Initial Report: Developing a Software Tool to Aid Search and Rescue of Missing Aircrafts

1. Overview

This report outlines the initial progress and planning for the project aimed at developing METUSAR, a software tool to enhance Search and Rescue (SAR) operations for missing aircraft. By integrating Geographic Information Systems (GIS), Multi-Criteria Decision Analysis (MCDA), and search theory, the project aims to address critical inefficiencies in current SAR methods.

2. Problem Context

SAR operations face significant challenges, including:

- **Vast Search Areas**: Covering large, undefined regions with limited resources.
- **Limited Data Availability**: Incomplete or fragmented data on the missing aircraft's last known position.
- **Resource Optimization**: Allocating time and resources effectively.
- **Dynamic Environments**: Adapting to changing weather, terrain, and other conditions.

Traditional tools, such as paper-based plans and manual calculations, are inadequate for modern SAR demands. This project proposes an innovative software solution to overcome these challenges.

3. Objectives

- Develop a GIS-based software tool to visualize and analyze spatial and non-spatial data.
- Generate reliable probability maps to narrow down search areas.
- Implement segmentation and search pattern comparison functionalities to optimize SAR efforts.
- Validate the tool's effectiveness through case studies and simulations.

4. Progress

4.1. Data Collection

- **Spatial Data**: Acquired digital elevation models (DEM), settlement locations, road networks, and visibility maps.
- **Non-Spatial Data**: Compiled historical SAR data, including last known positions, probable crash locations, and signal points.

4.2. Methodology Development

- Designed a workflow integrating GIS and MCDA methods, specifically Simple Additive Weighting (SAW), Analytical Hierarchy Process (AHP), and Ordered Weighted Averaging (OWA).
- Defined key criteria for probability mapping, such as LKP, visibility, signal strength, and environmental conditions.

4.3. Software Design

- Selected ArcGIS and Visual Basic for software development.
- Drafted initial user interface (UI) designs, focusing on simplicity and functionality.
- Structured the tool into three main modules:
    1. **Probability Mapping**: Generating maps using MCDA techniques.
    2. **Area Segmentation**: Dividing search areas based on probability maps.
    3. **Search Pattern Comparison**: Analyzing the effectiveness of different search patterns.

5. Preliminary Findings

- MCDA methods offer flexibility in integrating diverse criteria for probability mapping.
- GIS tools enhance spatial visualization and provide a dynamic platform for SAR planning.
- Probability maps based on historical data show promising results in narrowing down high-probability areas.

6. Challenges and Mitigation

6.1. Data Accuracy

- **Challenge**: Limited accuracy in spatial and non-spatial data.
- **Mitigation**: Employ data validation techniques and integrate real-time updates where possible.

6.2. Computational Resources

- **Challenge**: High computational demand for processing large datasets.
- **Mitigation**: Optimize algorithms and use high-performance computing resources.

6.3. User Adoption

- **Challenge**: Ensuring the tool meets the practical needs of SAR planners.
- **Mitigation**: Collaborate with SAR experts during development to align features with operational requirements.

7. Next Steps

1. Finalize data integration and preprocessing.
2. Develop core modules for probability mapping and area segmentation.
3. Conduct preliminary testing on simulated case scenarios.
4. Refine the user interface based on feedback from SAR experts.

8. Conclusion

The METUSAR project is progressing as planned, with significant advancements in data collection, methodology design, and software development. By addressing key challenges and leveraging advanced spatial and decision-making technologies, METUSAR aims to revolutionize SAR operations and save lives by enhancing efficiency and decision-making capabilities.