Aalto University

TU Delft

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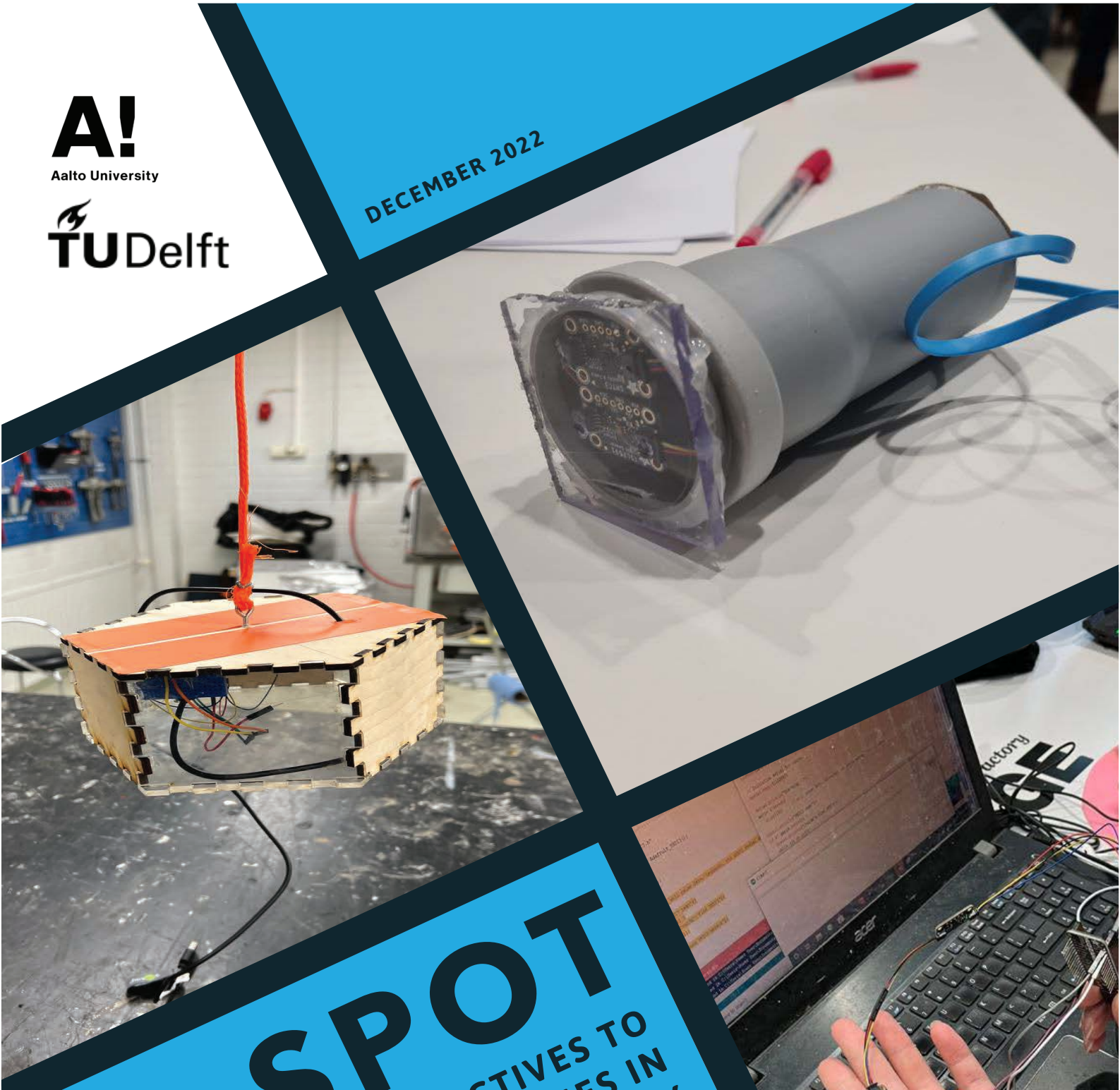


# SPOT

## SOCIETAL PERSPECTIVES TO INNOVATION OPPORTUNITIES IN TECHNOLOGY

## SENSOR-BASED PROTOTYPES WITH IALL TECHNOLOGY

ATTRACT

Report:

# Prototyping for Environmental Surveillance: *A student perspective*

Prepared for:

# IALL

Projects completed within the course:
**Mechanical Engineering in Society**
2022

**Student contributors:**

This compilation of student prototypes represents a curated selection from 23 team submissions. The prototyping process supported students' critical review of the considerations they considered important and the core user interactions that they wanted to test.

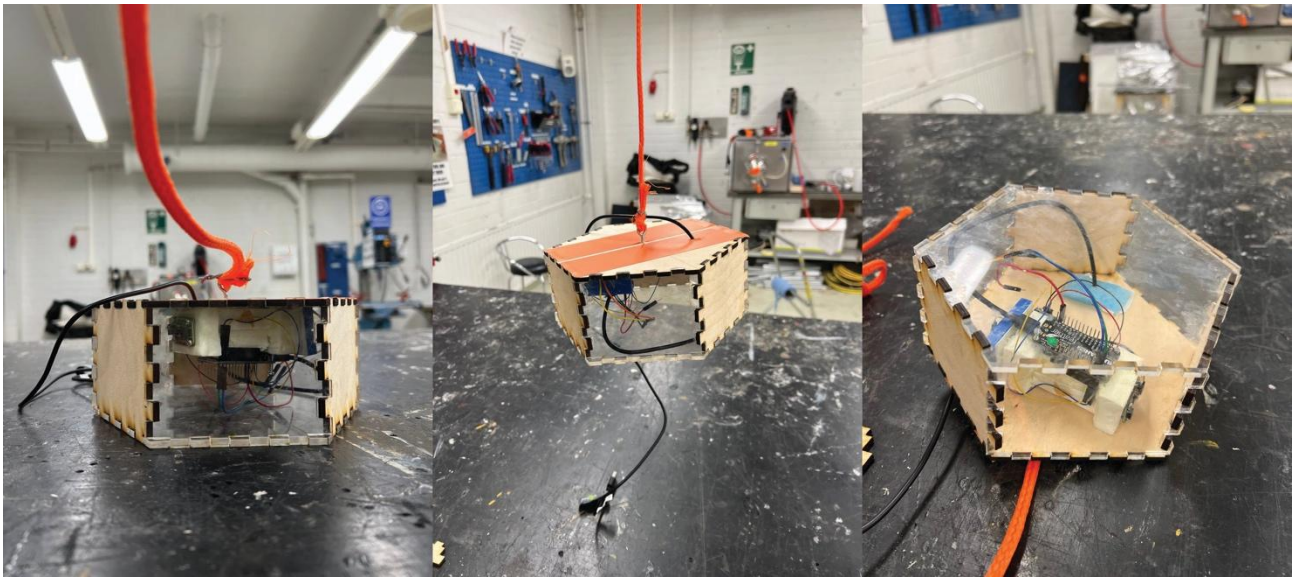
**Nature of student assignment:**

Students were introduced to the IALL project through the ATTRACT technology card. Keeping **sustainability** as a key consideration, students explored the possibility of using IALL lens technology to facilitate **environment surveillance**. Surveillance in this project was linked to observing natural conditions like climate monitoring and animal behavior, which may impact decision making within the context of engineering projects.

The students briefly ideated potential application opportunities for the lens technology, exploring a range of use situations for the lens, with 7 prototypes focusing on observation of wildlife, including the monitoring of turtle egg hatching and tracking population numbers of endangered species in tundra environments, as well as 9 prototypes explored the observation of the natural word through, for example, astrophotography and allowing for more detailed image and video capture of remote areas from drones. Monitoring of the natural world was explored through 6 prototypes, such as capturing images of algae within bodies of water over time and documenting ice reflexivity via a weather balloon. Finally, 1 prototype explored monitoring of work environments and work practice to enhance health and wellbeing.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101004462

# Prototype #1: Wildlife movement



*The prototyped device is intended to monitor the activity of endangered forest species and recognize if they've crossed predefined boundaries.*

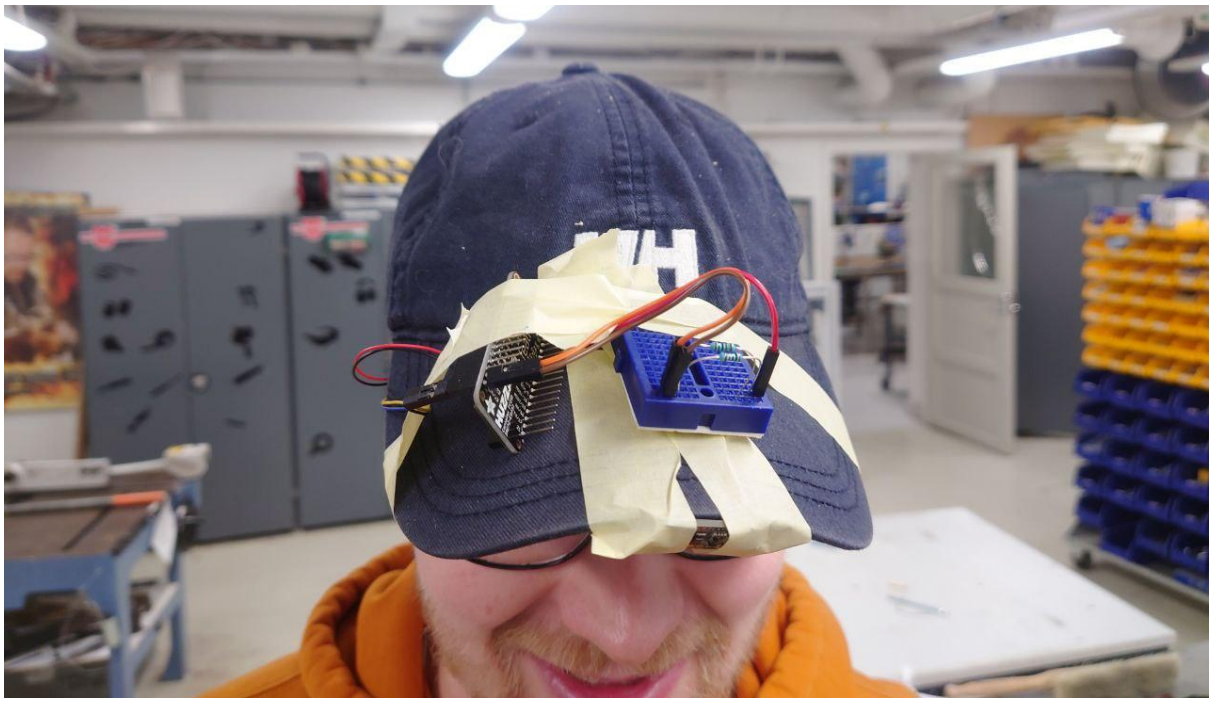
## DESIGN CONSIDERATIONS

The device needs to blend in with the forest: wood and colors common in nature can be used as camouflage for the device. To ensure the device allows for long term use it should have a high-capacity battery, a solar panel and optimization of the hardware.

The device must be sturdy with a water-sealed frame. Wires and sensors exposed to the outside need to be properly sealed for leaks. The wires needed to be exposed outside for easy data retrieval for field workers. It also needs an easy access panel for maintenance engineers.

The device should have a transparent panel to ensure light reaches the main sensor and for image or video capturing using an IALL lens. An easy and generic mounting mechanism can be used that is suitable for the climate of the area in which it is installed. This could perhaps even be rope available locally for the installation.

# Prototype #2: Workplace monitoring



*The device is meant to be used by personnel to monitor the work environment. Firstly, the device can monitor ways of working if required to respond to specific company policy. This could be useful in dangerous or volatile working environments. The lens' ability to focus will keep the device small. Secondly, the device can also monitor the temperature and moisture levels of the work environment to ensure a healthy workplace.*

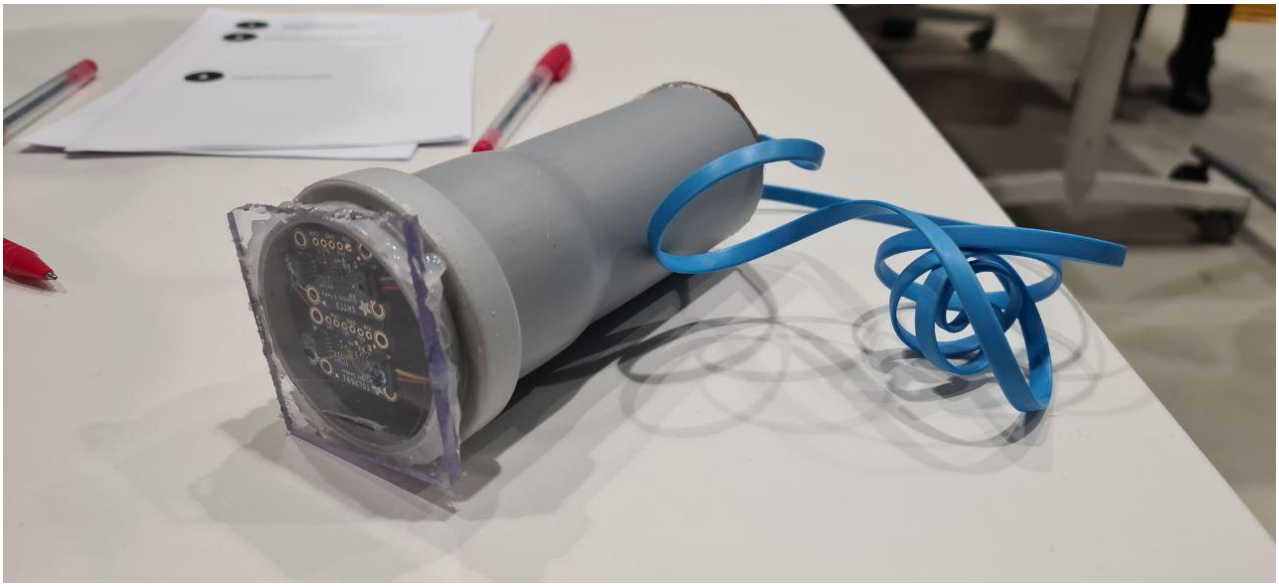
## DESIGN CONSIDERATIONS

The prototype was placed on a cap, to be worn during work by the user. Core user interactions to test with the prototype was how to enable monitoring by the sensors while not limiting the performance of the user. The cap also needed to be comfortable to wear

Three key considerations while producing the sensor-based prototype were the sensor's sensitivity, durability, and size. The core user interactions tested included monitoring of the temperature of each person wearing the prototype device as well as the humidity of the room.

The distance sensor and the IALL lens technology will allow for the tracking of relative distance between users wearing the same prototype device or from specific item or equipment.

# Prototype #3: Long-term placement in extreme environments



*A device to monitor environmental data and migration in extreme environments such as deserts, which experience drastic temperature differences and sandstorms, or at sea.*

## DESIGN CONSIDERATIONS

The first design consideration was to ensure the device and lens casing were waterproof and dust resistant, as the device is designed to be used in locations with these conditions.

This was accomplished by having a transparent acryl front-plate through which the sensors could still function. The back-plate is waterproofed with a rubber grommet through which the power and data chord run. The tubular design is more rigid and doesn't collect as much dust as a squarer design option would.

The inside features foam padding which is used to dampen knocks and bangs and works as insulation as well.

The device is reasonably small and thus can be installed in a range of spaces effectively.

# Prototype #4: Drone mounting

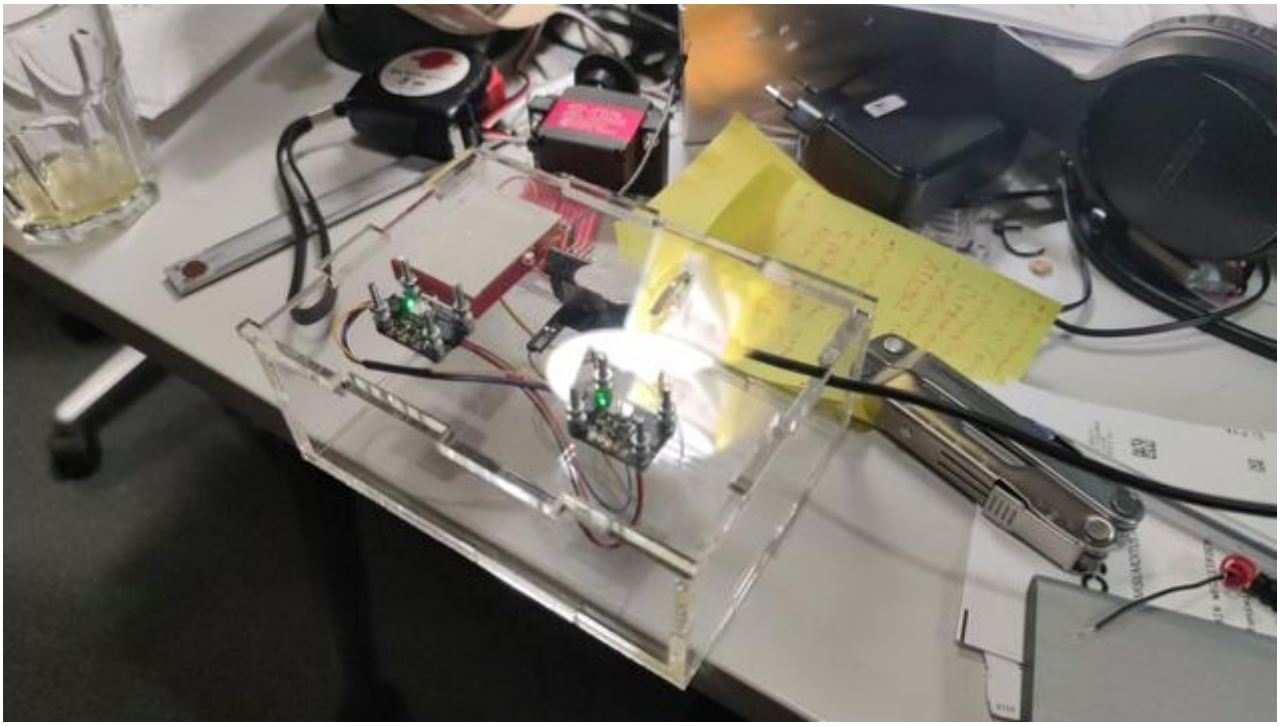
*The device is a prototype to observe environments and capture air measurements from a drone. While the drone camera can be used for navigation the IALL lens allows for a broader range of focus for image or video capturing.*

## DESIGN CONSIDERATIONS

The device features a light casing, which would protect the sensor from forces of nature (such as wind, precipitation, or temperatures). The main design considerations were aerodynamic drag and weight.

Because our sensor prototype would be installed in a drone it needed to create minimal aerodynamic drag. The spheroid shape is symmetrical along the vertical axis thus the aerodynamic drag is the same in every direction it moves - a good addition as a drone can travel along all 6 axes.

# Prototype #5: Observation buoy



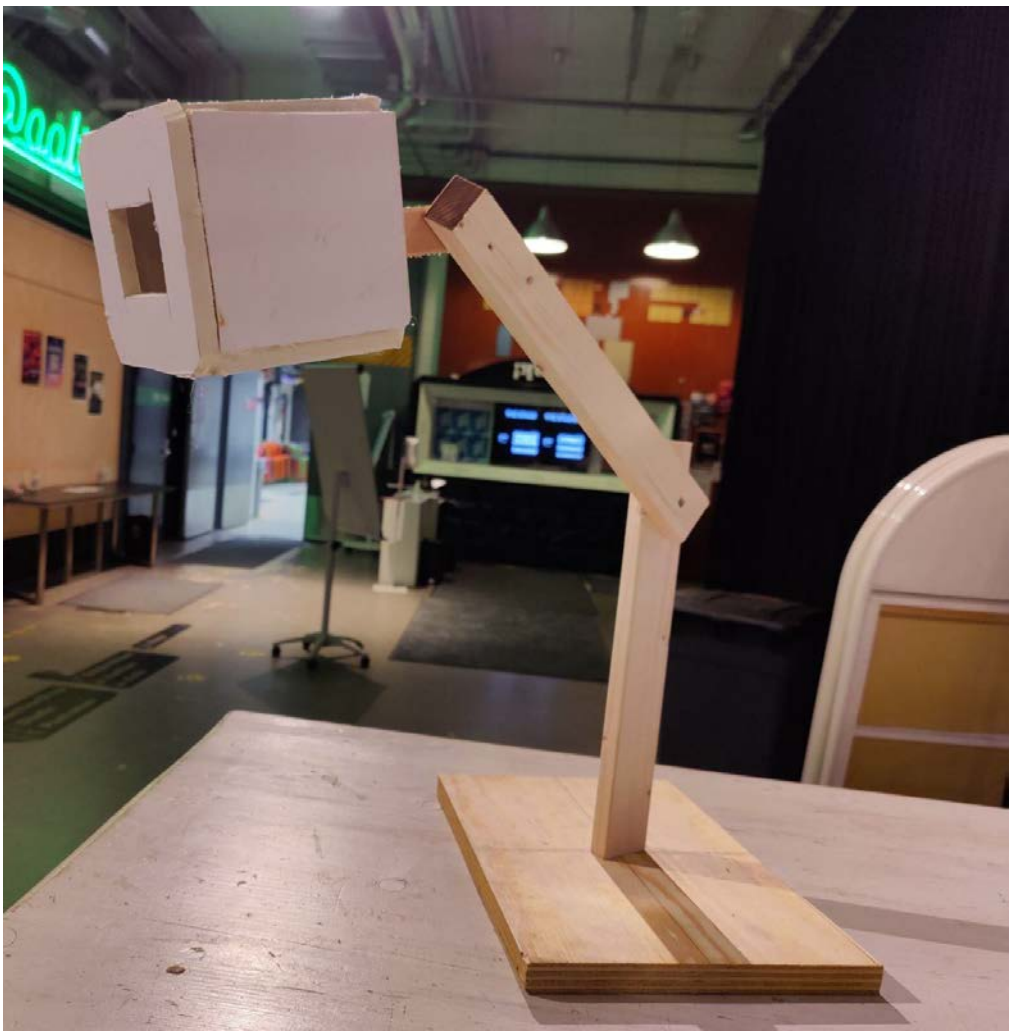
*The device is intended to be installed in the Baltic Sea region and will be used to monitor the environment and study aquatic life with the aid of an IALL lens.*

## DESIGN CONSIDERATIONS

The sensor-based prototype is measuring temperature and light level at specific locations within the Baltic Sea, while recording marine life behavior and presence. As the IALL lens provides a substantial focus range the device can capture aquatic life at varying distances from the device. The device is placed below a buoy and must thus be waterproof to secure the vital electronics. The design must be impact resistant as floating debris could hit the device.

The core user interactions would be extracting the data via a wireless system, as the prototype would record data at given intervals of time.

# Prototype #6: Astrophotography



*The system was designed as a prototype for astrophotography and videography and would be placed on the top of the hill. The concept features 3 degrees of freedom to help the lens change its orientation.*

## DESIGN CONSIDERATIONS

The key consideration for this prototype was to ensure that there is no fluctuation in power supply voltage, as it can result in misleading data.

The use case will require the device to be waterproof, able to withstand fluctuating max/min temperatures and accessible to ensure retrieval of data. Users can easily access the sensor box in case of repairs, replacement of part, or data retrieval through a hatch on one of the sides of the enclosure.