INDIAN INSTITUTE OF TECHNOLOGY TIRUPATI

JAL SHODHAK

AUTONOMOUS WATER CLEANING ROBOT

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Problem Statement

River and Ocean Pollution

Rivers and oceans are increasingly plagued by the accumulation of solid waste and chemical pollutants, posing a grave threat to aquatic ecosystems, biodiversity, and water quality.

Introducing Jal Shodhak: Revolutionizing Water Cleaning

Introduction

Jal-Shodhak

Main Components:

1. Hydro-Sweep
2. Suction robot (X-shaped robot)
3. Suction pipe

The goal of the project: To create an efficient and versatile water-cleaning robot

Applications and Relevance of Jal Shodhak

Importance of cleaning water bodies to combat pollution.

Applications

Cleaning rivers, oceans, and lakes, and addressing oil spills.
Ecological and societal benefits of a cleaner environment

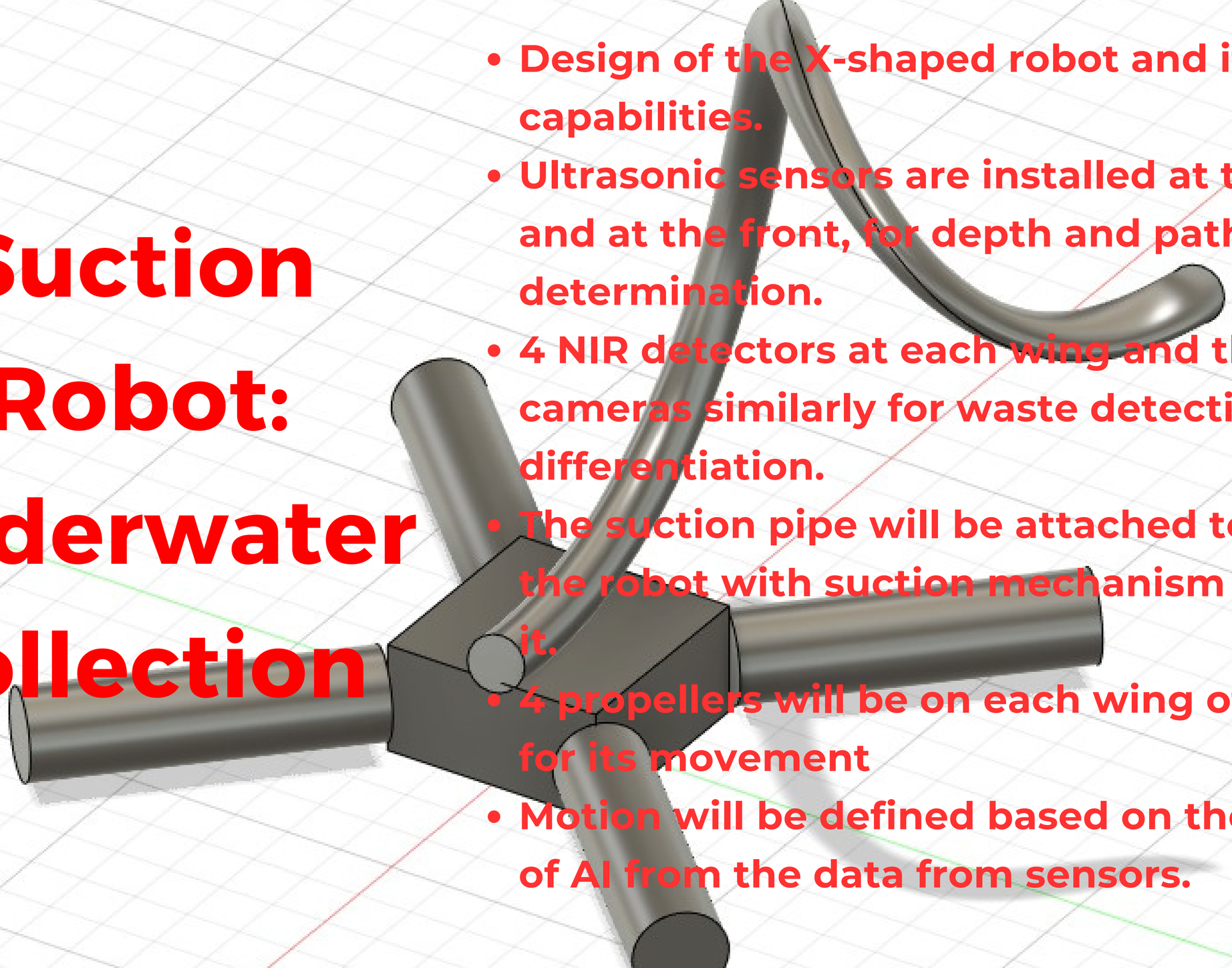
PROJECT PLAN SUMMARY

- **HydroSweep**
  As container, Solar pannels
  Overwater cleaning system
- **Suction Pipe**
  Suction, water filtration.
  Solid waste as well as chemical waste cleaning
- **Suction Robot**
  The under-water cleaner uses suction. Source of pollution
  NIR sensors, ultrasonic detection
- **Power transfer**
  Solar panels, fuel cells
  Underwater Inductive Power Transfer (alternative), as well as using wires

HydroSweep: Cleaning and Collection

- HydroSweep's design and appearance.
- 8 Solar Panels are attached on the top for power generation.
- The camera will be installed at the top center (at the pole shown).
- Mechanism of the arms with conveyor belts for collecting solid waste and oil spills.
- Role of the camera and AI in waste detection and efficient movement.

Suction Robot: Underwater collection

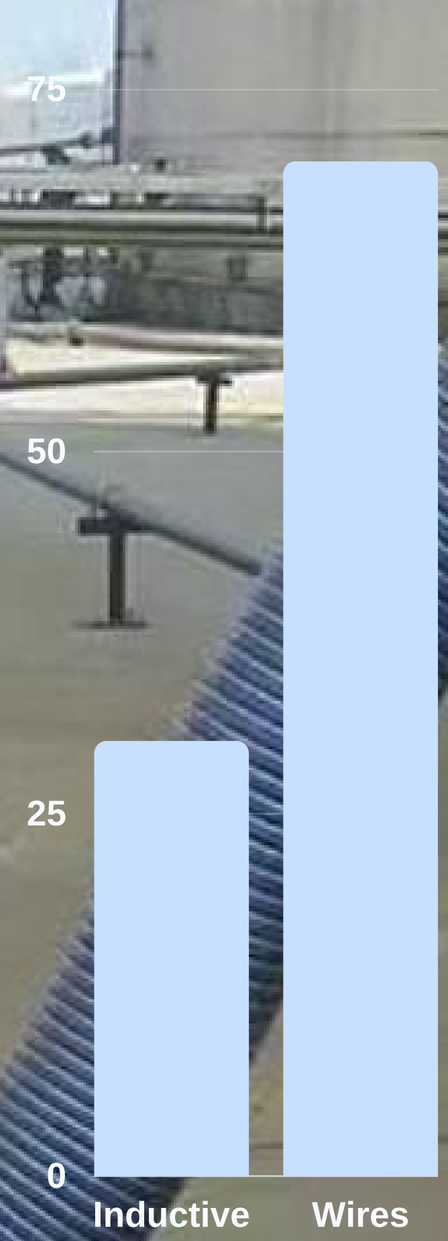


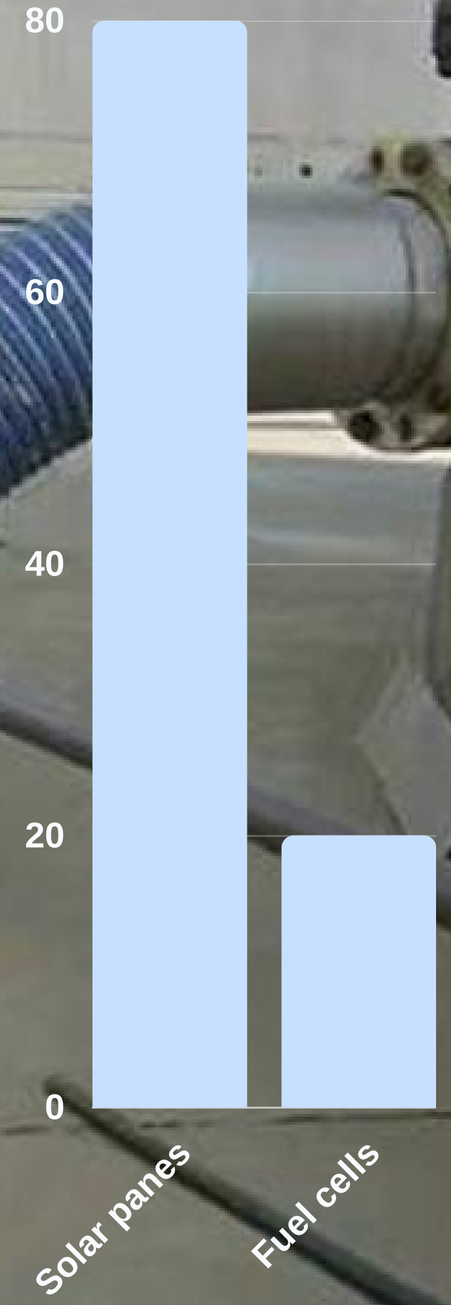
- Design of the X-shaped robot and its capabilities.
- Ultrasonic sensors are installed at the bottom and at the front, for depth and path determination.
- 4 NIR detectors at each wing and thermal cameras similarly for waste detection and differentiation.
- The suction pipe will be attached to the top of the robot with suction mechanism inbuild in it.
- 4 propellers will be on each wing of the robot for its movement
- Motion will be defined based on the response of AI from the data from sensors.

Suction Mechanism and Power

Suction pipe will be made of composite pipe material. Suction inlet, water intake, filtering mechanism, water flow, suction power and pump.

- Power transfer methods: inductive power transfer and using wires.
- Solar panels and fuel cells.





WASTE DETECTION MECHANISM

ULTRASONIC SENSORS

- Emmit pulses
- Measure time taken
- Recognise depth using speed of sound

AI INTEGRATION

- Computer Vision
- Process images from camera.
- Classifies items like plastic bags and debris

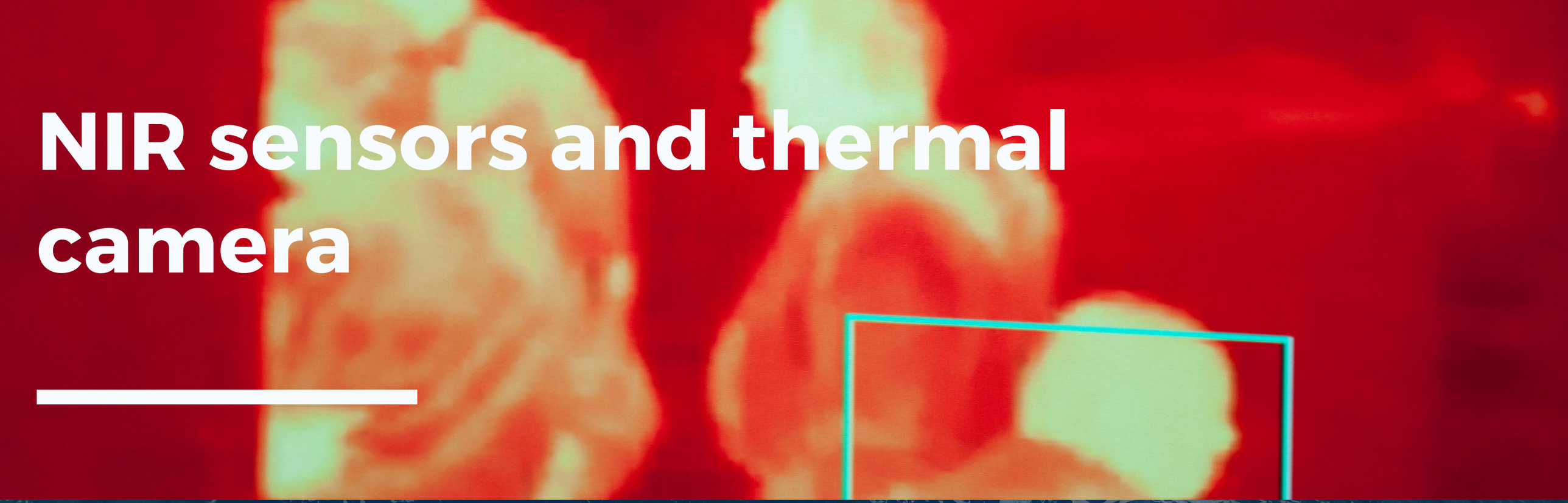
OBJECT AND REAL TIME DETECTION

- As the robot navigates, AI analyzes images to identify and categorize debris on the surface and underwater.

DATA FUSION FOR IMPROVED NAVIGATION AND DECISION MAKING

Optimizes robot navigation, accounting for ocean currents, temperature, and waste concentration. Debris environment

NIR sensors and thermal camera



- USE OF NIR SENSORS FOR MATERIAL IDENTIFICATION AND REAL-TIME DETECTION.
- THE CAPABILITIES OF A THERMAL CAMERA FOR DETECTING HOTSPOTS, ORGANIC MATERIAL, AND NAVIGATION.

PROJECT FEASIBILITY AND IMPACT

FEASIBILITY

- The practicality of our design and technology.
- The combination of sensors, AI, and robotic mechanisms makes the project feasible.
- The adaptability of our approach for different water bodies.

ENVIRONMENTAL IMPACT

- The positive impact of Jal Shodhak on water bodies
- How the system can efficiently remove debris, pollutants, and oil
- Potential to restore aquatic ecosystems and protect marine life

Current Developments and limitations

RE-BOAT:

1. Can't clean underwater waste.
2. Chases the waste resulting more energy consumption.

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1. Covers less area.
2. Time-consuming.

CLEARBOT

1. Can't clean under water waste.
2. Less storage capacity so it has to come again and again to empty.

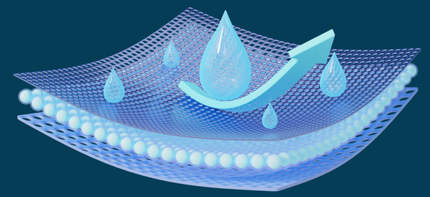
- Time consuming, water currents limits efficiency
- High energy consumption

Novelity of our Idea

Detection and collection of solid as well as chemical waste

Multitasking as one HydroSweep will have multiple suction robots

Detecting the source of the waste



Can clean the surface as well as the under-water waste.

Conclusion and Next Steps

JAL SHODHAK WILL EFFECTIVELY CLEAN THE RIVERS AND OCEANS MORE EFFICIENTLY AND BETTER THAN THE PRIOR DEVELOPMENTS.

STEPS THAT CAN BE TAKEN IN THE FUTURE TO IMPROVE IT:

- USING BIOLOGICAL SENSORS TO DETECT WASTES.
- MAKING THE SYSTEM MORE PORTABLE AND LESS ENERGY-CONSUMING.
- INCREASING THE GARBAGE CARRYING CAPACITY OF THE CONTAINER IN HYDROSWEEP.

Protocal for a demonstrative model

- CONCEPTUALIZATION
- **COMPONENT SELECTION**
- **MECHANICAL DESIGN**
- **SENSOR AND AI INTEGRATION**
- **POWER SYSTEM IMPLEMENTATION**
- **AI SIMULATION**
- **CONSTRUCTION AND ASSEMBLY**
- **TESTING AND REFINEMENT**