SMART INDIA HACKATHON 2025

SAMUDRA – SAND ANALYSIS & MAPPING USING DEEP RECOGNITION ALGORITHMS

- Problem Statement ID: 25037
- Problem Statement Title: Development of a low-cost camera-based automated beach sand grain size mapping system
- Theme: Miscellaneous
- PS Category: Hardware
- Team ID:
- Team Name: Team Dope

Your paragraph text

TEAM DOPE

Development of a Low-Cost Automated Beach Sand Grain Size Mapping System

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SandScan: Geo-Tagged Grain Analysis System

OUR SOLUTION

- Low cost portable and automated camera based device that brings sand analysis directly to the field.
- Built around a powerful microcontroller and a camera module.
- Eliminates the need for expensive lab equipment and manual labor, making coastal research accessible to everyone.

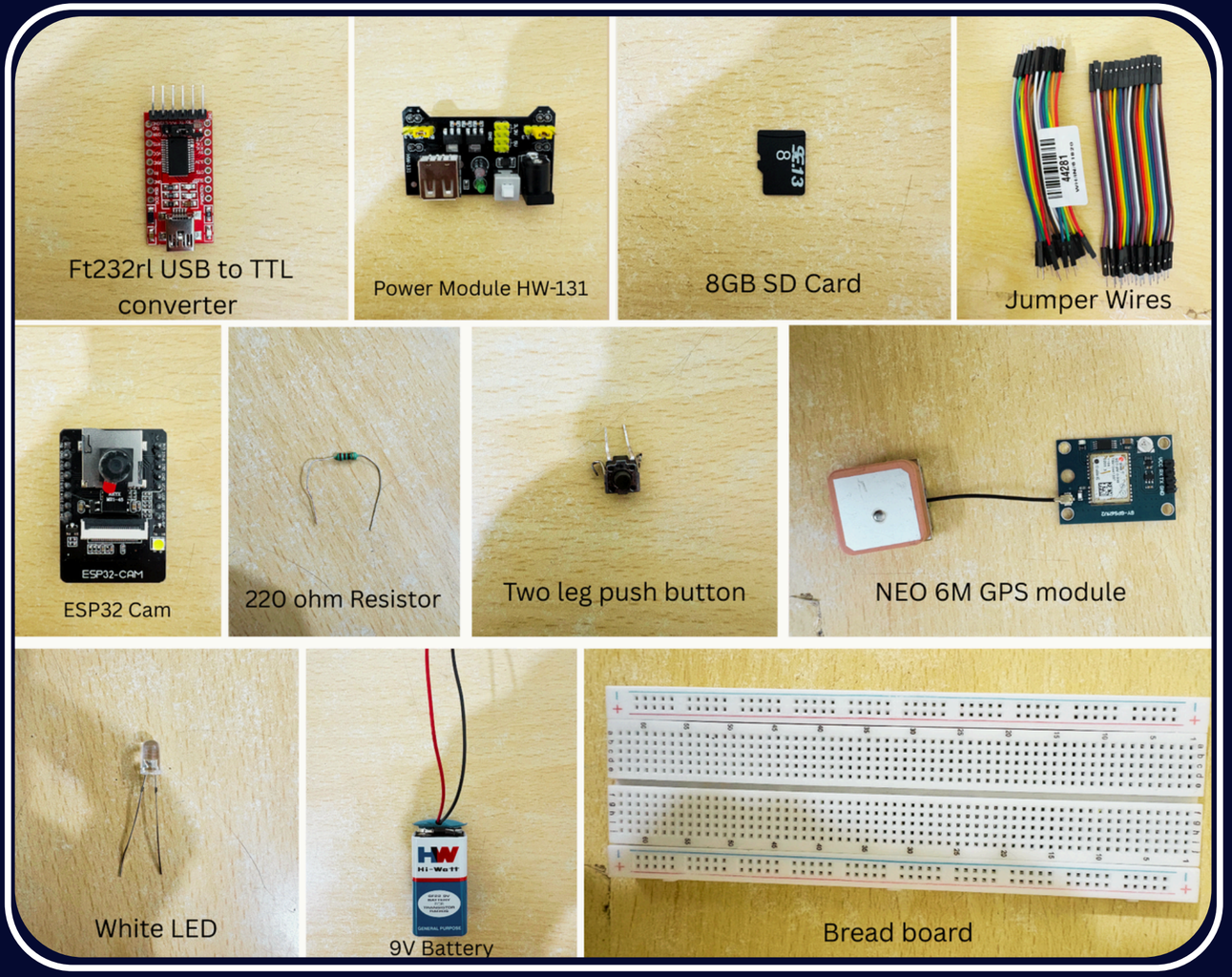
HOW IT ADDRESSES THE PROBLEM?

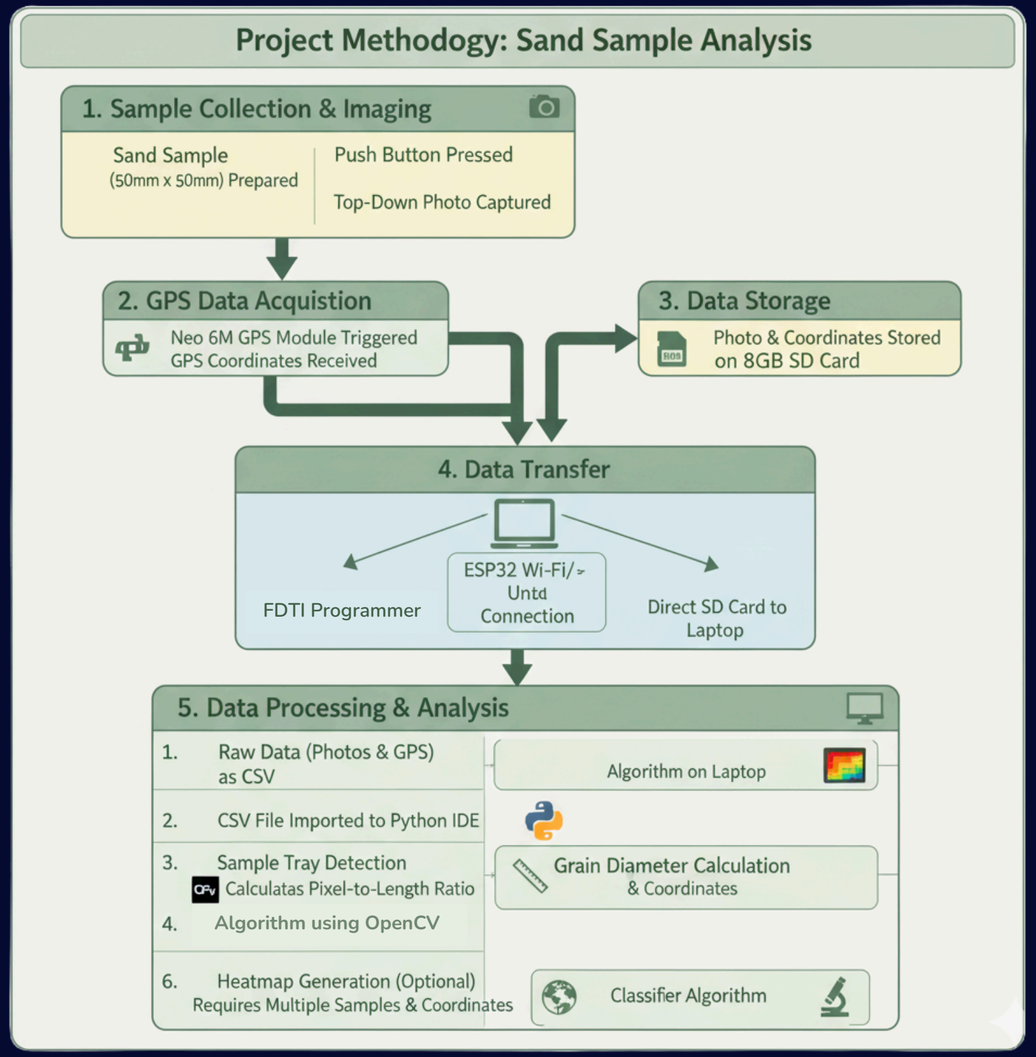
- Replaces slow, expensive and non-scalable lab work with rapid on-site data collection.
- Is scalable thus allowing wide deployment using affordable tools.
- Provides an efficient and scalable alternative for large-scale environmental studies.

INNOVATION AND UNIQUENESS

- Our system is unique as it automates the entire process from data collection to analysis.
- Complements lab methods by delivering broad real-time data at a fraction of the cost.
- Uses low-cost sensors and image processing to offer a portable grain-size analysis alternative.

TECHNICAL APPROACH





FEASIBILITY AND VIABILITY

FEASIBILITY

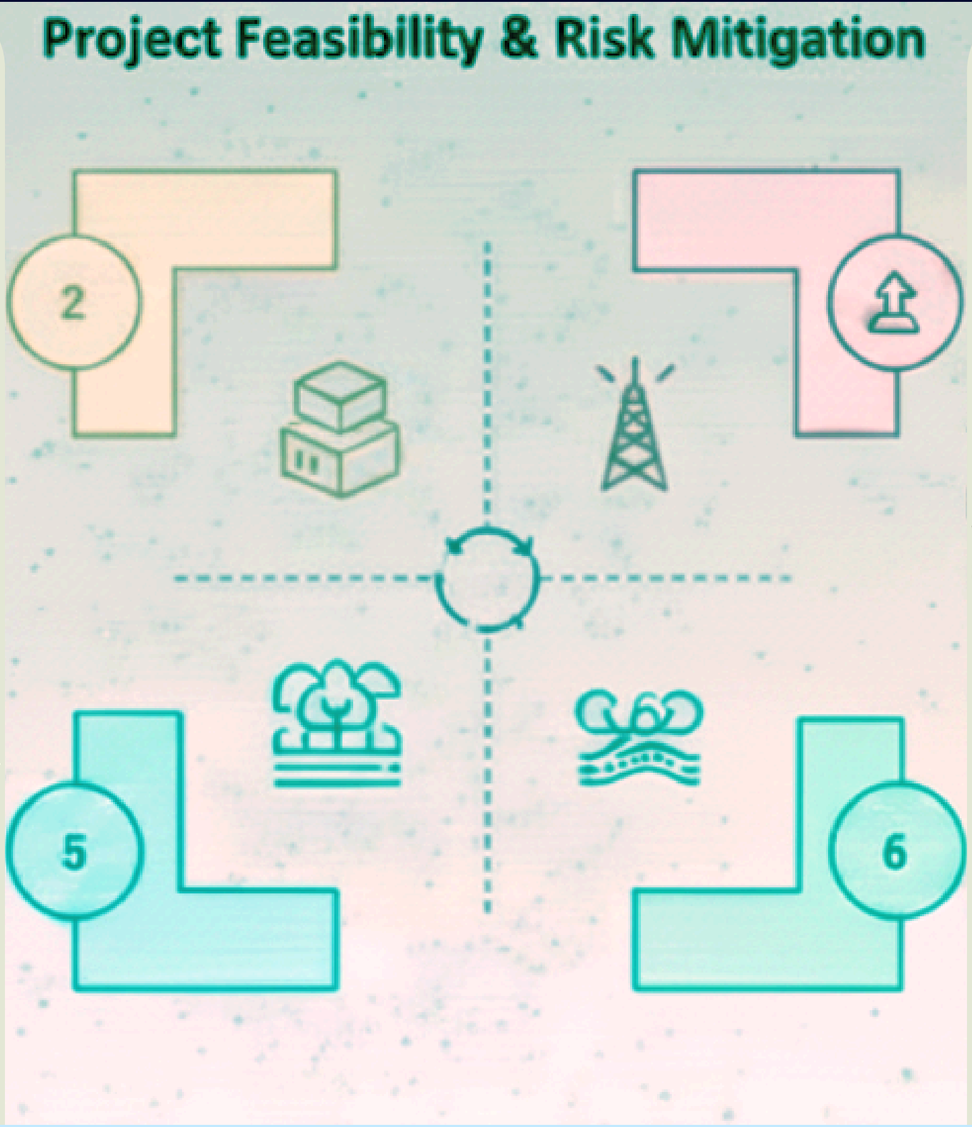
1.Low-Cost Components:
The project utilises readily available and affordable hardware, such as the ESP32-CAM, Arduino Uno R4 Wifi and a Neo 6M GPS module, making it economically accessible.

2. Simple Technical Approach:
The core function of capturing an image, using a reference object to calculate grain size, is a straightforward application of image processing and embedded systems.

LONG TERM VIABILITY

1.Market Scalability:
The project's low cost and ease of use enable large-scale deployment, positioning it as the new standard for global coastal monitoring, especially in developing nations.

2. Data Monetization:
The system can evolve from a hardware product into a data-service platform, generating long-term revenue by providing valuable coastal data and predictive models.



POTENTIAL CHALLENGES

1.Accuracy Limitations:
The primary risk is the trade-off between cost and absolute accuracy. The camera-based method will not match the precision of a controlled lab environment.

2. Environmental Factors:
The device's performance could be affected by real-world conditions like lighting variations (sun glare, shadows), camera stability, and moisture.

STRATEGIES TO OVERCOME THESE CHALLENGES

1. **Develop a Robust Calibration Protocol:** Implement a simple, user-friendly calibration method using a standard reference object to ensure consistent measurements.

2. **Durable Enclosure:**
Encasing the device in a waterproof and dust-proof housing is the first step to protecting it from moisture, sand, and other environmental elements.

TEAM DOPE

IMPACT AND BENEFITS

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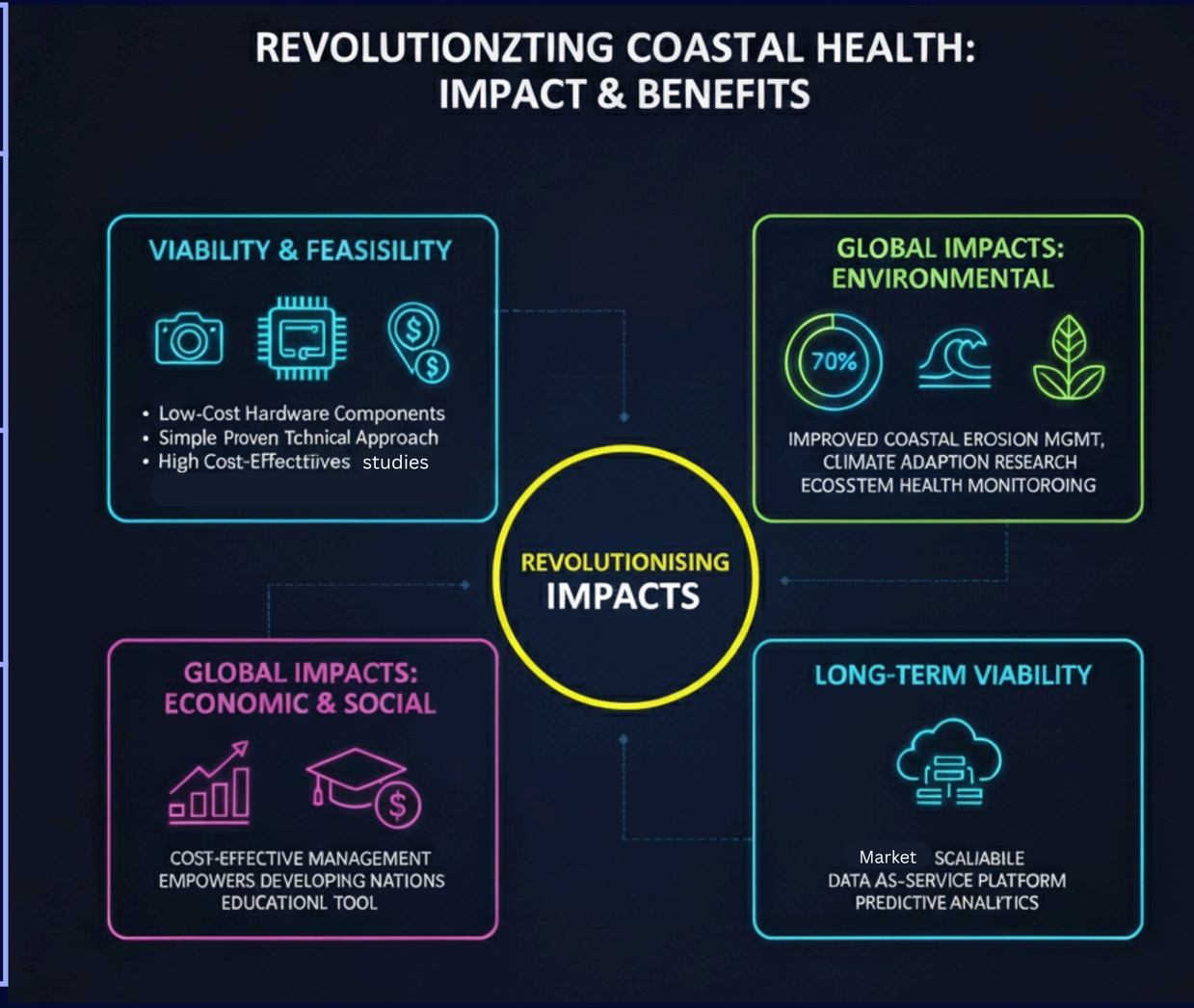
Solves Global Data Deficit	This keeps coastal management in a reactive state, unable to address problems until they become crises.
Democratizatio n of Data	Its low cost allows for adoption by local communities, students and NGOs in developing nations. This fosters a bottom-up, citizen science movement, creating more comprehensive network for monitoring the world's coastlines.
Proactive Management	This data enables the development of hyper-accurate predictive models for erosion and storm damage, which allows for targeted, preventative measures rather than costly last-minute interventions.
Unified Coastal Health	This project has the potential to become a central node in a unified global network. Each device contributes to a real-time "health dashboard" for the planet's coasts, providing a cohesive, scalable solution to a worldwide challenge that no single entity can solve alone.



RESEARCH AND REFERENCES

Some of the references we used for research and analysis include:

- https://youtu.be/JYchUapoqzc
- https://www.espressif.com/sites/default files/documentation/esp32_datasheet_en.pdf
- https://randomnerdtutorials.com/esp32-neo-6m-gps-module-arduino/