# AI for Search and Rescue


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## Background

- Search and Rescue (SAR) Incidents involve locating a missing person
- These missions require exceptional organization, sometimes with assistance from the local police department or other SAR groups.
- Currently, paper-based forms are the main organizational tool used to collect and represent information about the incident.
- SAR Coordinators must review all forms turned in at the Command Post before making decisions.
- Mainly focused on Bay Area Search and Rescue Council (BASARC) Forms and Incident Command System (ICS) Forms.

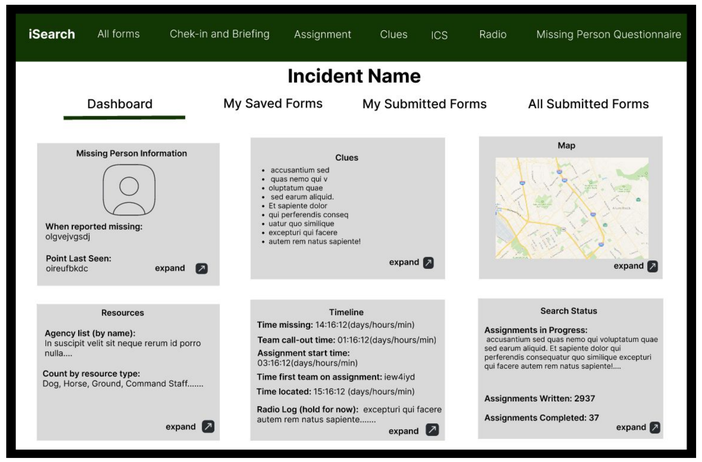
## Goal/Motivation

- Our main goal is to improve the overall efficiency of an incident.
  - Cloud-based application for data collection and analysis
  - Integrate a semantic search into the application to show connections in a search
  - Build a Search and Rescue Ontology
  - Create a system that can provide advice based on a knowledge repository of previous searches
  - Explore further applications of AI in SAR
    - Location Prediction

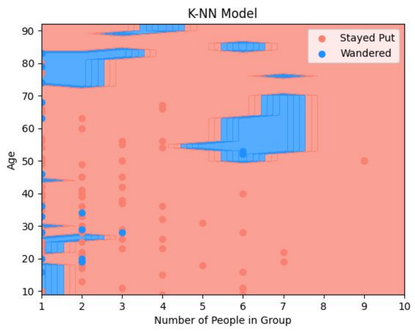

## Acknowledgements

- Robert J. Koester, for sharing part of the ISRID2 dataset with us (US Department of Homeland Security Science and Technology Directorate: HSHQDC-13-00107 and D14PC00153); see Koester, R. J. (2020). Enhancements to statistical probability of area models based upon updated ISRID data collection for Autistic Spectrum Disorders and Typically Developing children. J. Search Rescue, 4, 65-83.
- Gary Bloom, for his sponsorship of the project during the last two years.


## Dashboard



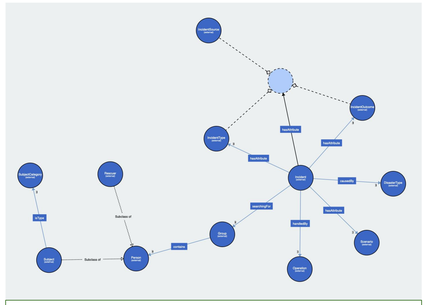

## Semantic Search and Machine Learning



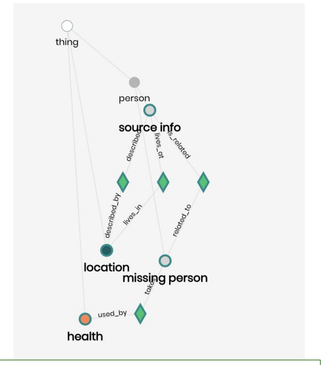

**K-Nearest Neighbors Graph (Based off ISRID2 Dataset)**

The K-Nearest Neighbors (KNN) model uncovers key insights about the relationship between age, group size, and wandering behavior when lost:

- Individuals aged 75-85, in groups of 1-3, show a higher tendency to wander, consistent with prior dementia-related findings.
- A novel classification occurs in the age group of 50-70, in groups of 5-7, where people tend to wander, prompting future research into the reasons behind this trend.



**Ontology Graph (Created through the ISRID3 Data Standards)**




**Mock Up Relationship Model (Missing Person Questionnaire)**

## Results

- Dashboard
  - Visualization of clue locations
  - Data populated using querying highlighting key details in the incident to the command post.
- Behavioral insights
  - Data set confirms Koester's findings and expert insight about dementia as a commonly found mental condition amongst missing person
- Population insights
  - Correlation age ⇔ group size
- Knowledge Repository Structure
  - Core ontology based on domain expertise and datasets
  - RDF triples now establish relationships from IDs to all other data properties
  - Foundation for generating SPARQL queries to filter RDF triples is complete
- Integration of historic data sets
  - ISRID2/3 (Bob Koester)

## Future Work

- Conduct usability tests based on mock searches
  - Improve navigation through website for mobile devices
- Expand ontology from datasets and domain expertise
  - Decide on ontology creation tools
- Explore usage of Probabilistic Reasoning methods
  - Assign values to the likelihood of finding missing person in specific areas
  - Decision-making mechanism through clustering of ISRID 2/3 data
- Complete integration of semantic search engine with main application
  - Assessment of different tools (MarkLogic, PoolParty, Elastic Search, Algolia)
- Incorporate more categories into clustering


**Front-end Team**

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