Shore Guard

Urban Solutions and Sustainability (USS) Resilient Future

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Problem

01 Coastal Erosion is a major problem for human development on coastlines

02 Existing hard protection measures are costly & compromise the environment and ecosystem

03 Existing soft protection measures can have long lead times, could also be environmentally destructive (beach nourishment), and significantly hinder human development in those areas

Solution

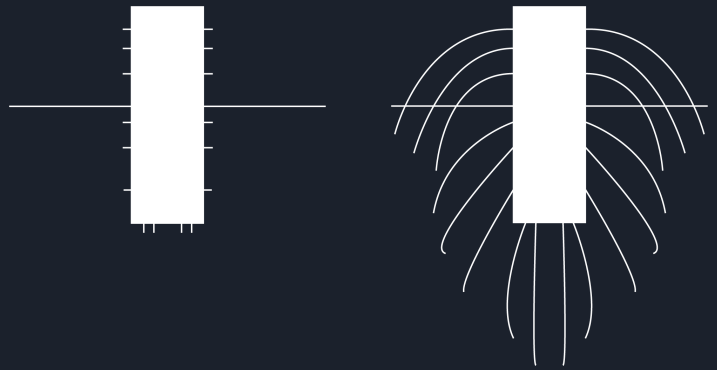
A Smart, Sustainable Coastal Protection Measure

1) Built on artificial trees, acting as nodes for a root network that hold onto coastal sediment
2) Made smart with intelligent & dynamic root system design powered by erosional simulation

Solution

Shore Guard protection devices mimic a mangrove tree's ability to provide habitat, breeding grounds and coastal protection while being adaptable to changes.

There are roots that are initially above ground (similar to prop roots), absorbing wave energy, whilst others anchors the device to the ground

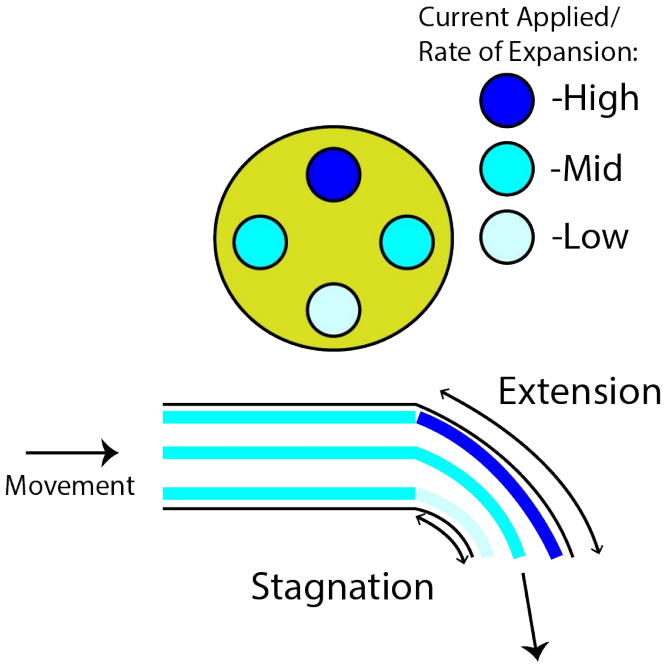


Solution

Artificial Roots: Encased in an elastic, biocompatible sheath that can be stretched and contorted by its inner expansion and contraction nitinol coils.

Can be shaped into any direction and any angle in a 3D Cartesian plane by altering the rate of expansion or contraction of the coils.

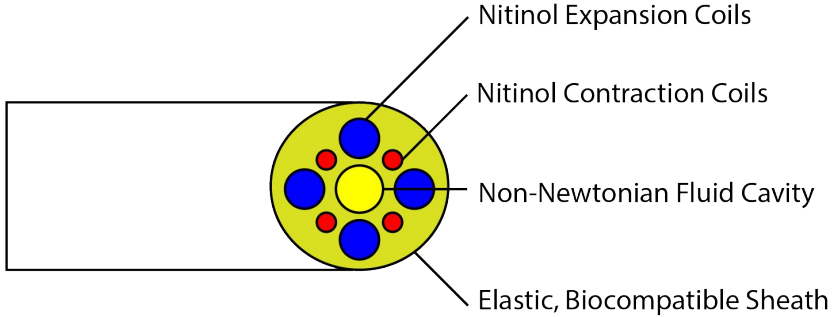
Directional Control of Roots



Solution

When the root system is in place, a non-newtonian fluid (e.g. Oobleck) will fill inside the artificial roots, adding weight and energy absorption properties.

Since Non-newtonian fluid can be pumped out, the shape of the roots can be changed even after finalisation by the user.

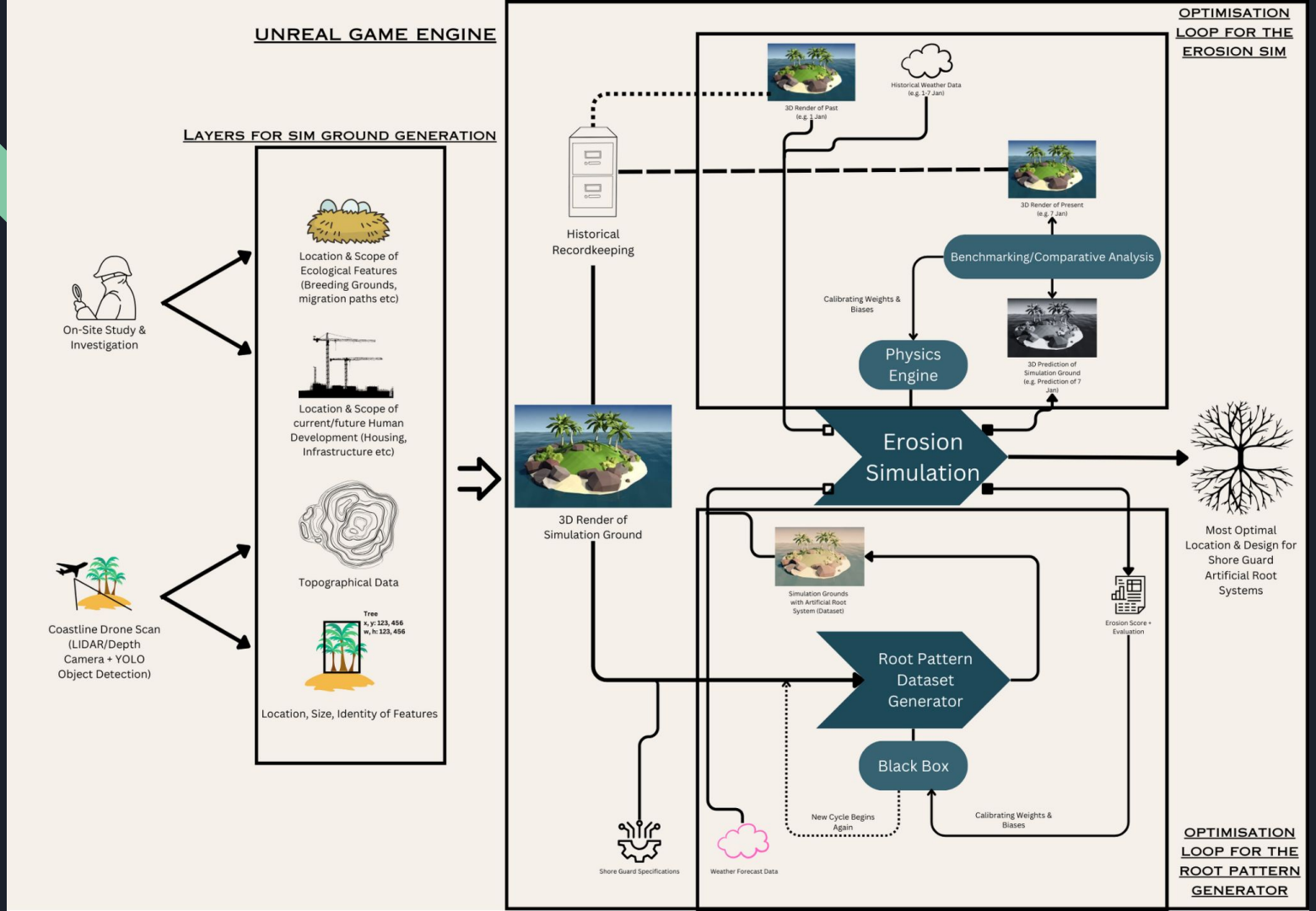


Solution (Underlying technology)

We aim to create a smart & adaptable system for the design of the root system, taking into account numerous factors such as ecological & anthropological considerations, as well as cost effectiveness with time.

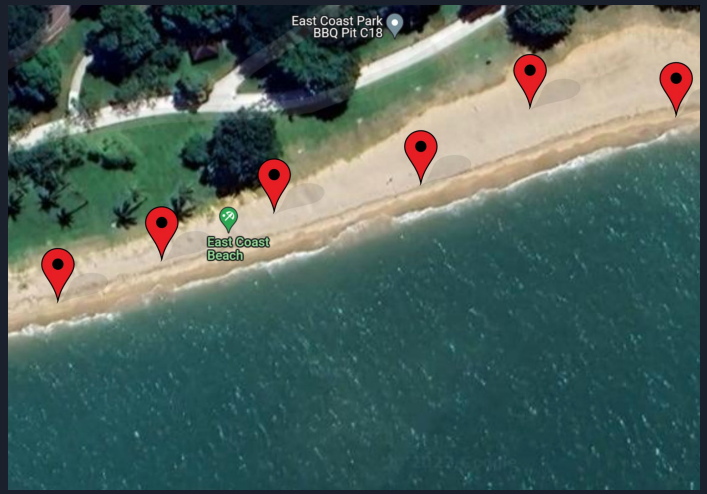
Main Features Include:

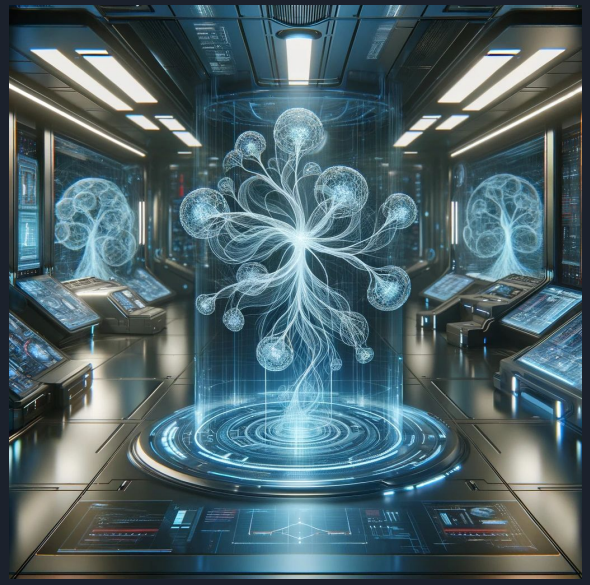
1) Simultaneous YOLO & LIDAR/ToF Depth Camera Scan of the coastline via Drone for important topographical info and preliminary feature identification/location
2) Utilising the UNREAL Game Engine for
    a) Generation of 3D Simulation Ground
    b) Shore Guard Root System Generator
    c) Erosion Simulation & Analysis

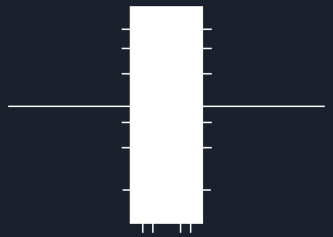

UNREAL GAME ENGINE
LAYERS FOR SIM GROUND GENERATION
On-Site Study & Investigation
Coastline Drone Scan (LIDAR/Depth Camera + YOLO Object Detection)
Location & Scope of Ecological Features (Breeding Grounds, migration paths etc)
Location & Scope of current/future Human Development (Housing, Infrastructure etc)
Topographical Data
Tree
x, y: 123, 456
w, h: 123, 456
Location, Size, Identity of Features
3D Render of Simulation Ground
Historical Recordkeeping
OPTIMISATION LOOP FOR THE EROSION SIM
3D Render of Past (e.g. 1 Jan)
Historical Weather Data (e.g. 1-7 Jan)
3D Render of Present (e.g. 7 Jan)
Benchmarking/Comparative Analysis
Calibrating Weights & Biases
Physics Engine
3D Prediction of Simulation Ground (e.g. Prediction of 7 Jan)
Erosion Simulation
Most Optimal Location & Design for Shore Guard Artificial Root Systems
Simulation Grounds with Artificial Root System (Dataset)
Erosion Score + Evaluation
Root Pattern Dataset Generator
Black Box
New Cycle Begins Again
Calibrating Weights & Biases
Shore Guard Specifications
Weather Forecast Data
OPTIMISATION LOOP FOR THE ROOT PATTERN GENERATOR

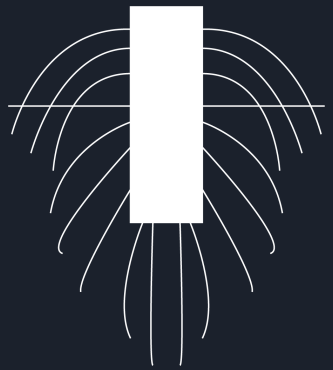
Solution (conc)

Using the generated root system data as shown in the previous slide, the Shore Guard devices would have optimal locations, as well as programming instructions for the roots upon deployment









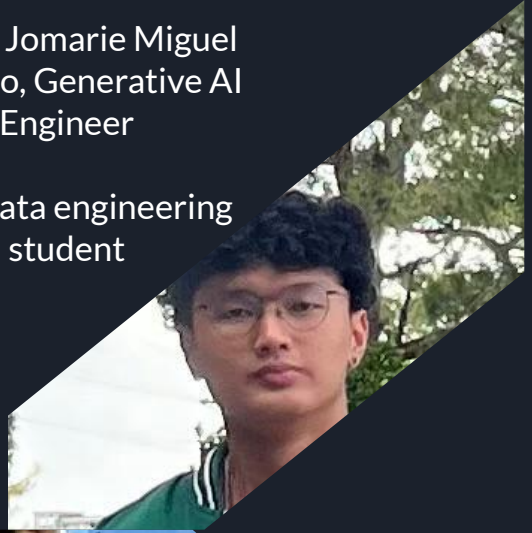
Meet the Team

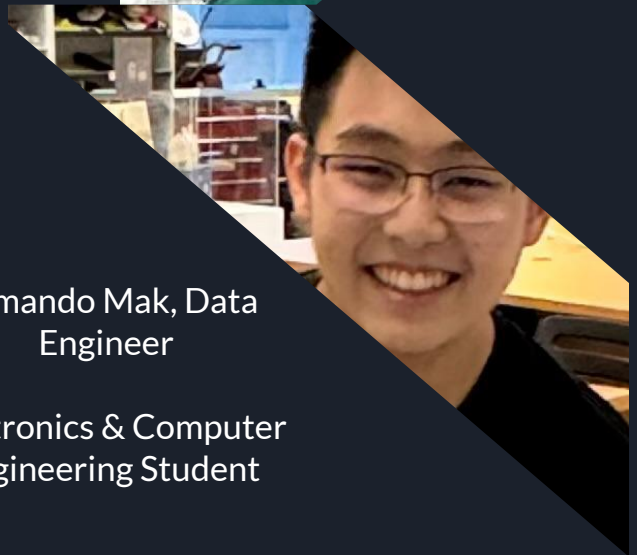
Lynuz Rham Panganiban, Team Leader

Nanotechnology & Material Science Student

Mojica Jomarie Miguel Payuyao, Generative AI Engineer

AI & Data engineering student



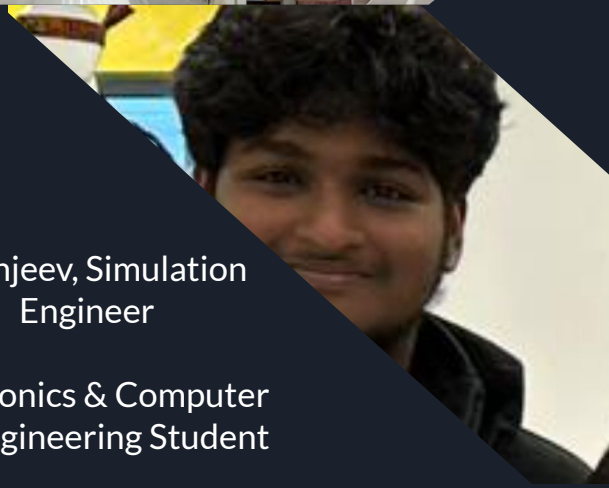


Armando Mak, Data Engineer

Electronics & Computer Engineering Student

Zhang Jucai, Product Engineer

Nanotechnology & Material Science Student



R Sanjeev, Simulation Engineer

Electronics & Computer Engineering Student

Target Market & Funding (Financial Projections and Go-to-Market Strategy)

For Funding it will mainly be split into two phases:

1. Product and Research development phase
   - Possible partners:
     - NUS, the host of Coastal Protection and Flood Resilience Institute(CFI)Singapore
     - Research companies and local universities affiliated with CFI Singapore
   - Funding:
     - PUB through the CFI programme
       - From the research project that deals with coastal protection: Shore protection with integrated nature-based solutions (Hydro)
       - "Singapore is a key pillar under PUB's $125 million Coastal Protection and Flood Management Research Programme (CFRP)1 that will galvanise research and technology development in coastal protection and flood management."
2. Sale of product to Government contractors or PUB (when the product is fully realised)
   - Potential Customers:
     - CPG corporation - made Stamford Diversion Canal and Stamford Detention Tank
     - Halex Construction

CFI SINGAPORE COASTAL PROTECTION AND FLOOD RESILIENCE INSTITUTE SINGAPORE

Benefits provided (Go-to-Market Strategy)

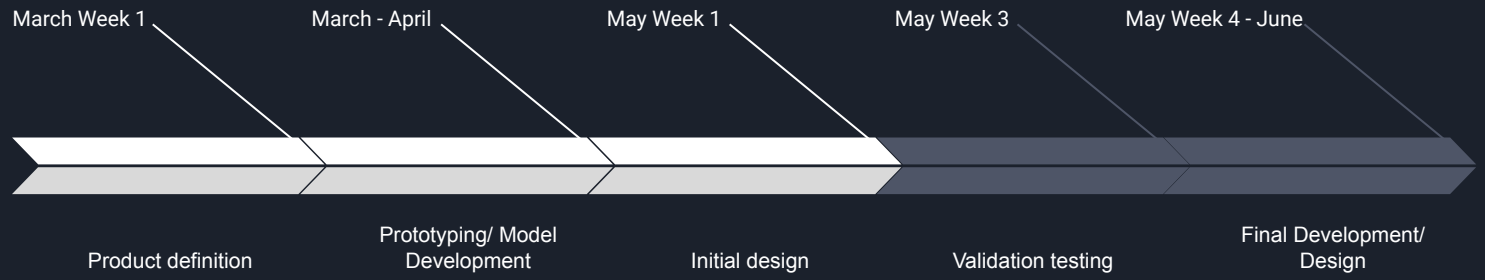
Benefits to partners:

- We can bring new insight and exchange ideas for the this project because:
  - We are a team that compromise of multidisciplinary engineers
  - We have a unique solution
- We provide manpower and data collection

Benefits for consumers (when the product is fully realised):

- Receives a product that:
  - Adapts to the climate and ecological factors
  - Gets the best of both hard and soft coastal protection solutions
    - MInimizes the cons
  - Easily deployable/ removable
  - Minimal size

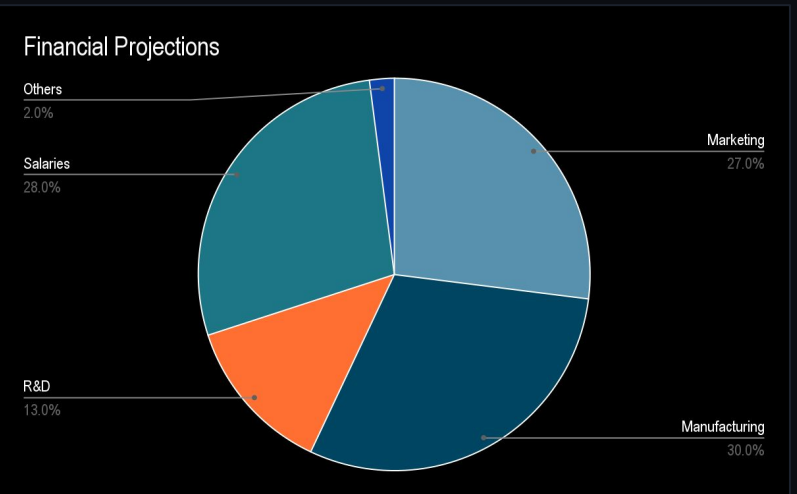
Product Roadmap



Goal	Collecting and preprocessing data. Finalize Project goals and Approach methods	Development of 3D model Generative models and map localization ai model	UI/UX of software is done and start integrating the Ai with the Website	Finish Integration test the software and test the limits of the ai	Get the Data and fail points from the testing and improve the product
Features	Preprocess the collected data for compatibility and consistency. Clearly outline project objectives and strategies. Ensure alignment of chosen methods with project goals.	Develop algorithms/models to create artificial trees and accurately mapping coastal locations.	Merge UI/UX design with AI functionalities. Seamlessly embed AI features into the website.	Perform rigorous tests on integrated software. Push AI functionalities to identify performance boundaries.	Gather insights and data from integration and stress tests. Analyze areas where the system falls short.
Metrics	Complete collecting past 50 years of data and at least 1000 data samples	Measure the precision and time taken of generated 3D models and map localization	Monitor user interaction post-AI integration Assess the impact of AI integration on website speed and functionality.	Measure and track software issues post-integration and Evaluate AI performance when handling increased demands.	Calculate the percentage of failures encountered during testing.

Financial Projections

Our company intends to venture into coastal development projects, or even eco-friendly construction and landscaping companies businesses as all this sectors focus mainly on sustainable development, marine conservation, attracting businesses looking to prioritize environmental impact



Year 1-2

R&D (Finish prototype)

CFI Singapore is a research programme done by NUS getting a 125 million from pub and working together with nus then we can get a small share of the fund to help develop our ideas and also get more intel on how to improve our idea. Get a startup grant from startup (SG)

Year 3

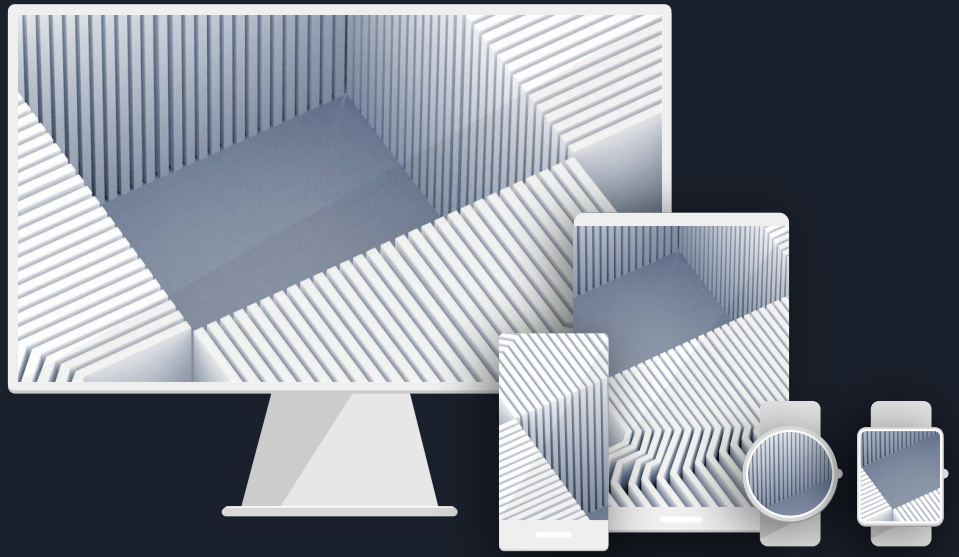
Start Up

After getting a Prototype finished and 2 years of R&D we Would go and propose to the government bodies like PUB our idea so that we can get their support and they would fund us. Becoming government Contractors

Year 4-5

Expanding

We will still be working with the government to reduce the coastal erosion rate.

We will also explore to other countries and start working with other private companies too.

Thank you!