

D2 INNOVATION



AI RDS

AI-Based Rescue Path Prediction System



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AI-Based Rescue Path Prediction System

AI - Drone Rescue System

The AI-Based Rescue Path Prediction System utilizes geospatial information and rescue incident data from the National Fire Agency as foundational training data for AI. It predicts high-risk accident areas in regions where mountain accidents frequently occur and forecasts the movement paths of individuals requiring rescue. The system supports rapid lifesaving operations within the golden hour.



01 Introduction

Data Collection and Refinement

Collection and refinement of mountain rescue incident data

Utilization and analysis of GIS spatial data

Development of spatial data preprocessing tools

AI Model for Accident Risk Area Prediction

Grid-based prediction of high-risk accident areas

Environmental modeling including spatial relationships, weather, and time factors

Development of AI models for predicting accident-prone areas and victim movement paths by accident type

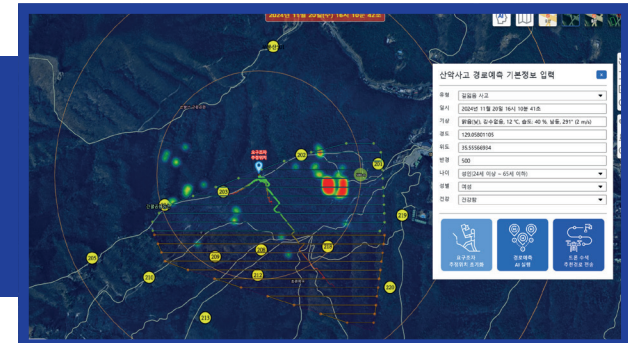
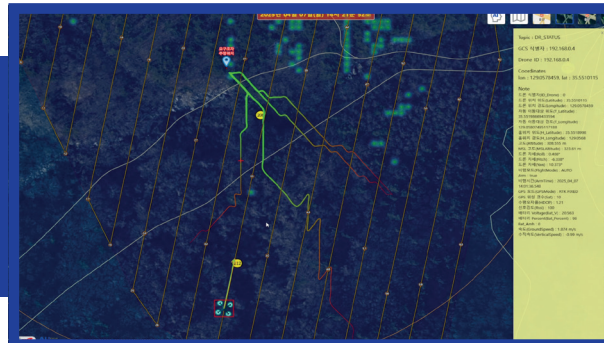
Determining Search Priority Areas

Search area recommendation based on accident risk prediction

Search area recommendation based on historical data

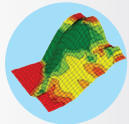
Prediction of victim movement paths

Drone search path recommendation





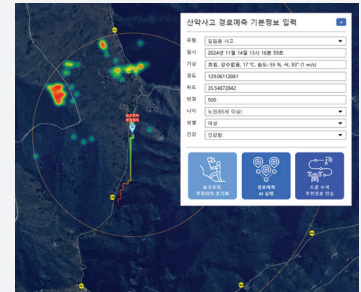
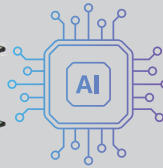
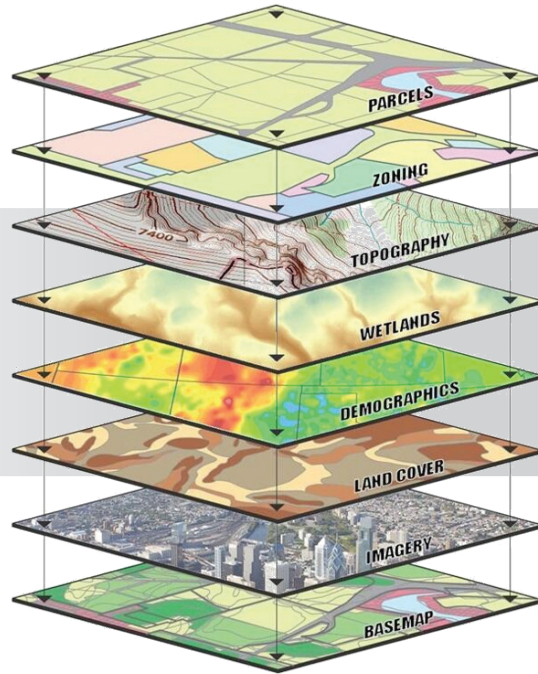
GeoSpatial



Terrain



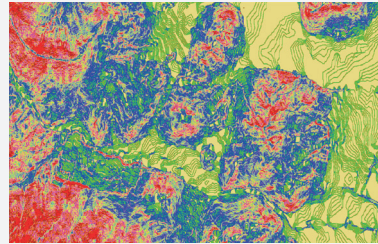
Accident log



02

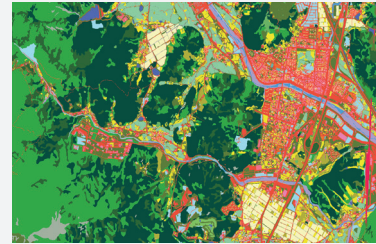
Construction of Training Data

Geospatial Data and Mountain Accident History



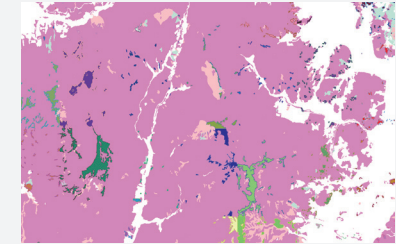
NGII

Terrain Ruggedness Index



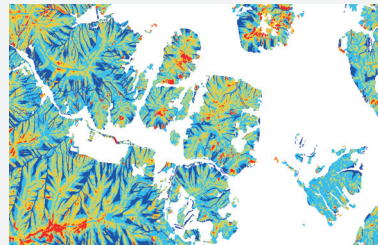
Ministry of Environment

Land Cover Map



Korea Forest Service

Forest Type Map



Korea Forest Service

Landslide Risk Map



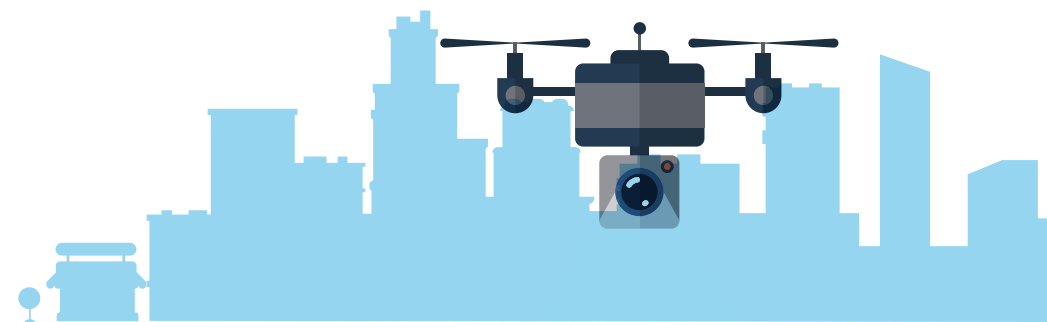
Korea Forest Service

Hiking Trails



National Fire Agency

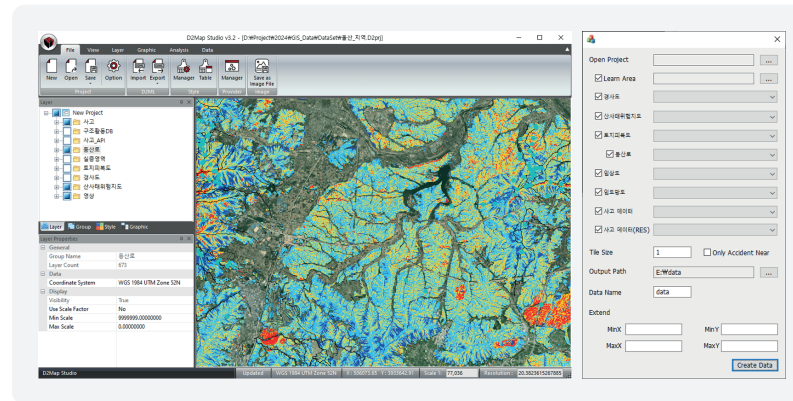
Mountain Accident History



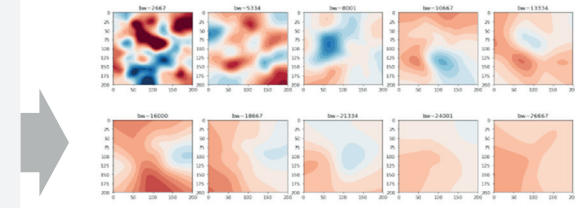
02

Construction of Training Data

Training Data Conversion Tool Development

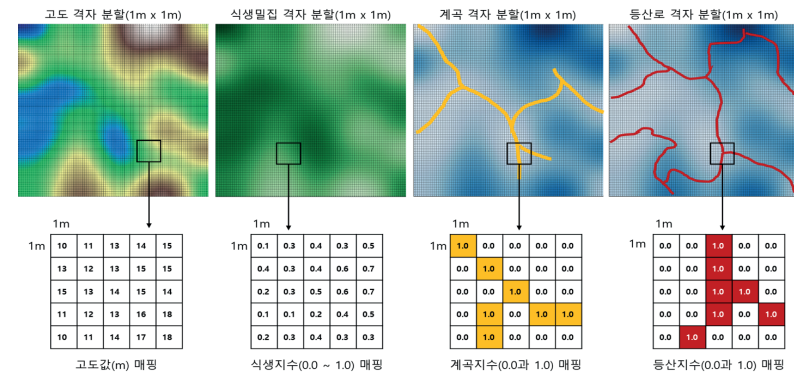
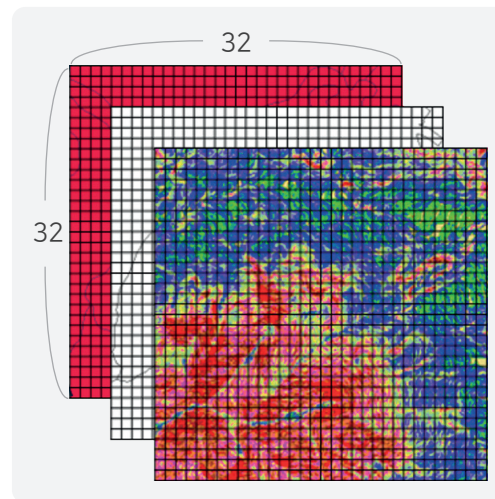


Preprocessing and extraction of GIS data



Refinement of mountain accident locations, weather, time, and environmental data

Cell-Based Training Data Construction

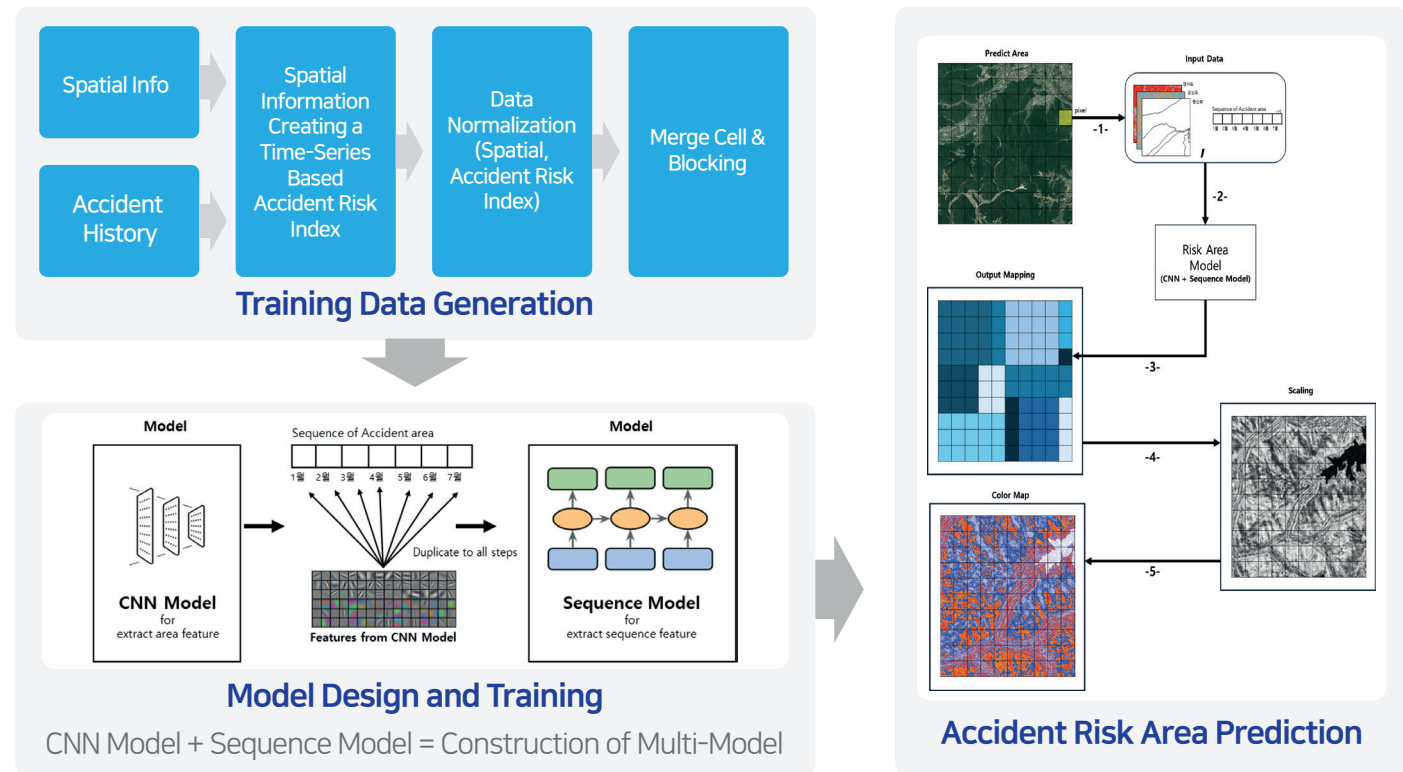


Generation of terrain data and environmental information (time, weather, accident data) by cell

03

AI Model

Prediction of High-Risk Accident Areas

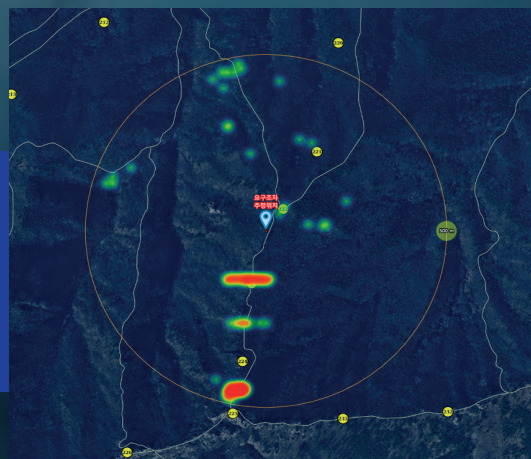


CNN (Convolutional Neural Network)

Spatial characteristics—including terrain complexity, slope, and elevation—are extracted using diverse GIS datasets such as ruggedness index, hiking trail maps, and landslide hazard maps.

Sequence Model(GRU)

Accident occurrence patterns are learned from monthly mountain accident records (2021–2023), and predictions are made by integrating temporal (day/night), meteorological (weather), and spatial information.

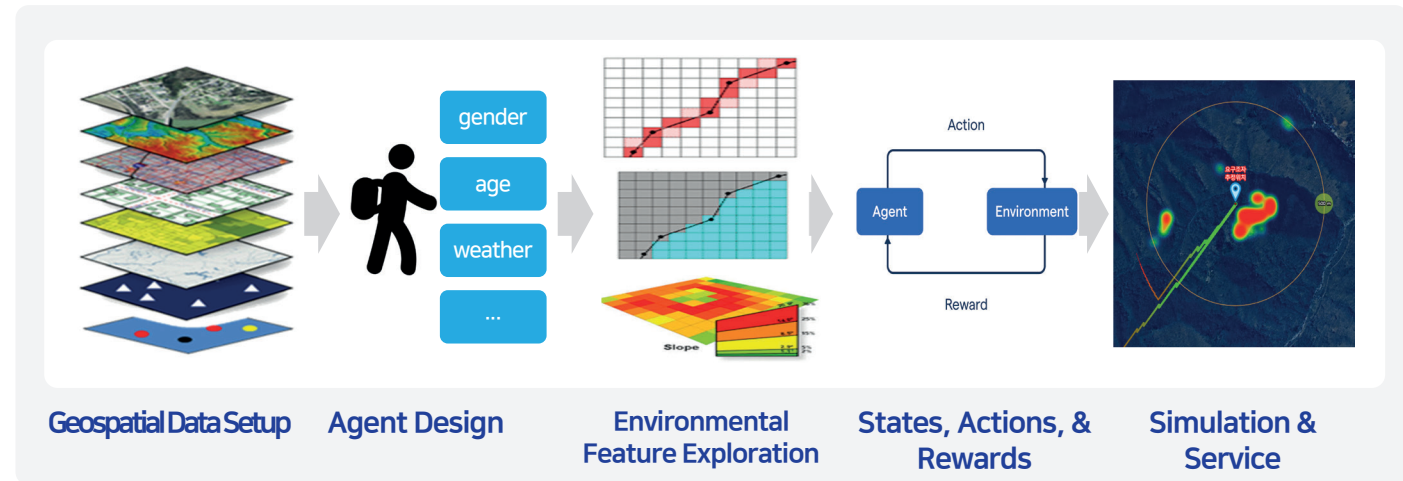


Nearby Accident Risk Area of the Estimated Rescue Target Location



Basic Input Information for Accident Risk Area Prediction

Trajectory Prediction

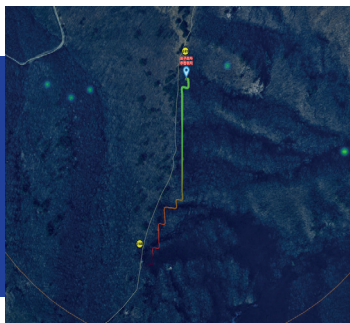


DQN(Deep Q-Network)

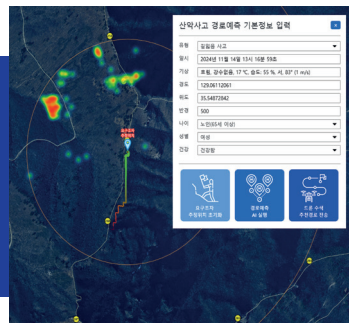
- The reinforcement learning-based agent learns optimal actions within a given environment
- Agent characteristics such as age (adolescent, adult, elderly), gender (male), and health status (healthy, with illness) influence behaviors such as path travel, visibility acquisition, and staying in place, with an Epsilon-Greedy strategy applied.

GIS Based Agent Rewards

- GIS environment configured with elevation, reservoirs, rivers, roads, forests, watersheds, and hiking trails
- Agent reward strategies reflect location-based conditions, watershed boundary avoidance, distance factors, and state changes
 - Rewards are given when the agent approaches hiking trails, roads, or forest roads
 - Penalties are applied when approaching rivers or reservoirs
 - Rewards for descending elevation; penalties for ascending elevation
 - Penalties or rewards based on slope variation



1-Hour Movement Path Prediction from Estimated Rescue Target Location

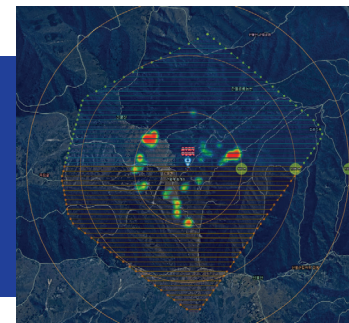
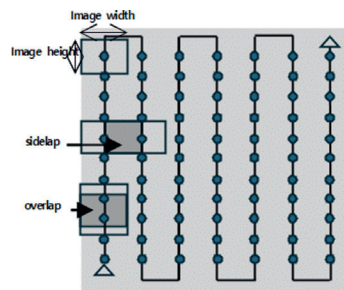
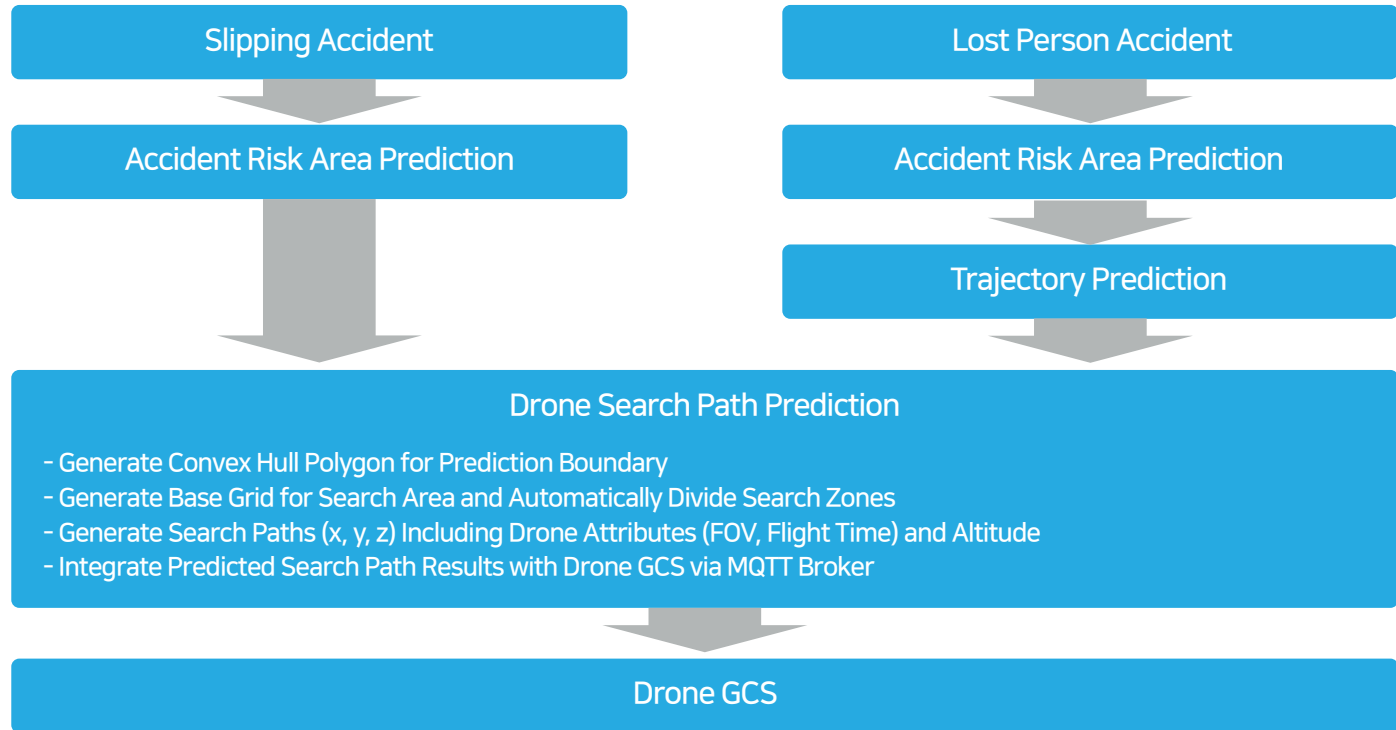


Basic Input Information for Movement Path Prediction (Age, Gender, Health)

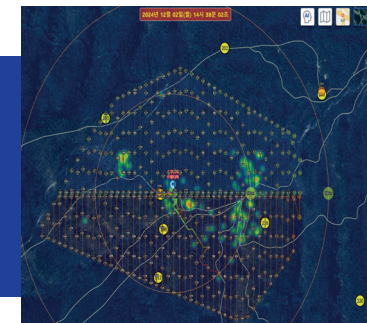
03

AI Model

Drone Search Path Prediction



Accident Risk Area Search Path Prediction for 2 Drones



Drone-Based Search Path Prediction with Risk Zones and Movement

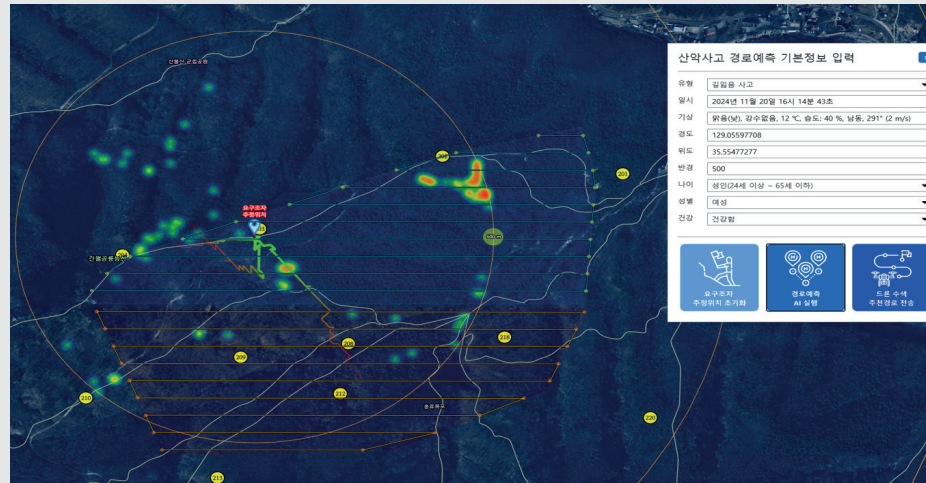
04

AI Case Study

Accident Risk Prediction

Performance Validation for Slipping Accidents

[Scenario] Starting from Deungeok Alps Trail in Sinbulsan, Ulsan, the individual passed Mountain Signpost No. 203, misstepped, fractured an ankle, and called for rescue.

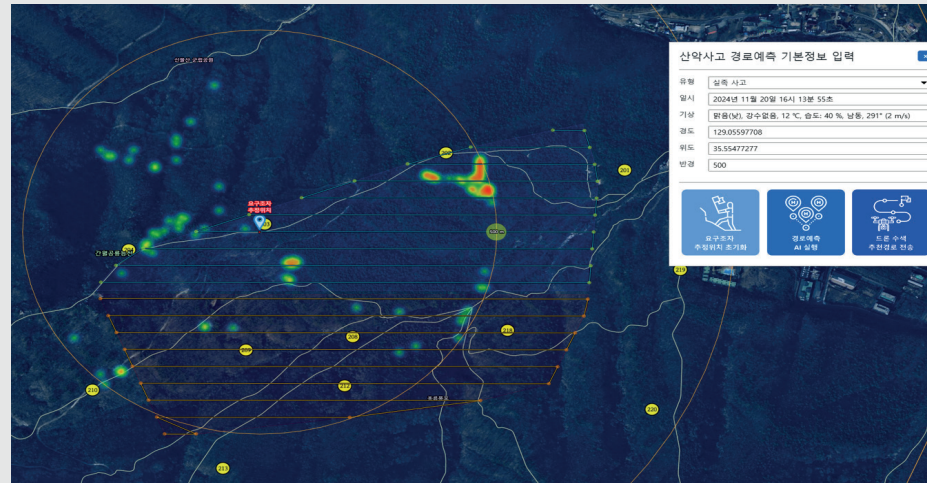


Average
Detection
Radius
319m

No	Reported Location of the Rescue Target	Estimated Central Location of the Rescue Target	Found Location	Radius(m)
1	129.055E, 35.554N	129.058E, 35.553N	129.057E, 35.555N	270
2	129.056E, 35.554N	129.058E, 35.553N	129.055E, 35.554N	374
3	129.060E, 35.556N	129.058E, 35.553N	129.058E, 35.55N	330
4	129.065E, 35.553N	129.058E, 35.553N	129.063E, 35.554N	301

Performance Validation for Lost Person Incidents

[Scenario] After departing from the Deungeok Alps Trail in Sinbulsan, Ulsan, the individual passed Mountain Signpost No. 203 about 20 minutes ago. As night fell and she became unsure of where to go, she contacted the rescue team. Her current location is unknown, and the caller is a woman in her mid-60s.



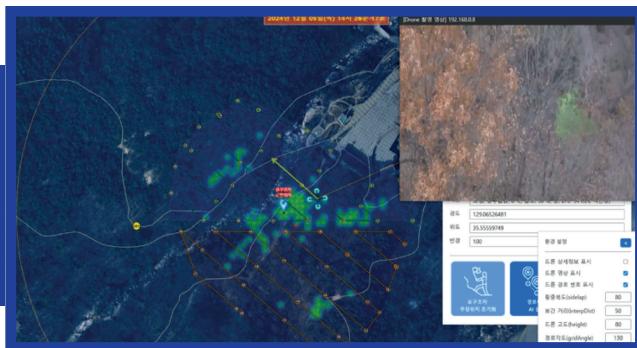
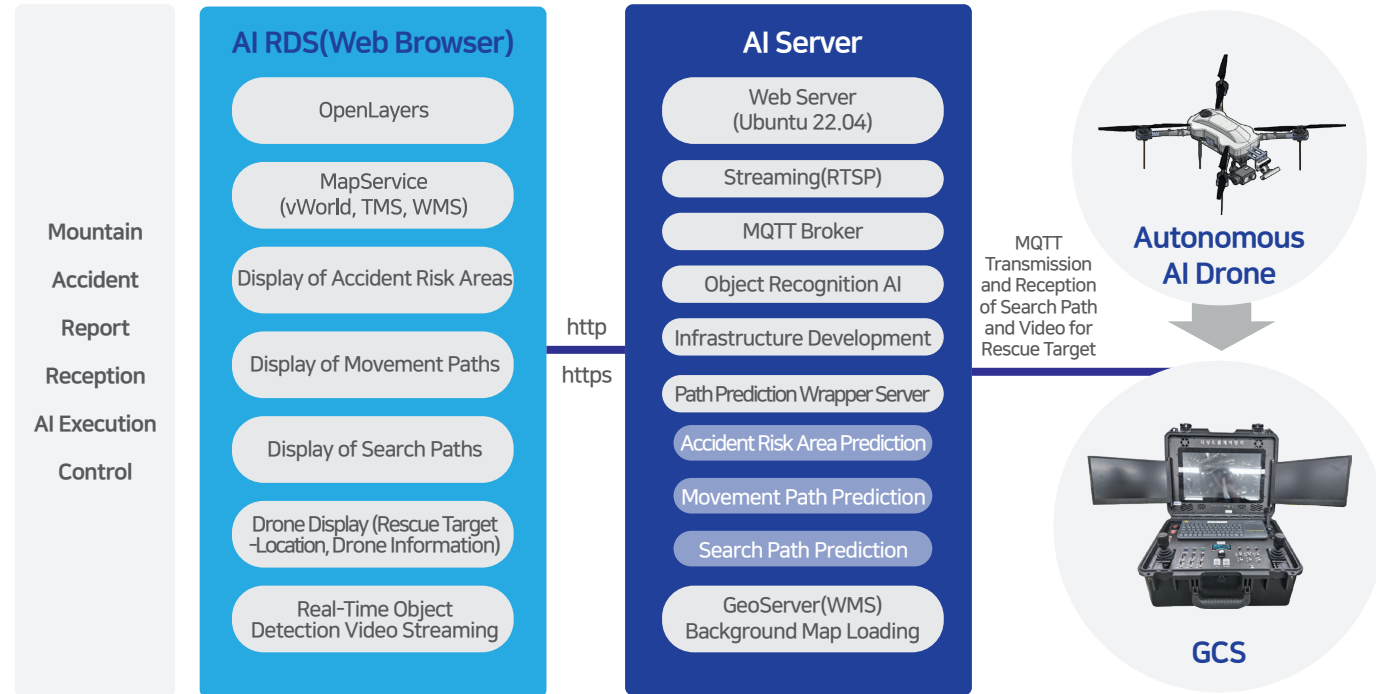
**Average
Detection
Radius
376m**

No	Reported Location of the Rescue Target	Estimated Central Location of the Rescue Target	Found Location	Radius(m)
1	129.058E, 35.555N	129.061E, 35.554N	129.058E, 35.555N	322
2	129.056E, 35.554N	129.059E, 35.553N	129.057E, 35.554N	461
3	129.060E, 35.556N	129.059E, 35.554N	129.056E, 35.553N	358
4	129.065E, 35.553N	129.059E, 35.554N	129.064E, 35.554N	362

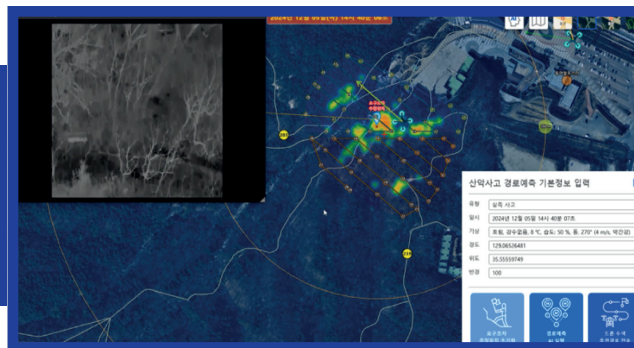
05

System Architecture

AI Rescue Drone System Architecture



Rescue Target Detection Object Recognition (EO Camera)Real-Time Integration



Rescue Target Detection Object Recognition (IR Camera)Real-Time Integration



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