation | **T1.4**<br>The dispenser will be sent a signal telling it to open up and a verification of the simulation starting is needed | B | Not Started |

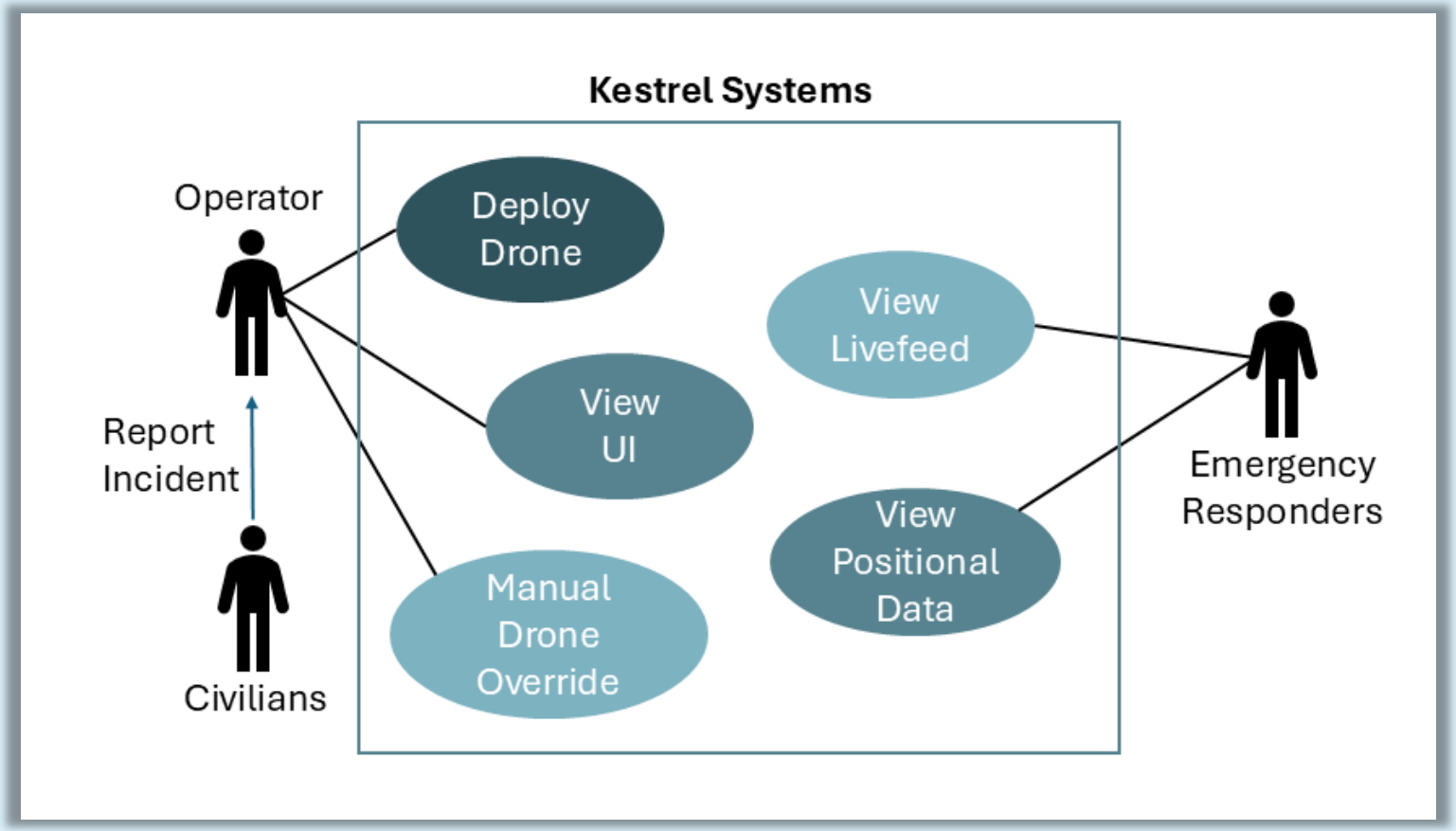
Quick Recap

System Design

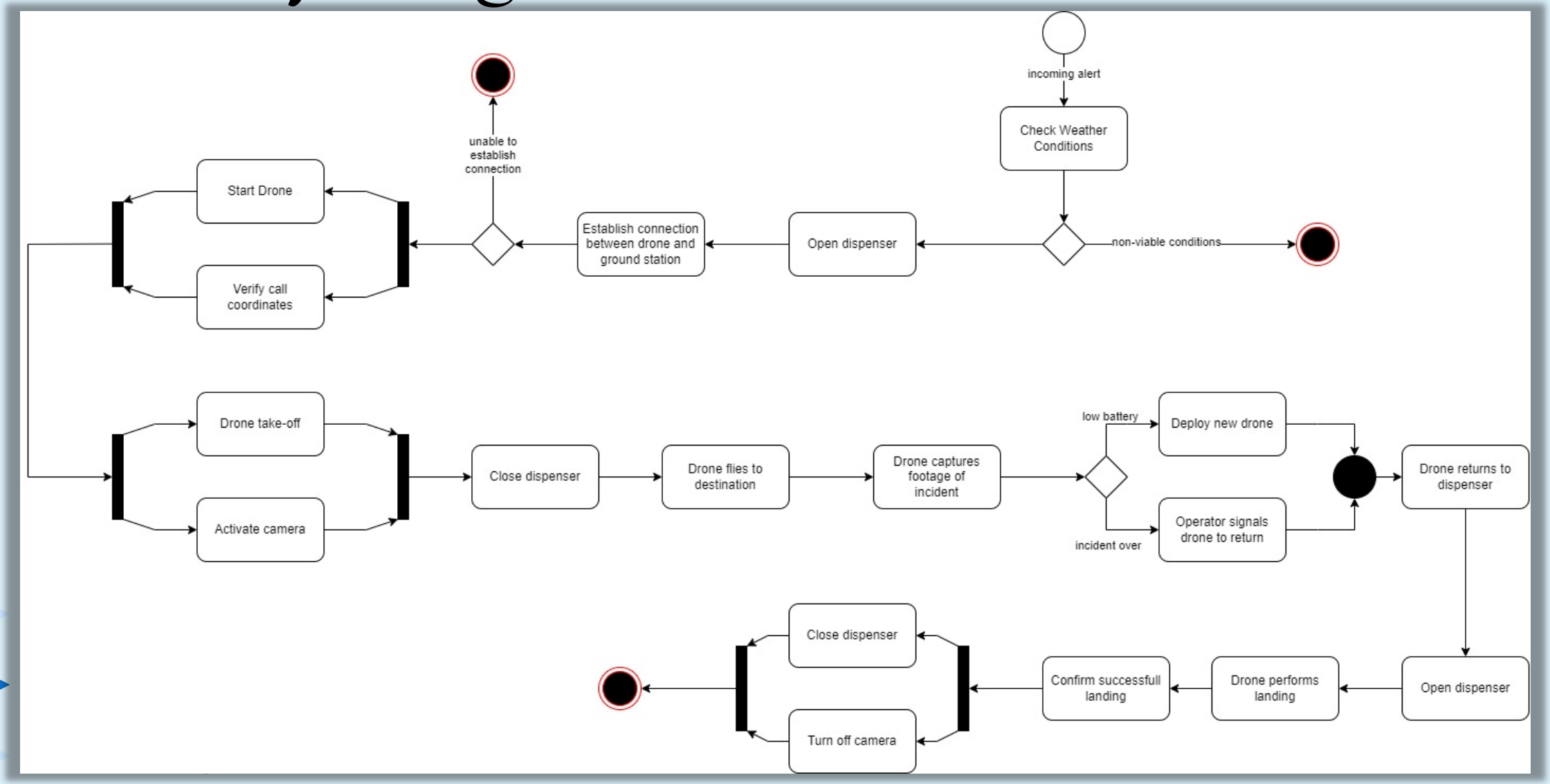
# System Design



# Use Case Diagram



# Activity Diagram



# Drone Software

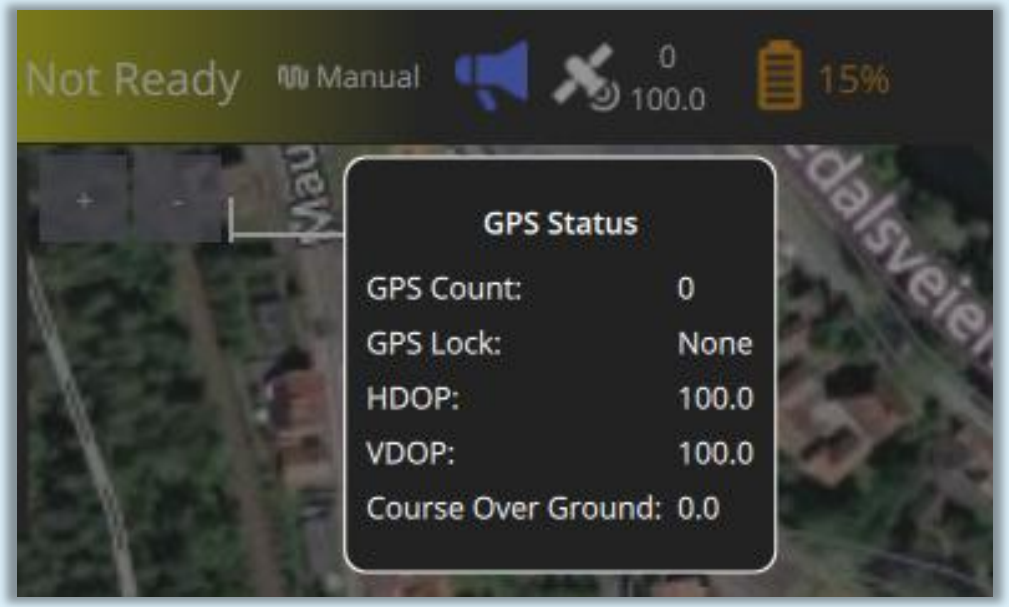
- ModalAI
  - *Linux-based*
  - *VOXL*
  - *PX4 Autopilot*
  - *Mavlink*

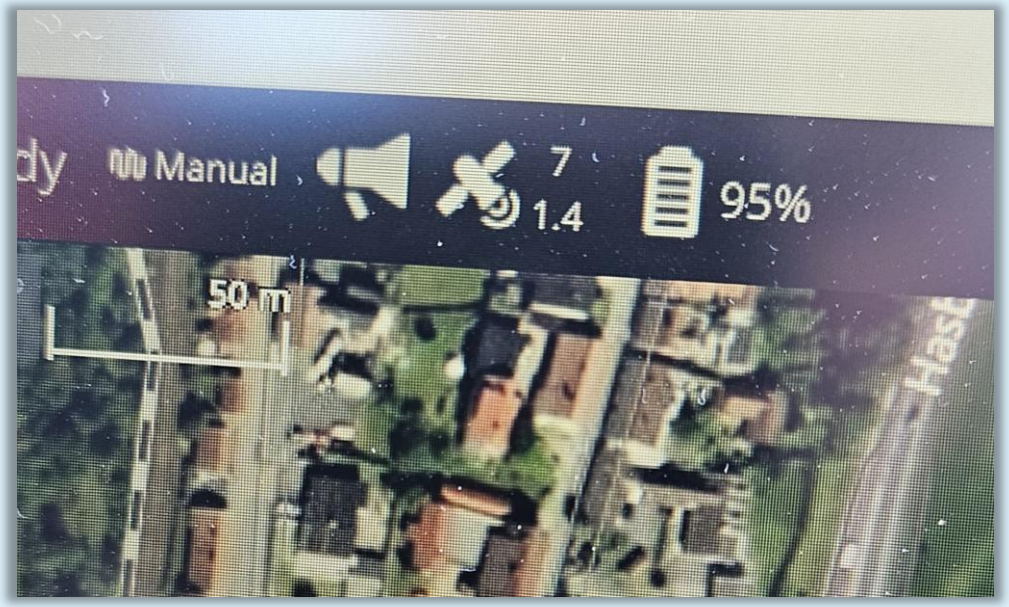

Quick Recap
Software Design
Electrical Design

# Autopilot

| Service Name | Enabled | Running | CPU Usage |
|---|---|---|---|
| docker-autorun | Disabled | Not Running | |
| modallink-relink | Enabled | Not Running | |
| voxl-auto-logger | Disabled | Not Running | |
| voxl-camera-server | Enabled | Running | 200.0% |
| voxl-cpu-monitor | Enabled | Running | 0.6% |
| voxl-dfs-server | Disabled | Not Running | |
| voxl-feature-tracker | Disabled | Not Running | |
| voxl-flow-server | Disabled | Not Running | |
| voxl-imu-server | Enabled | Running | 6.2% |
| voxl-lepton-server | Disabled | Not Running | |
| voxl-lepton-tracker | Disabled | Not Running | |
| voxl-logger | Disabled | Not Running | |
| voxl-mavcam-manager | Enabled | Running | 0.0% |
| voxl-mavlink-server | Enabled | Running | 0.4% |
| voxl-modem | Enabled | Running | 0.0% |
| voxl-neopixel-manager | Disabled | Not Running | |
| voxl-open-vins-server | Disabled | Not Running | |
| voxl-osd | Disabled | Not Running | |
| voxl-portal | Enabled | Running | 0.2% |
| voxl-px4-imu-server | Disabled | Not Running | |
| voxl-px4 | Enabled | Not Running | |
| voxl-qvio-server | Enabled | Running | 7.6% |
| voxl-rangefinder-server | Enabled | Running | 0.8% |
| voxl-remote-id | Disabled | Not Running | |
| voxl-softap | Enabled | Completed | |
| voxl-state-estimator | Disabled | Not Running | |
| voxl-static-ip | Disabled | Not Running | |
| voxl-streamer | Enabled | Running | 0.1% |
| voxl-tag-detector | Disabled | Not Running | |
| voxl-tflite-server | Disabled | Not Running | |
| voxl-time-sync | Disabled | Not Running | |
| voxl-uvc-server | Disabled | Not Running | |
| voxl-vision-hub | Enabled | Running | 5.6% |
| voxl-vrx | Disabled | Not Running | |
| voxl-vtx | Disabled | Not Running | |
| voxl-wait-for-fs | Enabled | Completed | |

# GPS Triangulation

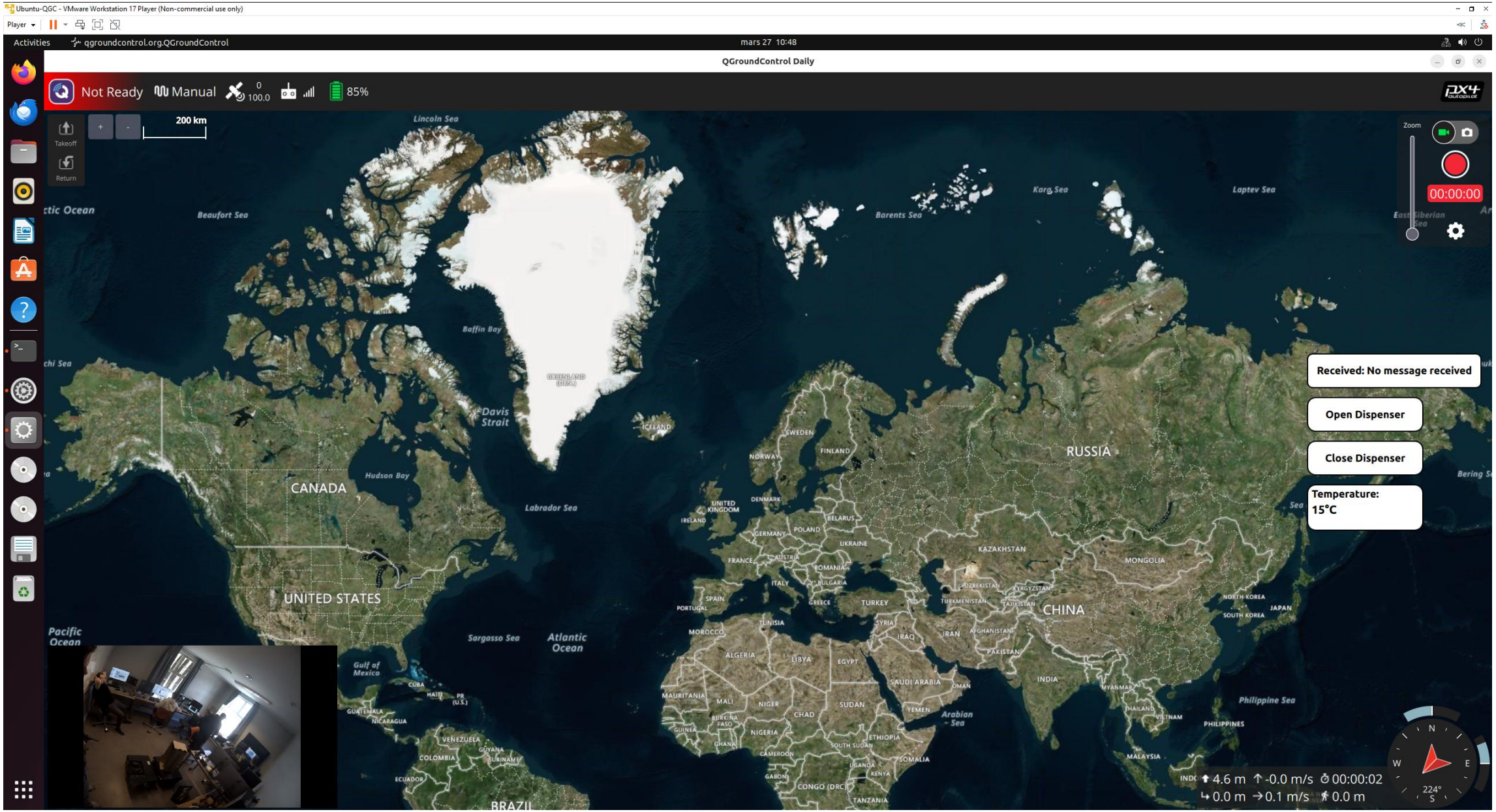



# QGroundControl

- Ground station
- Edit source code

Quick Recap
Software Design
Electrical Design


Ubuntu-QGC - VMware Workstation 17 Player (Non-commercial use only)
Player
Activities
qgroundcontrol.org.QGroundControl
mars 27 10:48
QGroundControl Daily
Not Ready
Manual
85%
200 km
Takeoff
Return
Zoom
00:00:00
Received: No message received
Open Dispenser
Close Dispenser
Temperature:
15°C
CANADA
UNITED STATES
RUSSIA
CHINA
BRAZIL
Lincoln Sea
Beaufort Sea
Baffin Bay
Davis Strait
Hudson Bay
Labrador Sea
Barents Sea
Kara Sea
Laptev Sea
Pacific Ocean
Atlantic Ocean
Sargasso Sea
Gulf of Mexico
Arabian Sea
Philippine Sea
4.6 m
-0.0 m/s
00:00:02
0.0 m
0.1 m/s
0.0 m
224°

# Charging System

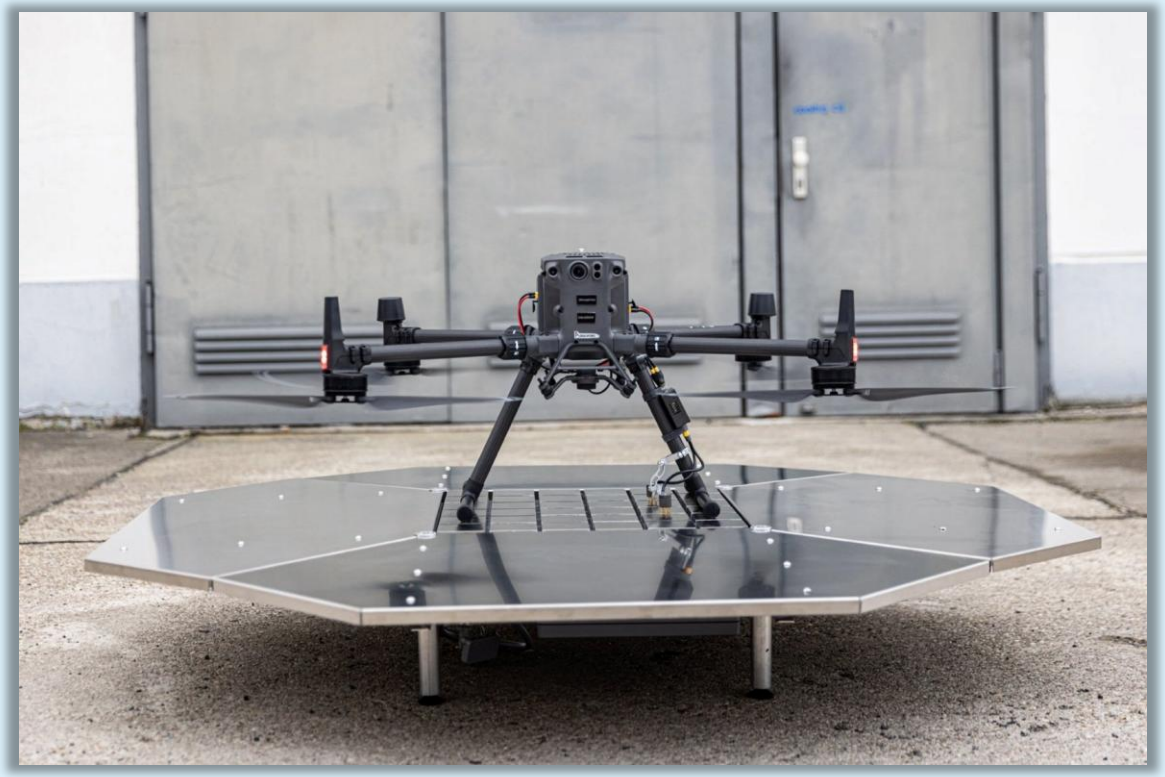
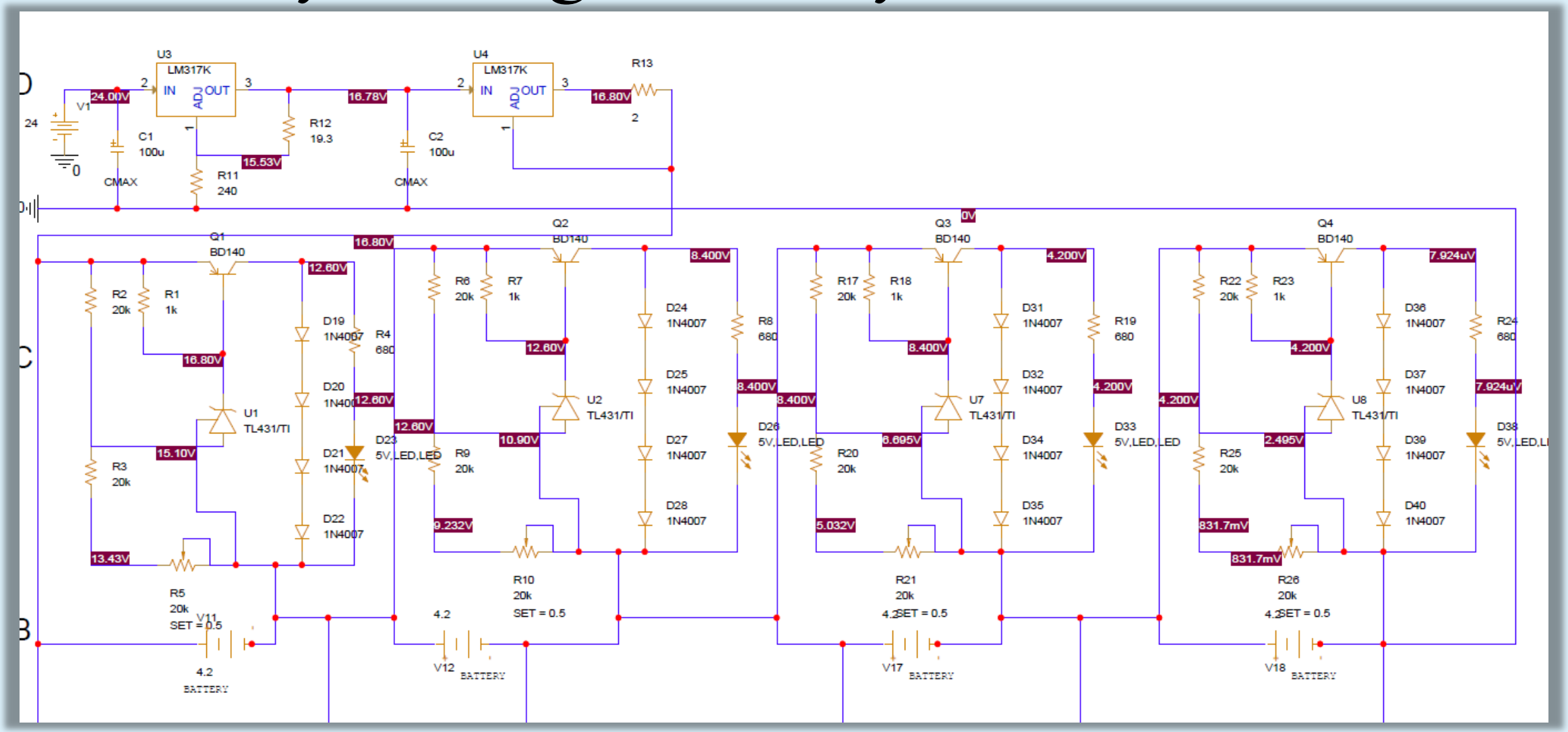
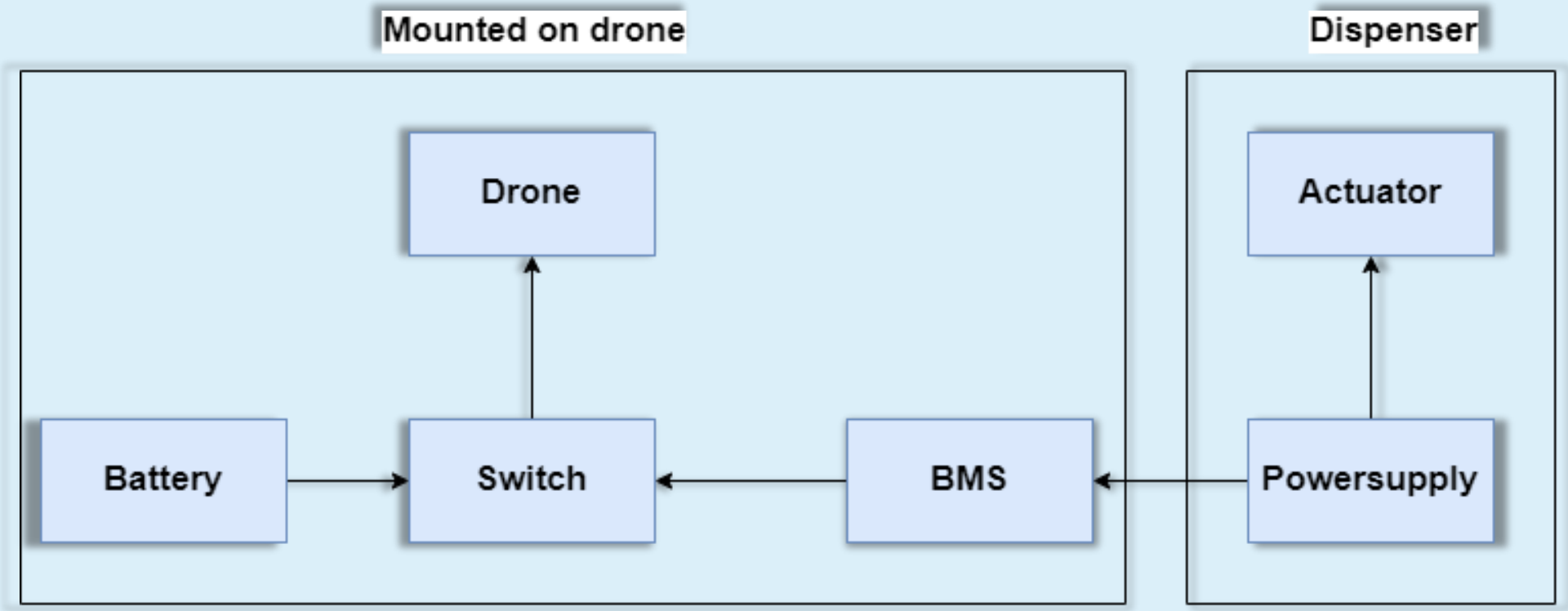


**Photo:** Skycharge

# Battery Management System



# Electrical System



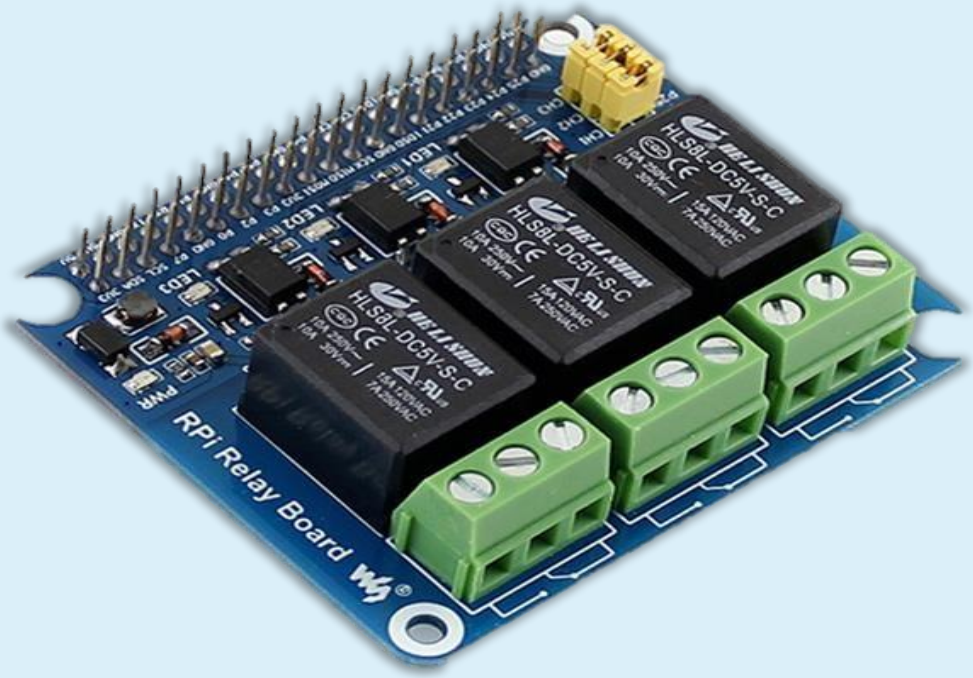


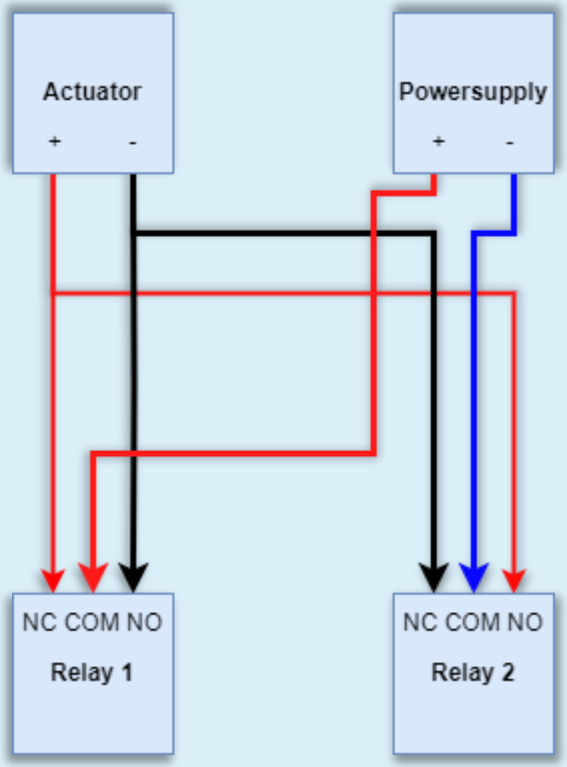
Software Design

Electrical Design

Mechanical Design

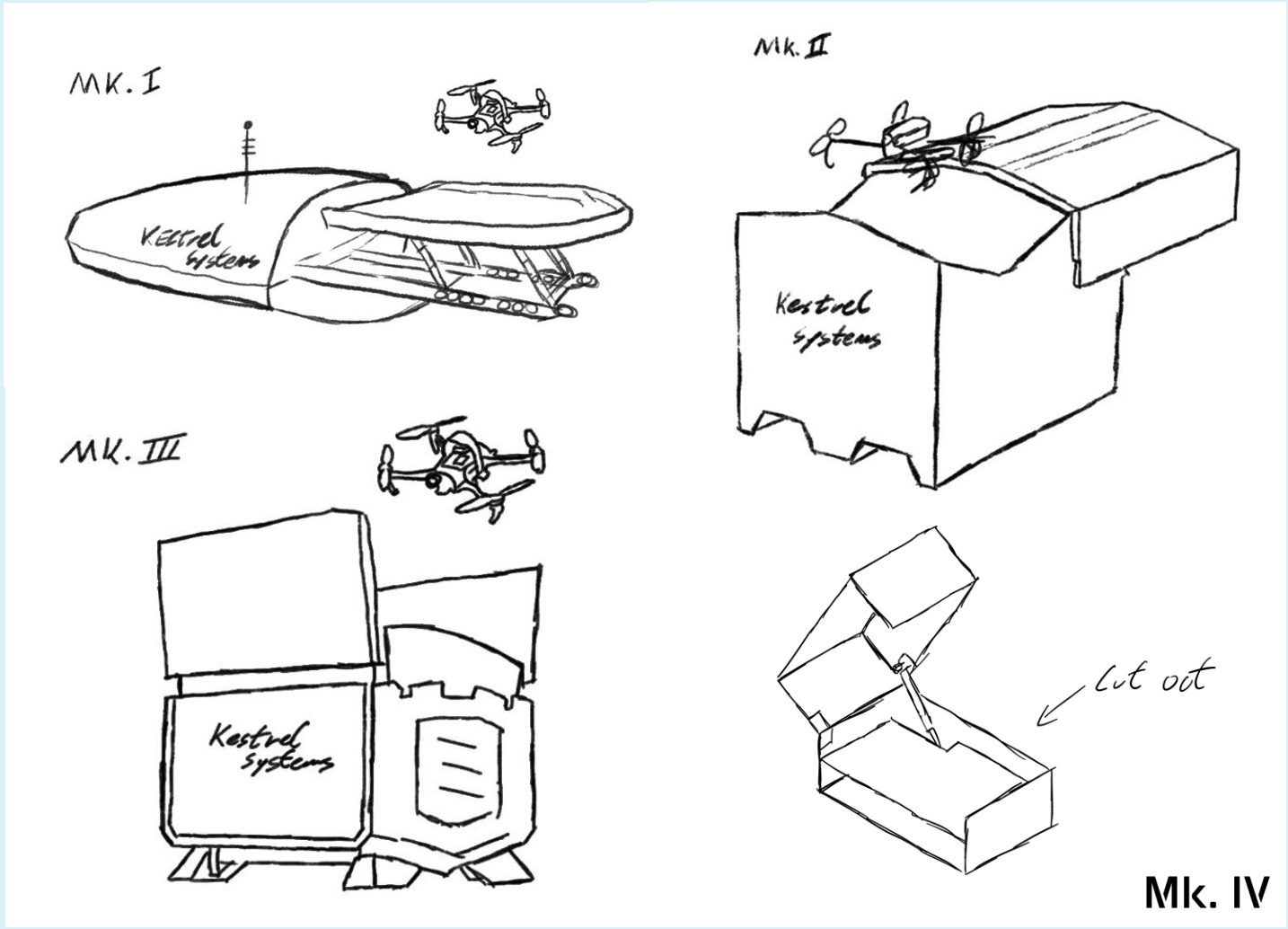
# Raspberry Pi Relay



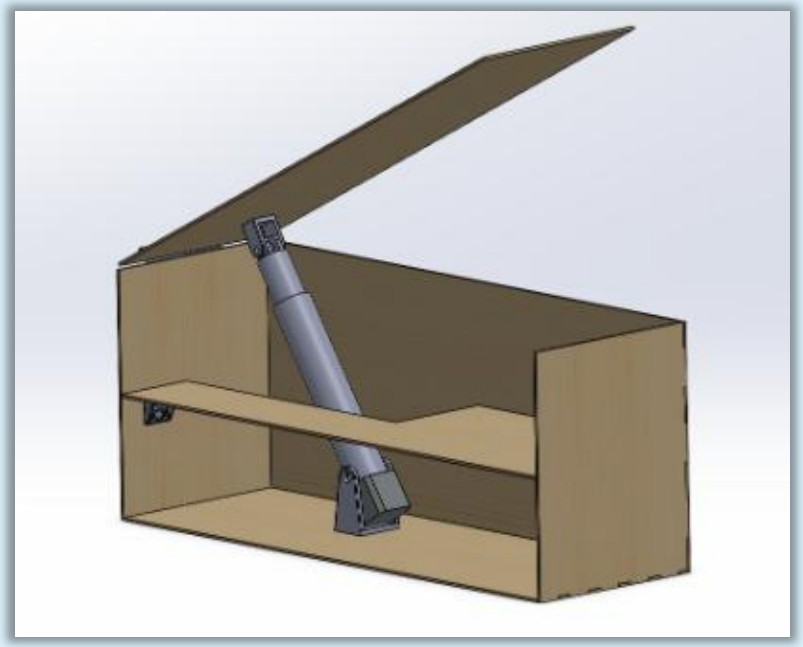
# Design Prototypes – Early Concepts

- Mk.I - Mk.IV
- Opening Mechanisms
- Climate Proofing
- Froze Design at Mk.IV



# Design Prototypes – Models


Mockup Model

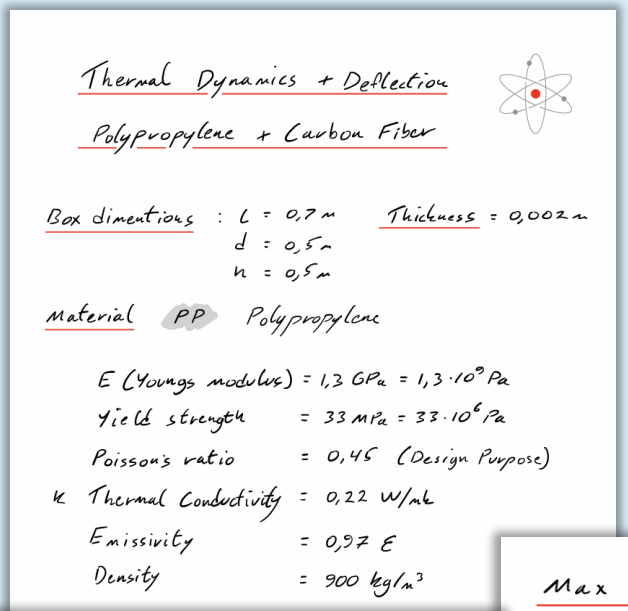


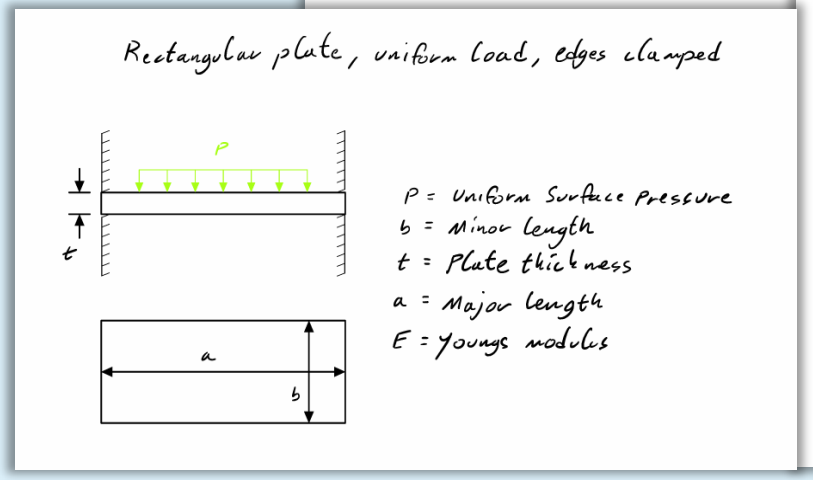
Cut Out Model

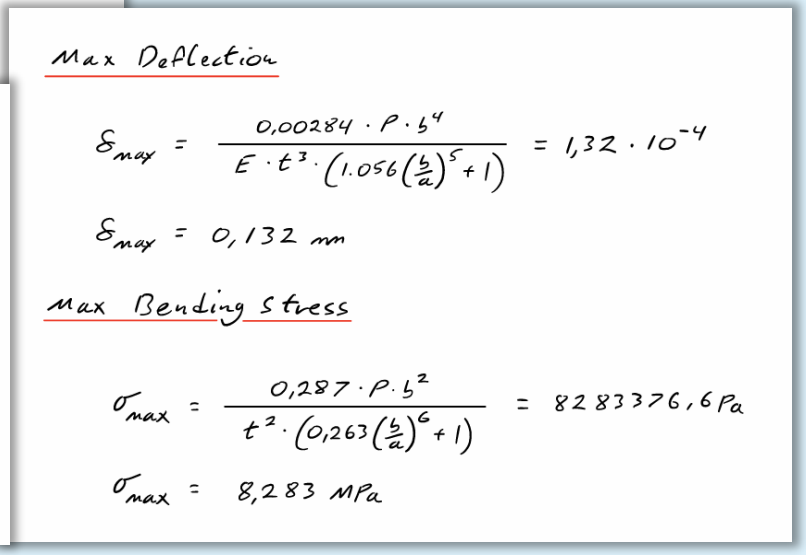
- Electrical Design
- Mechanical Design
- Next Phase

# Material Selection – Calculation

- Material Deflection
- Maximum Stress
- Thermo Dynamics





Electrical Design
Mechanical Design
Next Phase

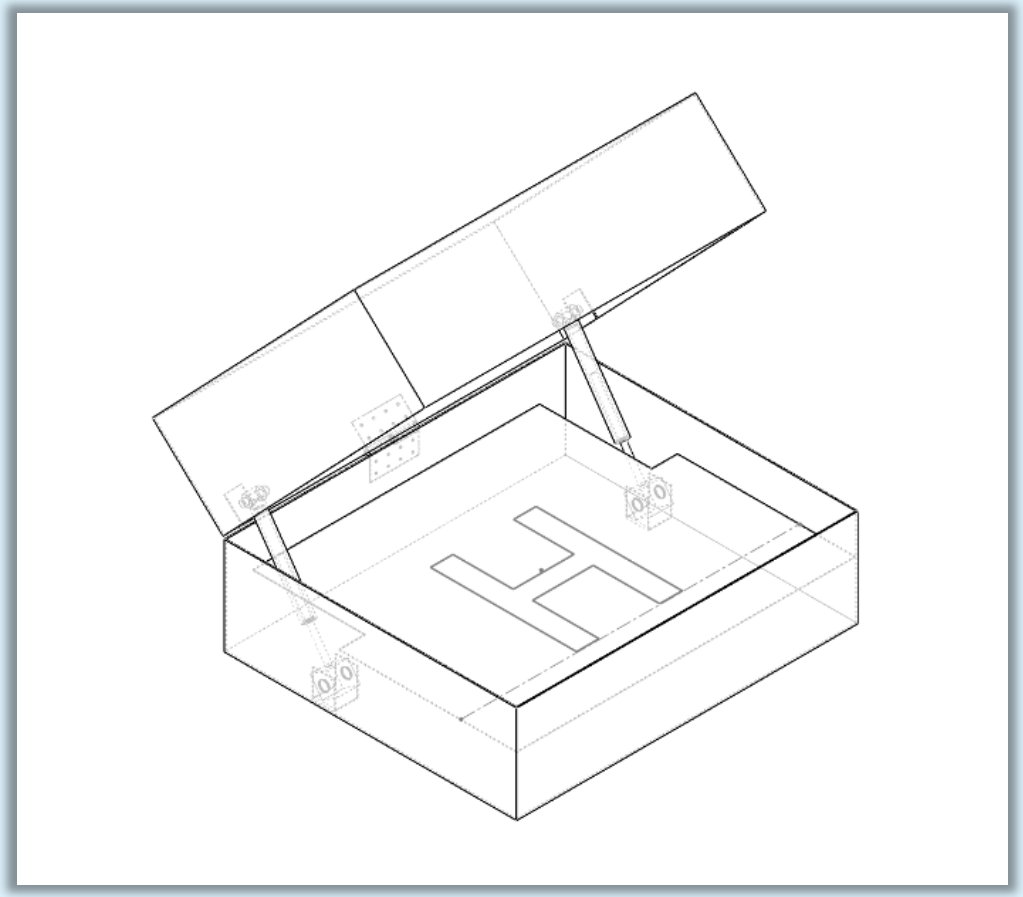
# Material Selection – Analysis

- Carbon Fiber, Polypropylene and Aluminum
- Finite Element Method
- Ribbing - thinner material

Electrical Design
Mechanical Design
Next Phase

# Final Model – Mk.IV

- Vertical Opening
- Electromechanical Actuators
- Heating
- Cooling
- Weatherization
- Aluminum AW 1050A



Electrical Design
Mechanical Design
Next Phase

# Next Phase

# Implementation

- Mechanical
  - *Construct Dispenser*
- Computer
  - *Software Communication*
  - *Develop User Interface*
- Electrical
  - *PCB Design*

Mechanical Design
Next Phase
The End

# Minimum Viable Product

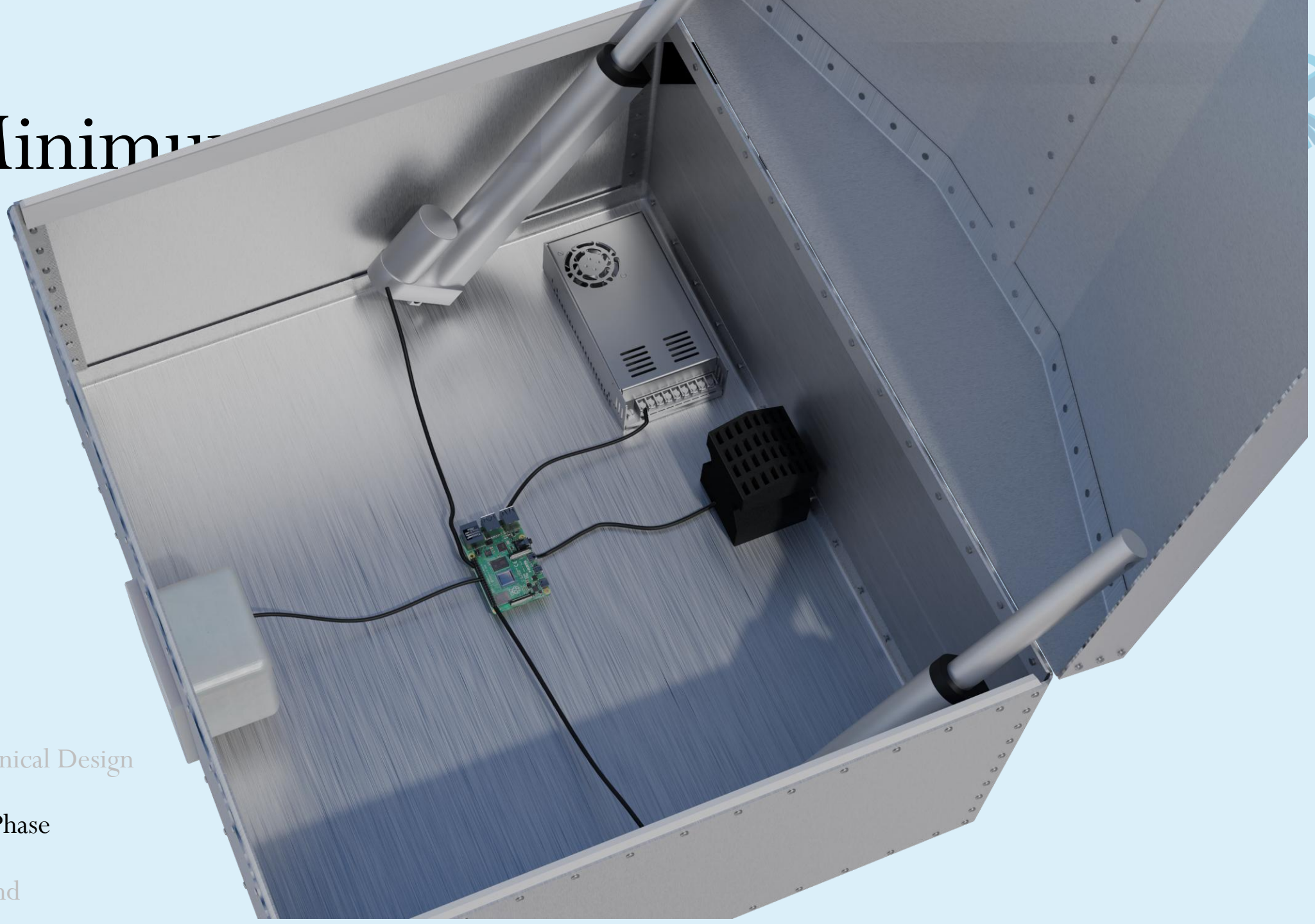
- Enclose drone
- Open/Close dispenser
- Charge drone
- GS communicate with drone and dispenser
- Take off/Landing
- Store data

Mechanical Design
Next Phase
The End

# Minimum Viable Product

# Minimum Viable Prod

# Minimu



- Mechanical Design
- Next Phase
- The End

# Verification

- System Testing
  - *Drone functionality*
  - *Dispenser*

**Photo:** Kongsberg Modellflyklubb, 2022

Mechanical Design
Next Phase
The End

# Documentation

- «Er det ikke dokumentert, er det ikke gjort»
  - *Karoline Moholth*
- Overleaf is our friend
- Continuous updates on website


Mechanical Design
Next Phase
The End

# Thanks for your attention!

Website

Instagram

itfag.usn.no/grupper/D06-25/

@kestrelsystems