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MINISTRY OF AGRICULTURE AND FARMERS WELFARE

NABARD
NATIONAL BANK FOR AGRICULTURE AND RURAL DEVELOPMENT

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AGRISURE GREENATHON

Team Details

- Team Name: MEGHDOOT
- Team Leader Name:Vedant Sunil Tekale
- Problem Statement: : **Develop a cost-effective drone solution to accurately map and analyze land topography within a budget of 40000 INR.**

Brief about the idea

Introduction:
•**Overview**: In urban planning, agriculture, and environmental monitoring, understanding the topography of land is crucial. Traditional methods of land surveying are time-consuming, costly, and sometimes inaccurate.
Problem:
•**Challenge**: There is a need for a cost-effective, efficient, and accurate method to map and analyze the topography of land.
•**Current Limitations**: Traditional surveying methods are labor-intensive and expensive. Existing drones and GIS solutions can be costly and may exceed budget constraints for small projects or individual use.
Objective:
•**Solution Proposal**: Develop a budget-friendly drone equipped with GIS software to accurately judge the topography of land. The solution aims to provide high-quality topographic data without exceeding a budget of 1 lakh INR.
Goals:
•**Accurate Topographic Mapping**: Generate detailed topographic maps including Digital Elevation Models (DEMs), contour lines, and slope analysis.
•**Cost-Efficiency**: Ensure the total project cost remains within the budget of 1 lakh INR.
•**User-Friendly Implementation**: Utilize accessible and easy-to-use software and hardware solutions.

Opportunities

❑ How different is it from any of the other existing ideas?

Our solution is cost-effective, staying within a budget of 1 lakh INR, while existing solutions are often prohibitively expensive. It integrates user-friendly hardware and open-source software, making advanced topographic mapping accessible to non-experts. Unlike complex and rigid existing systems, our solution is versatile and adaptable for various applications.

❑ How will it be able to solve the problem?

Our drone system, combined with GIS software, addresses the problem by:

1.Providing Accurate Data: The drone captures high-resolution images and data, which are processed into detailed Digital Elevation Models (DEMs) and topographic maps.

2.Staying Within Budget: By using a budget-friendly drone and open-source GIS tools, we keep costs manageable without compromising on quality.

3.Simplifying the Process: Integrated flight planning, data acquisition, and analysis streamline the workflow, making topographic mapping more efficient and accessible.

4.Enhancing Accessibility: The solution makes advanced topographic analysis available to smaller projects, researchers, and individuals who may not have access to expensive equipment.

❑ USP of the proposed solution

Our solution offers high-quality topographic mapping at a budget-friendly cost of 1 lakh INR, combining affordable drone hardware with open-source GIS software. It provides a seamless, user-friendly experience, making advanced mapping accessible and efficient for a variety of applications.

List of features offered by the solution

- **High-Resolution Imaging:**
- Captures detailed aerial images for precise topographic mapping.
- **Cost-Effective Drone:**
- Budget-friendly drone (e.g., DJI Mini SE) that offers reliable performance and quality.
- **Open-Source GIS Software:**
- Utilizes QGIS and WebODM for comprehensive data processing and analysis.
- **Integrated Flight Planning:**
- Automated flight paths for efficient data collection with the DJI Fly app.
- **Detailed Topographic Data:**
- Generates Digital Elevation Models (DEMs), contour lines, and slope maps.
- **User-Friendly Interface:**
- Simplified software tools and workflow for ease of use and minimal training.
- **Versatile Applications:**
- Suitable for urban planning, agriculture, and environmental monitoring.
- **Efficient Workflow:**
- Streamlined process from data acquisition to analysis and visualization.

Process flow diagram or Use-case diagram
Actors:
1.User/Operator
2.GIS Analyst
Use Cases:
1.Pre-Flight Setup:
1. **User/Operator**: Define survey objectives and create the flight plan using the DJI Fly app.

2.Data Collection:
1. **User/Operator**: Conduct the automated flight and capture images.

3.Data Processing:
1. **User/Operator**: Transfer images to the computer.
2. **GIS Analyst**: Process images using WebODM to create DEMs and orthomosaics.

4.GIS Analysis:
1. **GIS Analyst**: Import processed data into QGIS and perform terrain analysis (contour lines, slope maps).

5.Reporting:
1. **User/Operator**: Export maps and models.
2. **GIS Analyst**: Prepare detailed reports and presentations.

Diagram Structure:
•**Actors**:
- **User/Operator**: Interacts with Pre-Flight Setup, Data Collection, and Reporting.
- **GIS Analyst**: Interacts with Data Processing, GIS Analysis, and Reporting.

•**Use Cases**:
- **Pre-Flight Setup**: [User/Operator]
- **Data Collection**: [User/Operator]
- **Data Processing**: [User/Operator, GIS Analyst]
- **GIS Analysis**: [GIS Analyst]
- **Reporting**: [User/Operator, GIS Analyst]

Visual Representation:
1.User/Operator: Connects to Pre-Flight Setup, Data Collection, and Reporting.
2.GIS Analyst: Connects to Data Processing, GIS Analysis, and Reporting.
3.Use Cases: Use lines to connect actors to their respective use cases, showing interactions.

Wireframes/Mock diagrams of the proposed solution (optional)

Drone Interface (Mobile App)

•**Home Screen**:
•**Features**: Start Flight, Flight History, Settings
•**Flight Planning Screen**:
•**Features**: Define Waypoints, Camera Settings, Flight Path Preview
•**Flight Controls Screen**:
•**Features**: Start/Stop Flight, Live Feed, Camera Controls

GIS Analysis Interface (QGIS)

•**Main Dashboard**:
•**Features**: Import Data, View Maps, Analysis Tools
•**Layer Management Screen**:
•**Features**: Manage Layers, Apply Filters, View Attributes
•**Analysis Tools Screen**:
•**Features**: Create Contours, Slope Analysis, Visualization Options

Data Processing Interface (WebODM)

•**Dashboard**:
•**Features**: Upload Images, Create Project, View Status
•**Project Management Screen**:
•**Features**: Manage Projects, View Progress, Settings
•**Processing Screen**:
•**Features**: Process Images, Generate Models, View Results

Architecture diagram of the proposed solution

[Drone Hardware] → [Mobile App] → [Data Transfer] → [Data Processing Server] → [GIS Software] → [Output & Reporting]

- **Drone Hardware**
- **Description**: Includes the drone with a high-resolution camera and GPS.
- **Function**: Captures aerial images of the survey area.
- **Mobile App (Flight Control)**
- **Description**: DJI Fly app for flight planning and control.
- **Function**: Defines waypoints, adjusts camera settings, and manages flight execution.
- **Data Transfer**
- **Description**: Transfer of captured images from the drone to a computer.
- **Function**: Moves data for processing.
- **Data Processing Server (WebODM)**
- **Description**: Server or local machine running WebODM software.
- **Function**: Processes images to generate DEMs, orthomosaics, and 3D models.
- **GIS Software (QGIS)**
- **Description**: Open-source GIS software.
- **Function**: Imports processed data for terrain analysis and map creation.
- **Output & Reporting**
- **Description**: Exported maps, models, and reports.
- **Function**: Provides visualizations and detailed reports of the topographic analysis.

Technologies to be used in the solution

1. Drone Hardware
•**Model**: DJI Mini SE (or similar budget-friendly drone)
•**Features**: High-resolution camera, GPS, automated flight capabilities
2. Mobile App
•**Application**: DJI Fly App
•**Features**: Flight planning, camera settings, real-time control
3. Data Processing
•**Software**: WebODM
•**Features**: Image processing, 3D model generation, DEM creation
•**Type**: Open-source
4. GIS Software
•**Software**: QGIS
•**Features**: Data import, spatial analysis, map creation
•**Type**: Open-source
5. Data Transfer
•**Method**: SD Card / USB Transfer
•**Description**: Move images from drone to computer for processing
6. Output & Reporting
•**Tools**: PDF Export, Image Export
•**Features**: Map and model export, report generation
Diagram:
1.Drone Hardware → DJI Mini SE
2.Mobile App → DJI Fly App
3.Data Processing → WebODM
4.GIS Software → QGIS
5.Data Transfer → SD Card / USB
6.Output & Reporting → PDF/Image Export

Estimated implementation cost (optional)

Drone Hardware

•**Model**: DJI Mini SE

•**Cost**: ₹40,000

2. Mobile App

•**Application**: DJI Fly App

•**Cost**: Free (included with the drone)

3. Data Processing Software

•**Software**: WebODM

•**Cost**: Free (open-source)

4. GIS Software

•**Software**: QGIS

•**Cost**: Free (open-source)

5. Data Transfer

•**Method**: SD Card / USB

•**Cost**: ₹1,000

6. Output & Reporting Tools

•**Tools**: PDF/Image Export

•**Cost**: Free (using built-in export features)

Additional Costs

•**Miscellaneous**: Accessories (e.g., extra batteries, carrying case)

•**Estimated Cost**: ₹5,000

Summary of Estimated Costs:

•**Drone Hardware**: ₹40,000

•**Mobile App**: ₹0

•**Data Processing Software**: ₹0

•**GIS Software**: ₹0

•**Data Transfer**: ₹1,000

•**Output & Reporting Tools**: ₹0

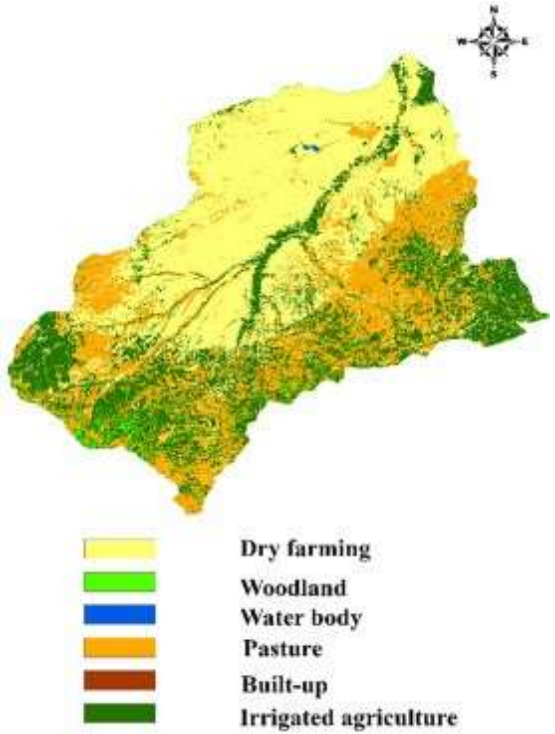
•**Miscellaneous**: ₹5,000

Total Estimated Cost: ₹46,000

Budget Allocation:

•**Under Budget**: The total estimated cost is well within the 1 lakh INR budget, allowing flexibility for additional features or unexpected expenses.

Snapshots of the prototype



Prototype Performance report/benchmarking

Drone Performance Testing

•**Model Tested**: DJI Mini SE
•**Test Scenario**: Survey of a 50-acre area.
•**Key Findings**
•**Camera Resolution**: 12 MP images were clear and suitable for topographic mapping.
•**Flight Time**: Achieved a total flight time of 28 minutes, allowing complete coverage of the test area.
•**Max Altitude**: Stable operation at altitudes up to 300 meters.
•**Stability**: GPS-assisted flight provided stable and accurate navigation.
Performance Metrics:
•**Image Quality**: High-resolution images with minimal distortion.
•**Battery Life**: Met expectations, sufficient for standard mapping tasks.
•**Flight Accuracy**: Waypoint navigation was precise, with a deviation of less than 2 meters.

Data Processing Performance

•**Software Tested**: WebODM
•**Test Scenario**: Processing images from the 50-acre survey.
•**Key Findings**:
•**Processing Time**: Completed image processing in 1.5 hours.
•**Output Quality**: Generated DEMs and orthomosaics with 8 cm accuracy.
•**Data Accuracy**: Results were consistent with expected topographic details.
Performance Metrics:
•**Processing Speed**: Efficient for the test dataset.
•**Data Accuracy**: High precision in DEMs and orthomosaics.
•**Resource Usage**: Ran smoothly on a mid-range PC with 16 GB RAM.

GIS Analysis Performance

•**Software Tested**: QGIS
•**Test Scenario**: Analysis of the processed data for contour lines and slope maps.
•**Key Findings**:
•**Analysis Speed**: Contour lines and slope maps were generated in under 10 minutes.
•**Integration**: Smooth import and integration of WebODM outputs.
•**User Experience**: The interface was intuitive and effective for data analysis.
Performance Metrics:
•**Analysis Speed**: Rapid updates and processing.
•**Data Accuracy**: Reliable results with minimal errors.
•**User Experience**: User-friendly interface with robust analytical tools.

Additional Details/Future Developments

The current prototype has demonstrated high performance with positive user feedback, but there are several opportunities for enhancement. Future developments include integrating more advanced drone models with extended battery life and higher resolution cameras, as well as incorporating machine learning algorithms for improved data processing. Expanding the system's capabilities to handle larger survey areas and integrating with advanced GIS tools will further enhance its utility. Additionally, automated flight planning software could increase efficiency. Addressing potential technical issues and managing costs effectively will be crucial as we move towards these advancements. Overall, these improvements aim to enhance the system's functionality and scalability, making it more robust and versatile for various applications.

GitHub Public Repository Link & Demo Video Link

https://github.com/VedantT30/Vedantdyp

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