

Barracuda

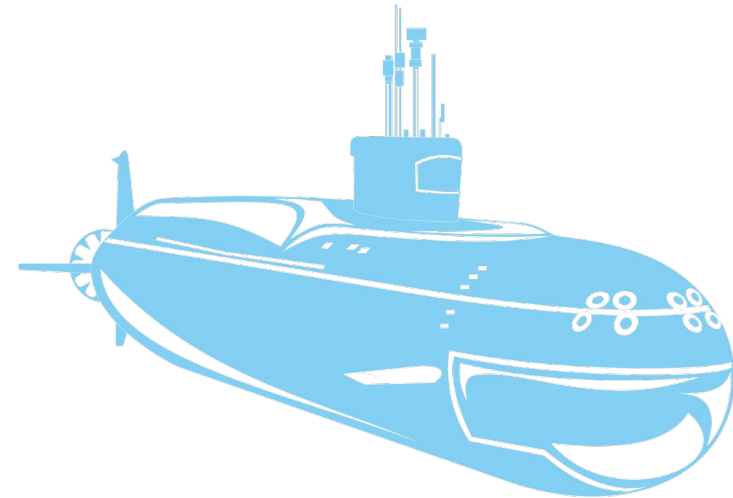
Mechatronic Systems Engineering

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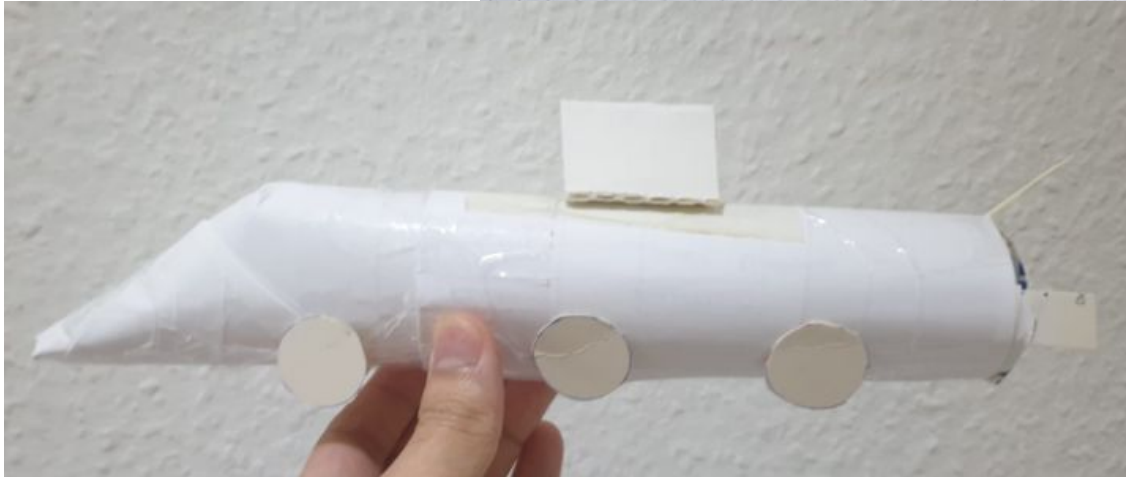
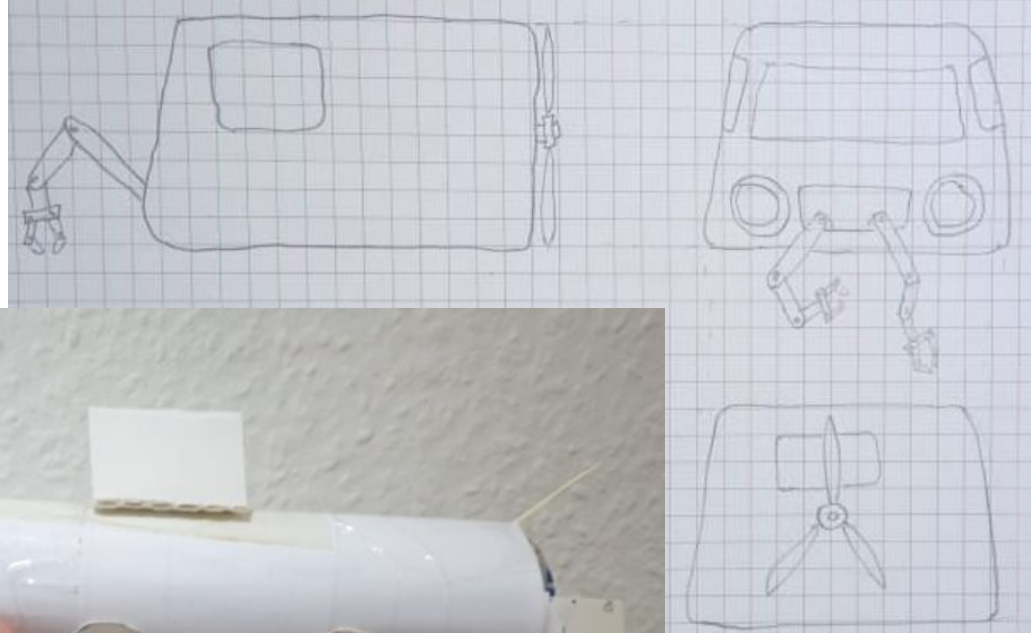
Instructor:
Prof. Dr. Stefan Henkler

1. Motivation and Goals
2. System design
 - Environmental Model
 - Application Scenario
 - Requirements
 - Functional Diagram
 - System of Objectives
 - Active Structure
3. MUML
 - Roles Definition
 - Block Definition Diagram
 - Component Diagram
 - State Chart
4. Cognitive Operator
5. Summary

- ▶ Development of a robot that assists in conducting rescue operations on the surface of the water and under it, as well as on the land



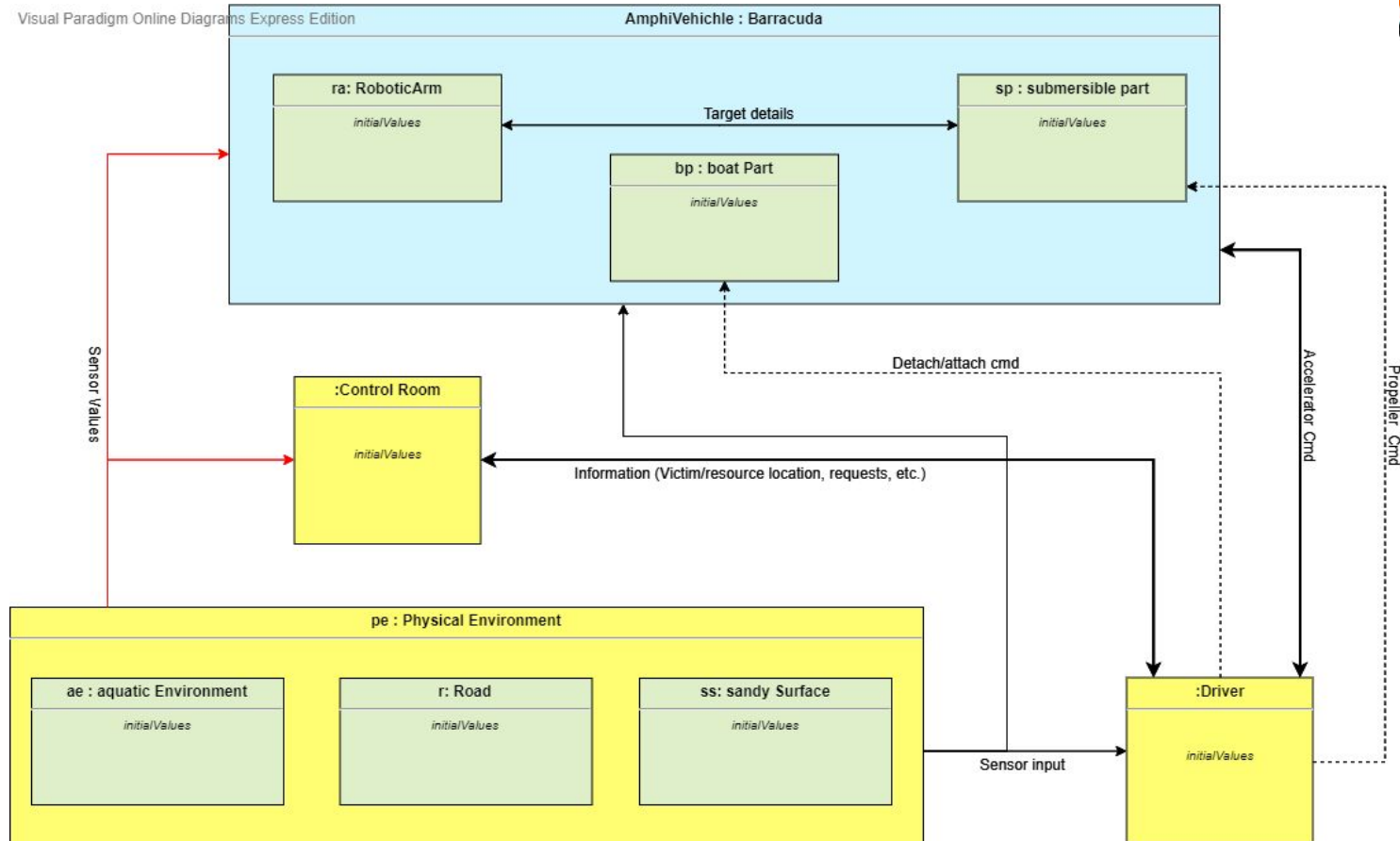
First Prototypes



- ▶ **CONSENS method and diagrams**
 - Environmental model
 - Applications scenarios
 - Requirements
 - Functions
 - System of Objectives
 - Active Structure

CONSENS - Environmental model

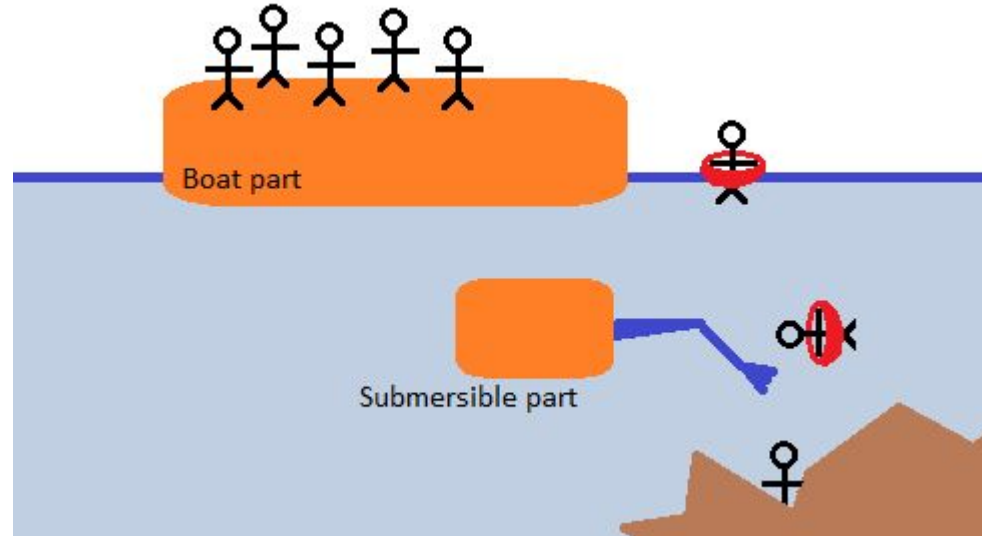
Visual Paradigm Online Diagrams Express Edition



CONSENS - Application Scenario

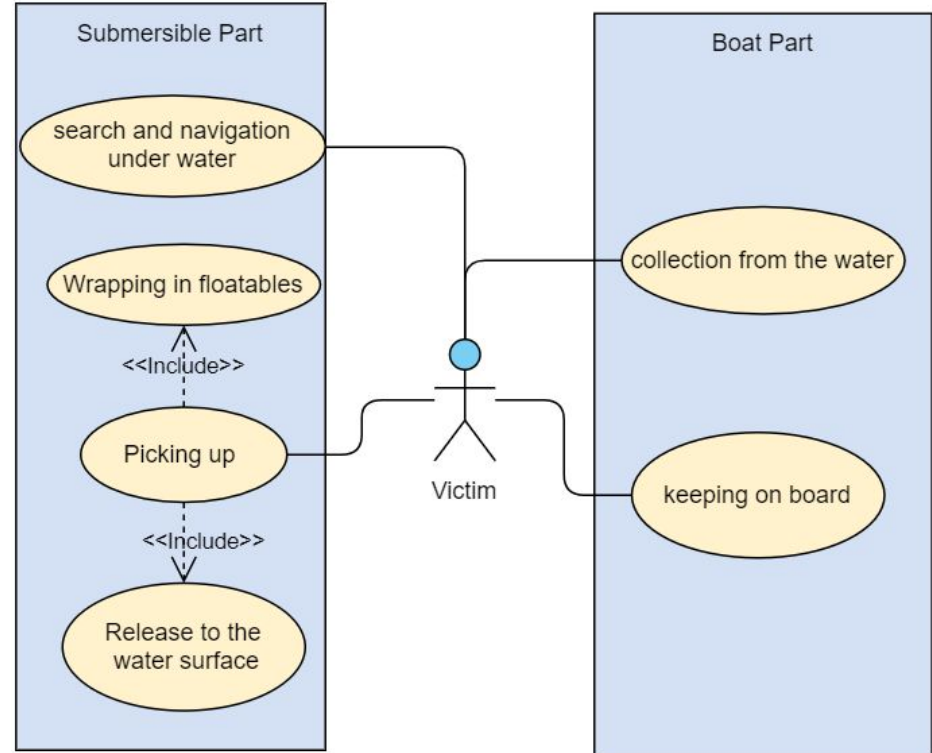
Scenario: Rescuing individuals, animals or valuable objects that stuck on the water surface or under it. The environment is deep rivers or lakes, seas, oceans.

- The rescue zone can be a sinking ship or an accident at the offshore gas or oil production.
- At the crash site it is necessary to detect all individuals on the water surface and provide their rescuing, as well as the search for drowned individuals, access to them and their release to the water surface.

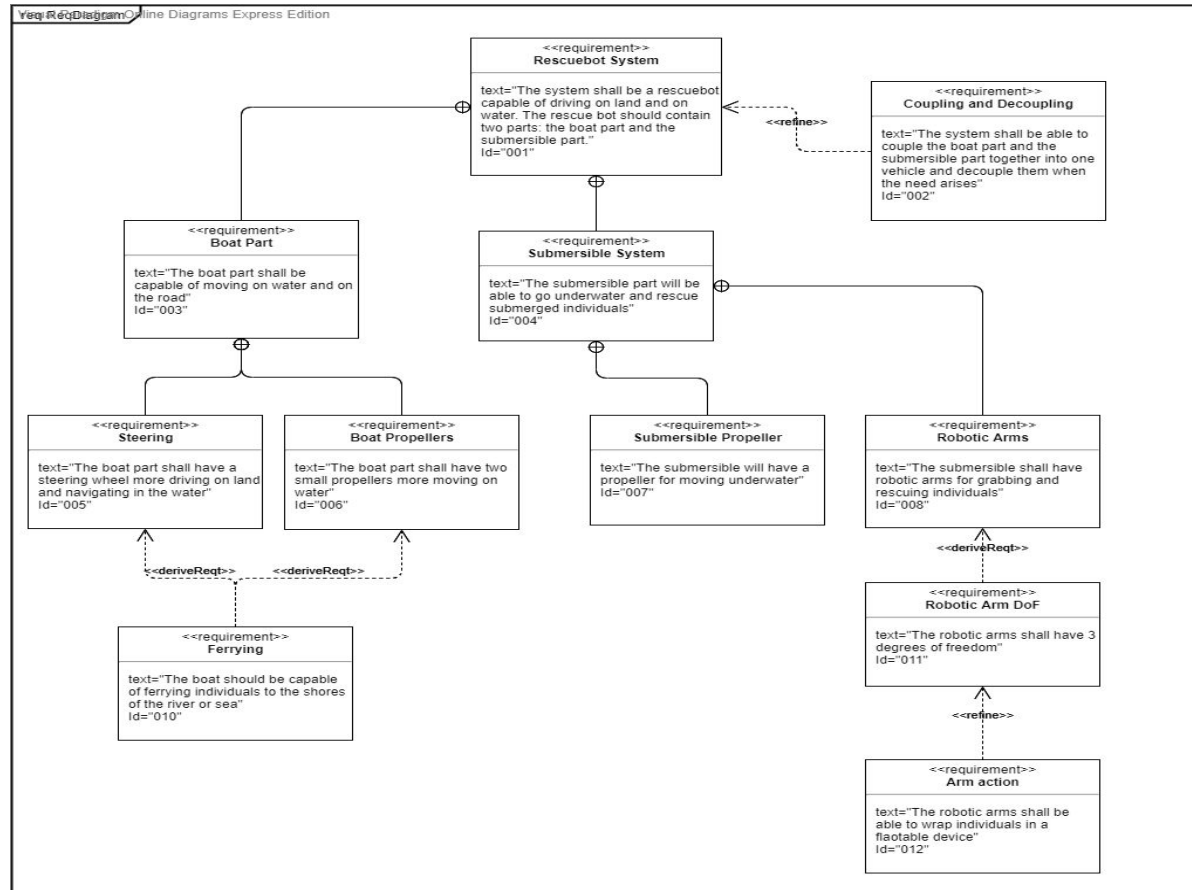


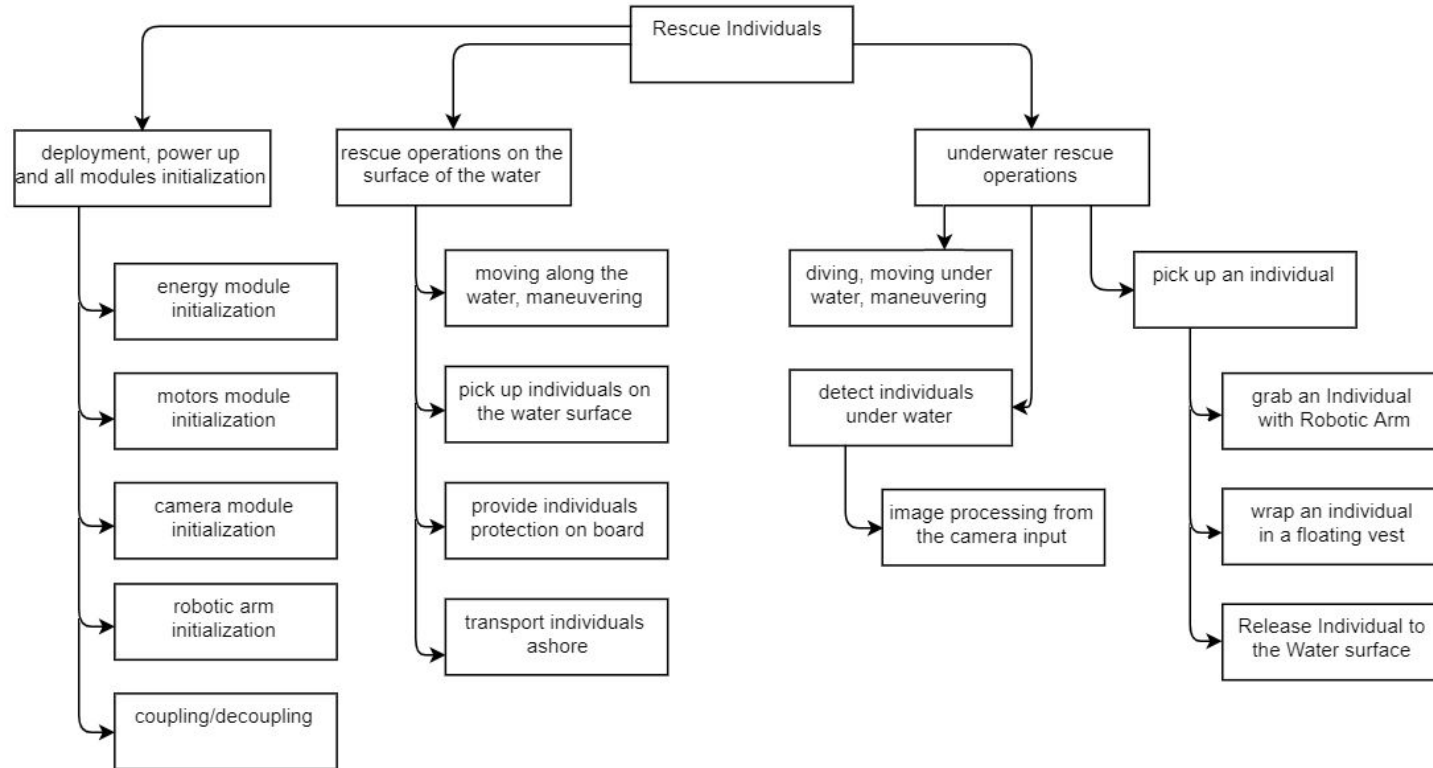
Rescue operation:

- Rescue Bot Deployment
- Crash site reaching
- Camera, Sensors, Robotic arm initialization
- Submersible Part Decoupling
- Rescue operation conducting
- Coupling into one vehicle
- Return to the shores

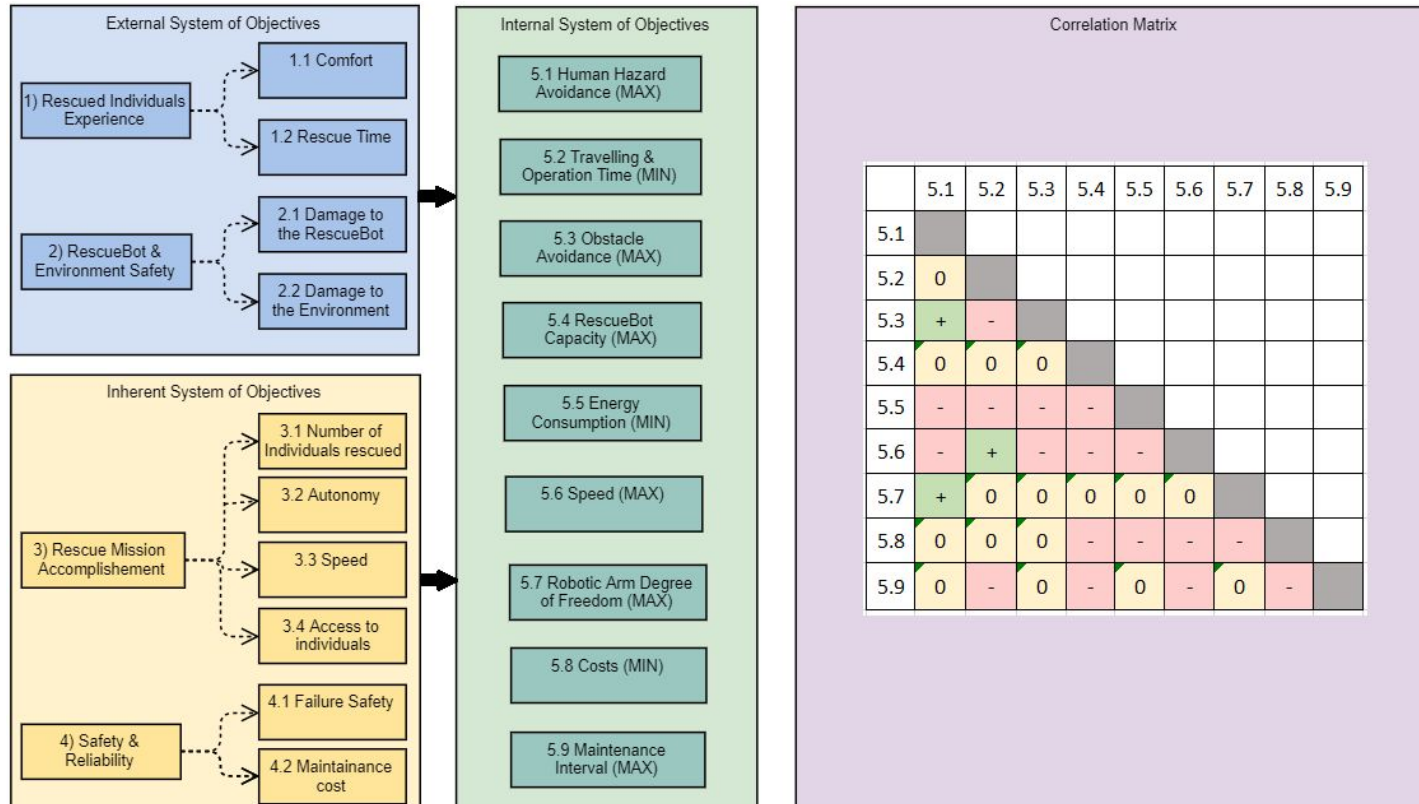


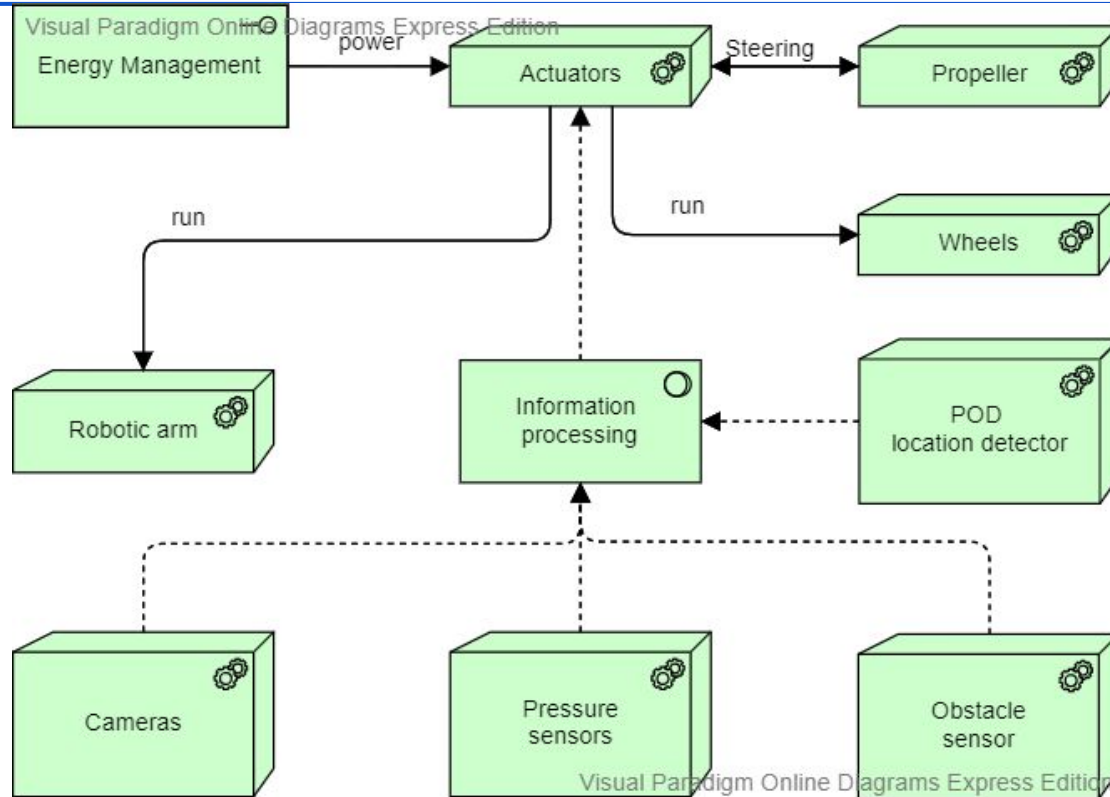
CONSENS - Requirements





CONSENS - System of objectives

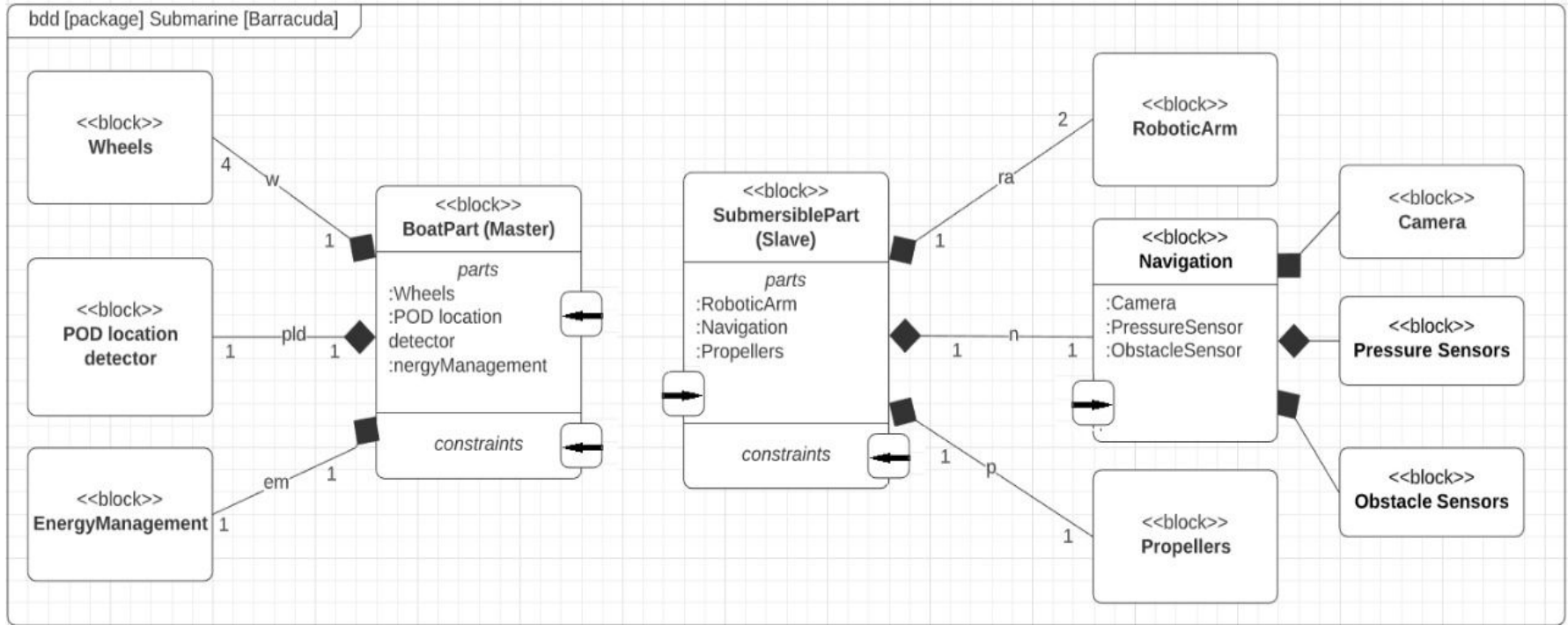




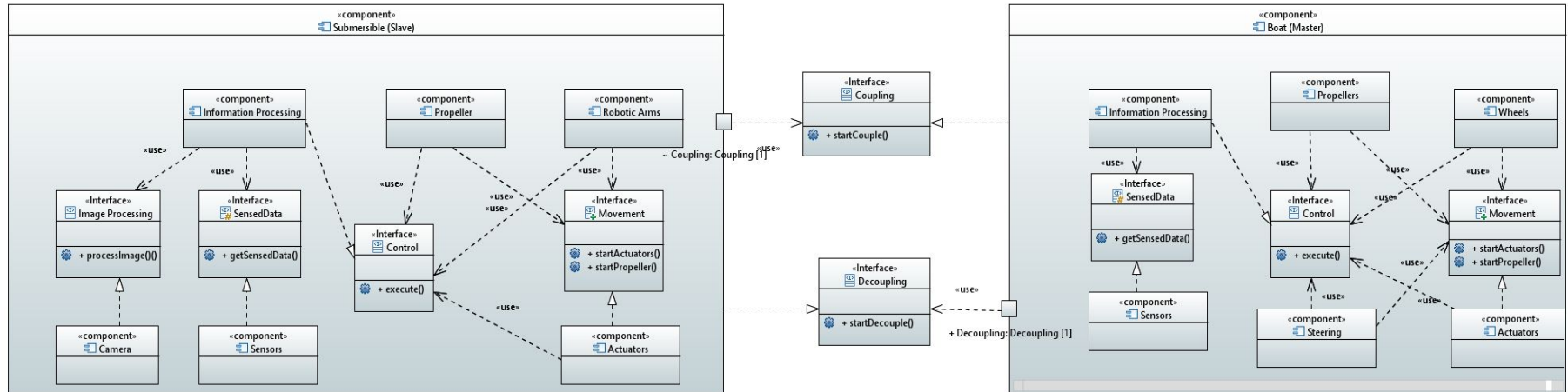
- Roles Definition
- Block Definition Diagram
- Component Diagram
- State Chart
- Uppaal model

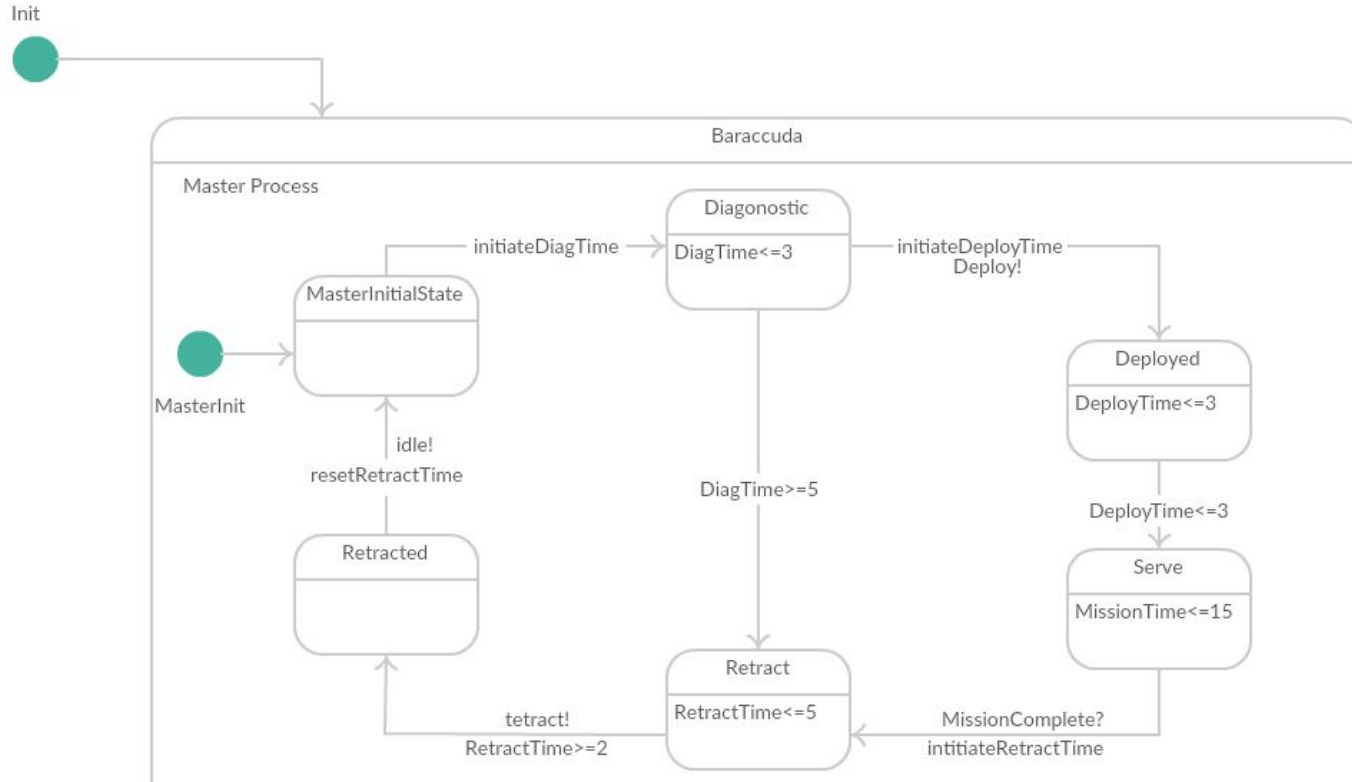
- The system consists of a Master and a Slave.
- The bot floating at a distance from the site of danger acts as Master and the slave bot performs the mission in the accident site.
- The Master performs continuous diagnosis of the system and it is responsible to deploy the slave.
- It also acts as a “First Aid Zone”, where slave transfers the victims.
- The slave has a robotic arm which could grab victims and transfer it to the Master.

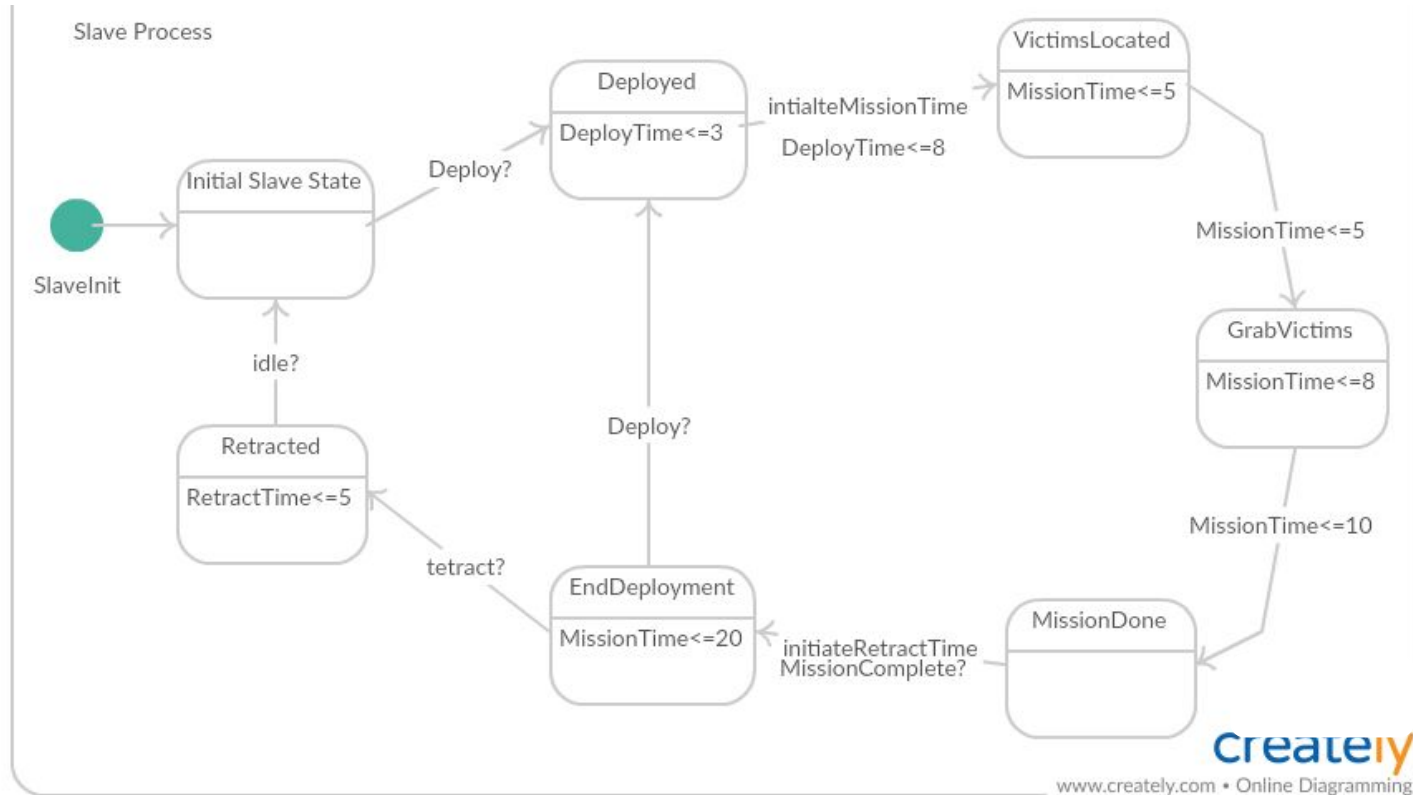
MUML - Block Definition Diagram



MUML - Component Diagram

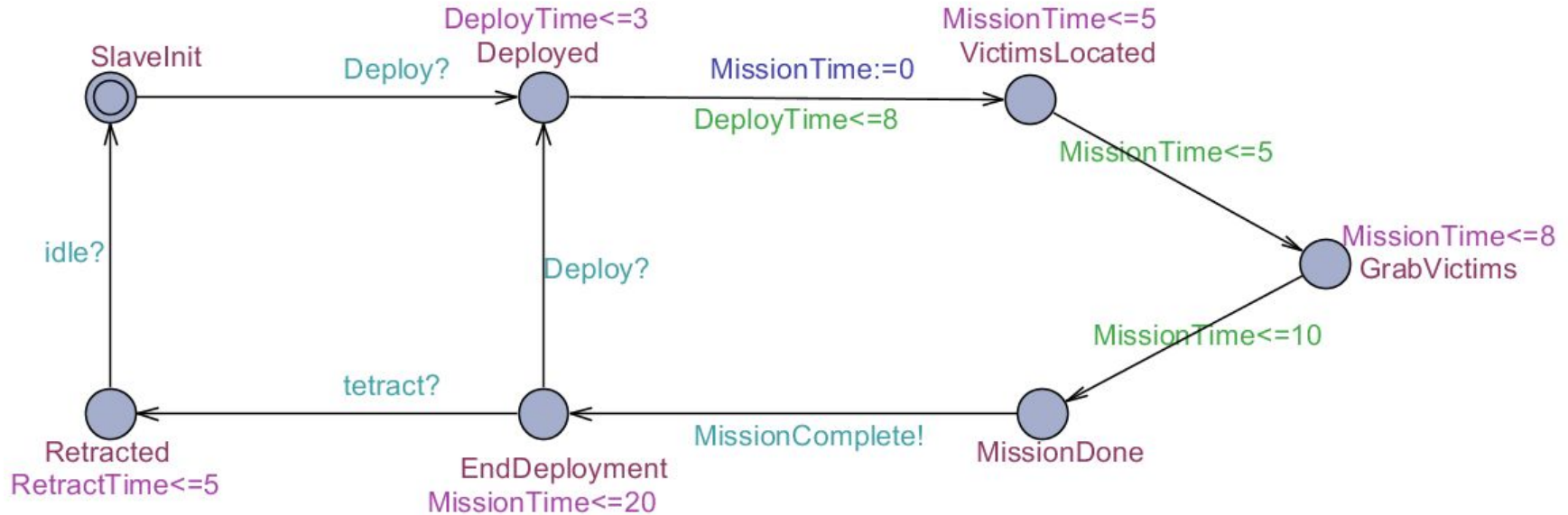






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The dataset:

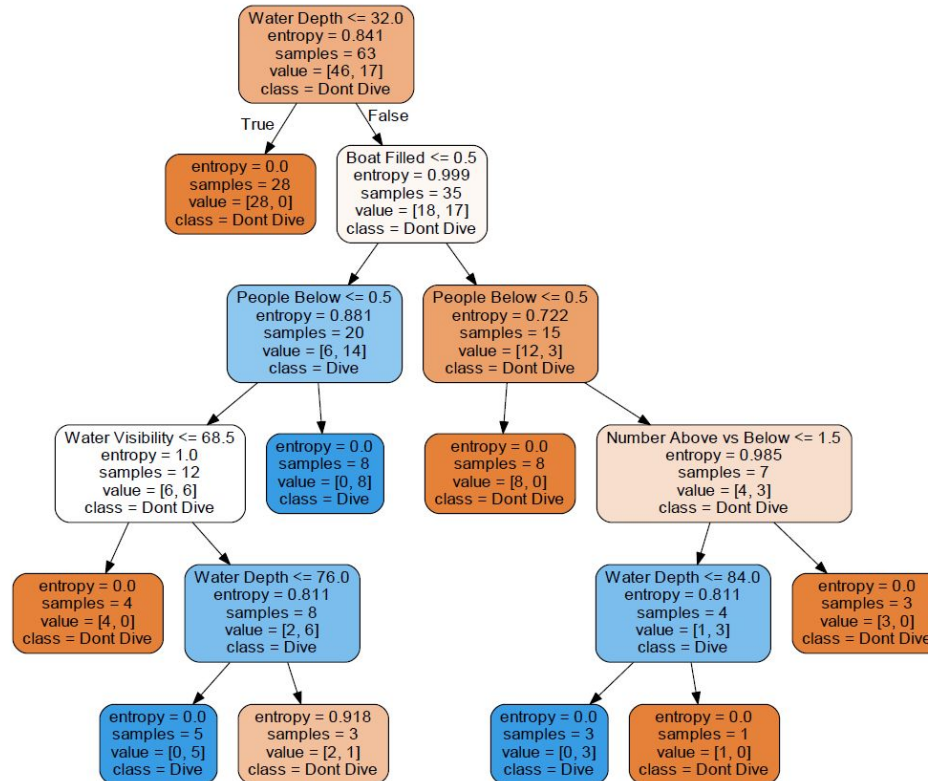
1	Water Depth	Boat Filled	Number Above vs Below	Visibility of the water	People Below	Dive or Not
35	29	FALSE	LOWER	5	FALSE	NO
36	29	TRUE	HIGHER	42	FALSE	NO
37	30	TRUE	EQUAL	142	FALSE	NO
38	34	FALSE	HIGHER	19	TRUE	YES
39	37	TRUE	LOWER	57	TRUE	YES
40	37	FALSE	LOWER	79	FALSE	YES
41	38	TRUE	LOWER	112	FALSE	NO
42	40	TRUE	EQUAL	79	TRUE	YES
43	41	FALSE	EQUAL	58	FALSE	NO
44	42	TRUE	HIGHER	85	FALSE	NO
45	42	FALSE	EQUAL	9	TRUE	YES
46	42	TRUE	HIGHER	110	TRUE	NO
47	45	FALSE	HIGHER	92	FALSE	NO
48	50	FALSE	HIGHER	23	FALSE	NO
49	52	FALSE	LOWER	91	TRUE	YES
50	52	FALSE	EQUAL	98	FALSE	YES
51	56	FALSE	EQUAL	109	FALSE	YES
52	59	TRUE	EQUAL	38	TRUE	YES
53	59	FALSE	LOWER	79	FALSE	YES

Features

- Water Depth: A threshold of 30 feet is used.
- Boat Filled.
- Number of People Above vs Below: Compares number of people who are still able to remain above the water against those sinking.
- Visibility of the water: The value varies inversely with the visibility.
- People Below: If the sensors can locate anyone below the surface.

Decision Tree Demo


- Read the dataset.
- Convert the part of the dataset to numeric values
- Split the data into training and testing sets
- Train the decision tree
- Test the decision tree



- Built a prototype and then decided a particular one as our rescue bot- Barracuda
- To determine basic structure, applied the CONSENS technique for specification and planning the solution
- Defining specific roles- Master and Slave bot: Concretized the existing structure by refining requirements. Verified the correctness on Uppaal
- Generated data set and thus developed a decision using the Scikit decision tree solution

The background of the slide is a repeating pattern of stylized orange fish swimming to the right. Each fish has a white stripe along its side and a white, comb-like detail on its mouth.

Thank You!

A light gray thought bubble with a black outline and a small tail pointing towards the bottom right.

Questions?