TED UNIVERSITY

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Department of Computer Engineering

CMPE 491 - Senior Project Specification Report

3D-EcoMap

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1.Introduction

In today's rapidly urbanizing world, optimizing travel routes is critical not only for cost savings but also for reducing environmental impact. As the number of vehicles on the road continues to increase, the urgency to reduce fuel consumption and emissions also increases. However, traditional navigation systems often rely on 2D maps that prioritize distance and traffic conditions only, ignoring the impact of road topography on fuel efficiency. 3D-EcoMap aims to address these issues by offering a flatter, slightly longer route rather than a shorter route with steep slopes, which can lead to significantly more fuel consumption. Our project offers an eco-friendly driving experience.

1.1 Description

3D-EcoMap is an innovative navigation system designed to improve fuel efficiency and environmental sustainability by integrating slope analysis into route optimization. The system detects road slopes by processing 2D satellite images into 3D models. These slopes are incorporated into algorithms that recommend the most fuel-efficient routes, helping drivers lower fuel costs and reduce their environmental impact. This web-based application offers a user-friendly interface for 3D map visualization, allowing users to interact with 3D models of their road routes and make eco-friendly navigation choices.

1.2 Constraints

The development of 3D-EcoMap is influenced by several constraints:

- **Economic**: The project requires resources for satellite image processing. If we want to work on a larger dataset, it might require a lot of computing power. 3D modeling, and high-performance computing could impact budgeting and operational costs. The constraints on our budget may affect our app's accuracy level.

- **Environmental**: Environmental factors like places having dense vegetation can cause the satellite images to be useless in detecting the routes in the area.
- **Political**: The project depends on access to geospatial data, which may involve permissions and comply with international data regulations.
- **Ethical**: Ensuring privacy and responsible use of satellite data is paramount to maintaining trust and ethical responsibility in the project's operation.
- **Reliability of User Data:** Our app greatly depends on the accuracy of user data since fuel-efficient routes can be different for different vehicles. Therefore we need to consider how user friendly our app in order to minimize errors caused by users.

1.3 Professional and Ethical Issues

Our team must be responsible in the acts of data handling and processing, especially considering the sensitivity of satellite imagery. It is crucial to protect user privacy, ensuring that all data collected or processed is kept confidential and used only for the intended purpose of the project. Additionally, the project team is responsible for providing users with accurate and trustworthy information, as route suggestions impact both safety and environmental outcomes.

2. Requirements

1. **Image Processing & 3D Modeling**: Use image processing algorithms and deep learning for 2D-3D transformations.
2. **Slope Analysis Module**: Create a module that analyzes road slopes within the 3D models to assess their impact on fuel efficiency.
3. **Fuel-Efficient Route Suggestions**: Integrate slope data with pathfinding algorithms (such as Dijkstra and A*) to provide the most fuel-efficient routes.
4. **3D Visualization**: Implement an interactive 3D map allowing users to explore routes and visualize slopes.
5. **Web-Based Access**: Design a responsive web platform where users can easily access and interact with all features.

6. **Pathfinding Algorithms**: Implement and optimize Dijkstra and A* algorithms using slope data to minimize fuel consumption.
7. **Web Development**: Build a web application using Spring Boot and WebGL-based 3D mapping libraries for cross-platform accessibility.

3. References

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