IE 482 Humanitarian Logistics
Earthquake Project Report

Group 1

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Drone and Machine Learning Based Destruction Analysis and Rescue Operations

1. Introduction:

Manual situation analysis using traditional methods often takes a considerable amount of time, delaying rescue efforts. By leveraging machine learning and drone technology, this project aims to streamline search and rescue (SAR) operations by adopting a more systematic approach.

2. Motivations:

Rapid Response: This project aims to increase the speed of rescue operations by performing destruction analysis with drones and machine learning.

Life-saving Focus: This project also aims to improve the detection process of earthquake victims in buildings by using infrared technology.

Digital Integration: Digital tools such as machine learning and drone technology offer a more effective and efficient search and rescue process compared to traditional methods.

3. Project Method:

Data Collection and Preparation: A data set will be created using demolition images captured by drones and other appropriate data sources.

Development of the Machine Learning Model: A model will be developed to perform destruction analysis using deep learning methods on the developed data set.

Integration of Infrared Technology: Infrared technology will be integrated, especially in detecting the presence of earthquake victims.

Fast and Automatic Analysis: The developed model will detect destruction by automatically analyzing drone images.

Mathematical Model: In addition to the above methods, a mathematical model inspired by Vehicle Routing Problems (VRP) will be employed to determine the optimal number and deployment strategy of drones for scanning specific areas. The model will consider factors such as the geographical layout of the disaster area, the capacity and range of drones, and the urgency of scanning certain regions. The objective function will aim to minimize the total distance traveled by drones while ensuring that every part of the area is covered. Constraints will include the maximum flight range of drones, their carrying capacity for data collection devices, and any operational limitations.

4. Results and Deliverables:

Developing a drone and machine learning-based system that will enable rapid analysis of post-earthquake destructions. This will enable rapid assessment of damaged areas and allow rapid decision-making in rescue operations.

Implementation of measures that will facilitate the detection of pancake-type destructions that are frequently seen in earthquake scenarios. By utilizing infrared technology, especially in conjunction with drone images, it will help effectively identify collapsed structures and possible victims trapped underneath.

Establishing a system for quickly assigning and prioritizing search and rescue teams (SAR Teams) to On-Site Operations Coordination Centers (OSOCCs). This optimized process will optimize resource allocation and increase the effectiveness of rescue operations, ultimately improving the process of saving lives in disaster areas.

The mathematical model will provide the optimal number of drones, their assigned routes, and scanning schedules. This will enable efficient coverage of the disaster area, minimizing drone usage while maximizing area coverage, thus enhancing search and rescue effectiveness.