



THE UNIVERSITY OF  
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# Understanding Human-AI Teaming Performance using Autonomous Systems in Virtual Environments

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# INTRODUCTION

- Significant of Explainability in AI-Enabled Autonomous Systems
  - Explanation:
    - Cognitive Process, Social Process, Product
  - Stakeholders: Domain Experts, Regulatory Entities, Managers, Data Scientists, Users
- Drawbacks of current explainability methods:
  - Computationally intensive
  - May not target the correct audience

# Human-AI Simulation

- The Explanation Interface
  - Cognitive: Assumed A/S is correct (function of MAP)
  - Social: Minimap Interface
  - Product: Dot on Minimap
- Light-weighted/Computationally efficient.
  - To start with...

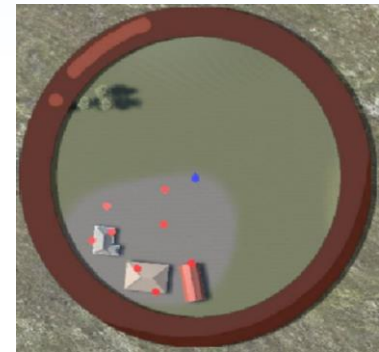


Fig. 1: Hostages Displayed on Minimap

# PROPOSED METHODOLOGY

## Combat Search and Rescue (CSAR) Scenario

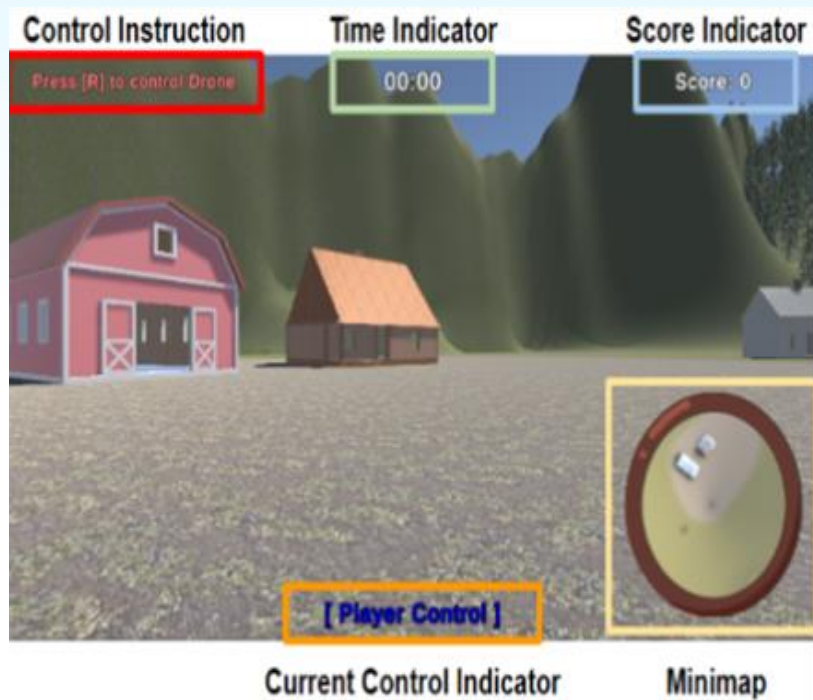


Fig. 2: SAR Player Interface

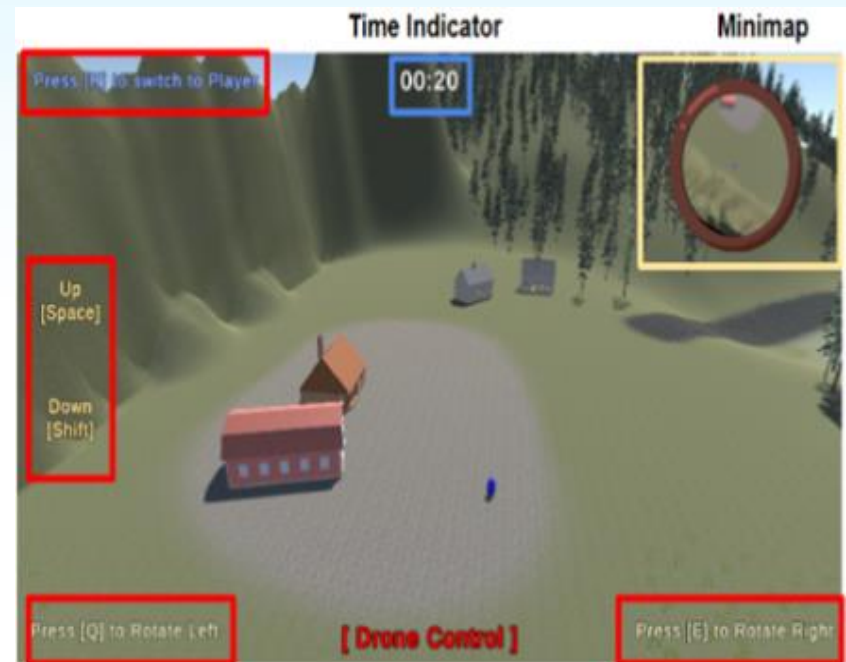


Fig. 3: SAR Drone Interface

# PROPOSED METHODOLOGY

## CSAR Scenario



Fig. 4: Top-Down View of Environment

# PROPOSED METHODOLOGY

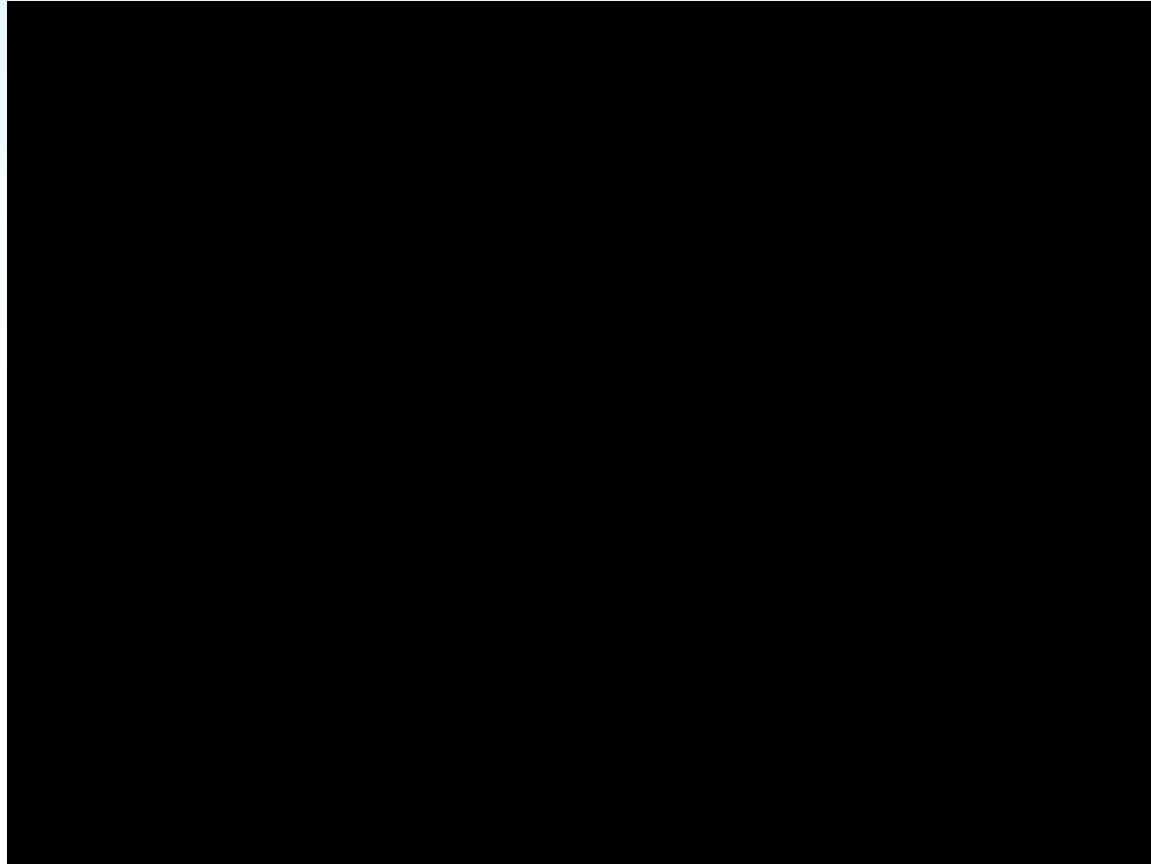
## CSAR Scenario



Fig. 5: Hostage Rescue

# PROPOSED METHODOLOGY

## CSAR Scenario



[Link](#)

Fig. 6: Drone POV - Hostage Spotting



# METHODOLOGIES FOR COMPARISON

- Frequency of Human-AI interactions
- Duration of Human-AI interactions
- Total number of hostages collected
- Time until exit (or complete, whichever is first)



# DATASETS USED FOR EXPERIMENTATION

- 10,000 images/class; 7 classes
  - Captured using empty environment
    - Varying camera position
  - Dimension : (640 x 640 x 3)
- Yolov5x; 86.7m params
  - Attached to UAV software-defined camera
  - Implementation: Python Embedding

# DATASETS USED FOR EXPERIMENTATION

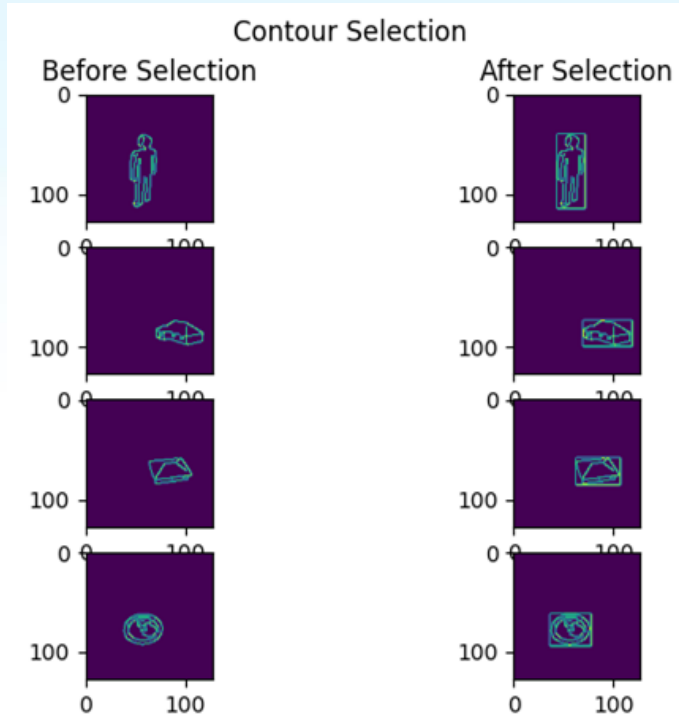


Fig. 7: Automatic Label & Anchoring

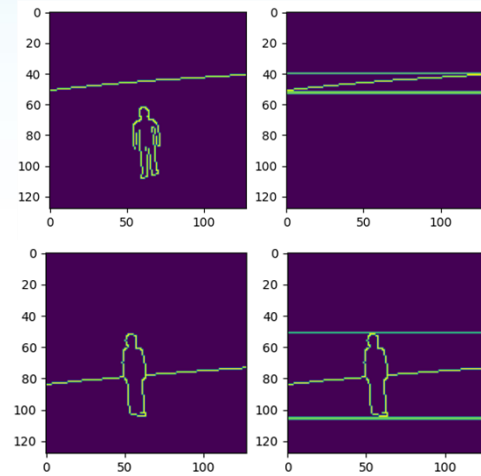


Fig. 8: Poor Labeling

# DATASETS USED FOR EXPERIMENTATION

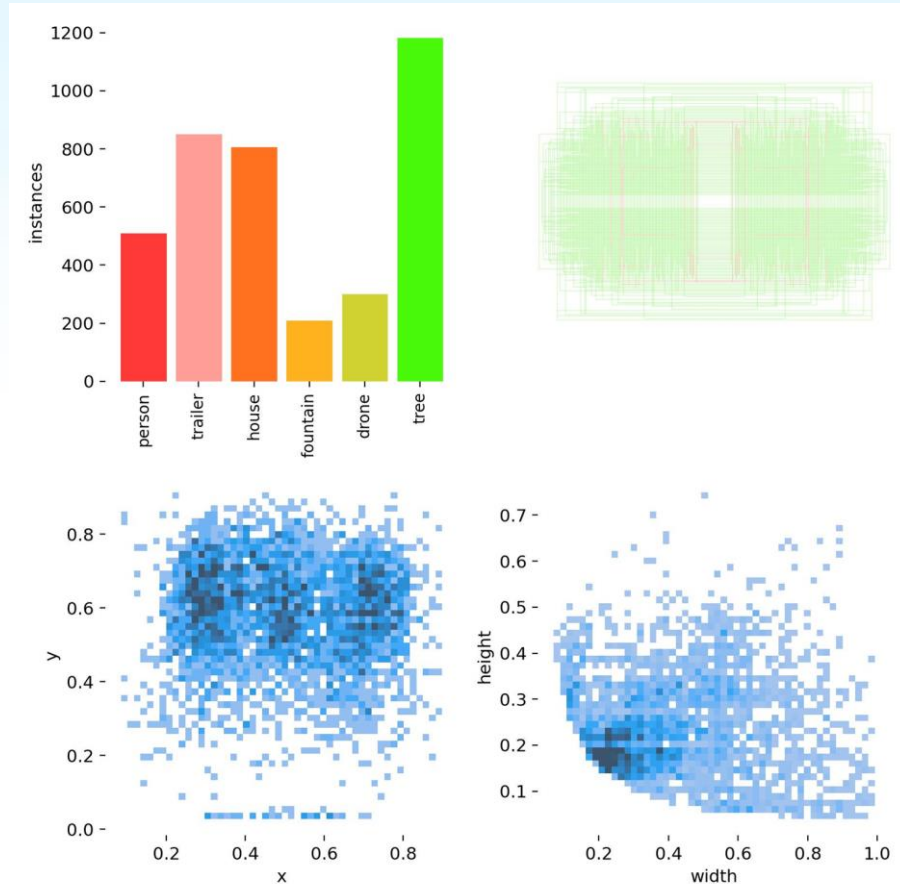


Fig. 9: Training Dataset - Label/Box Distributions

# EXPERIMENTAL RESULTS

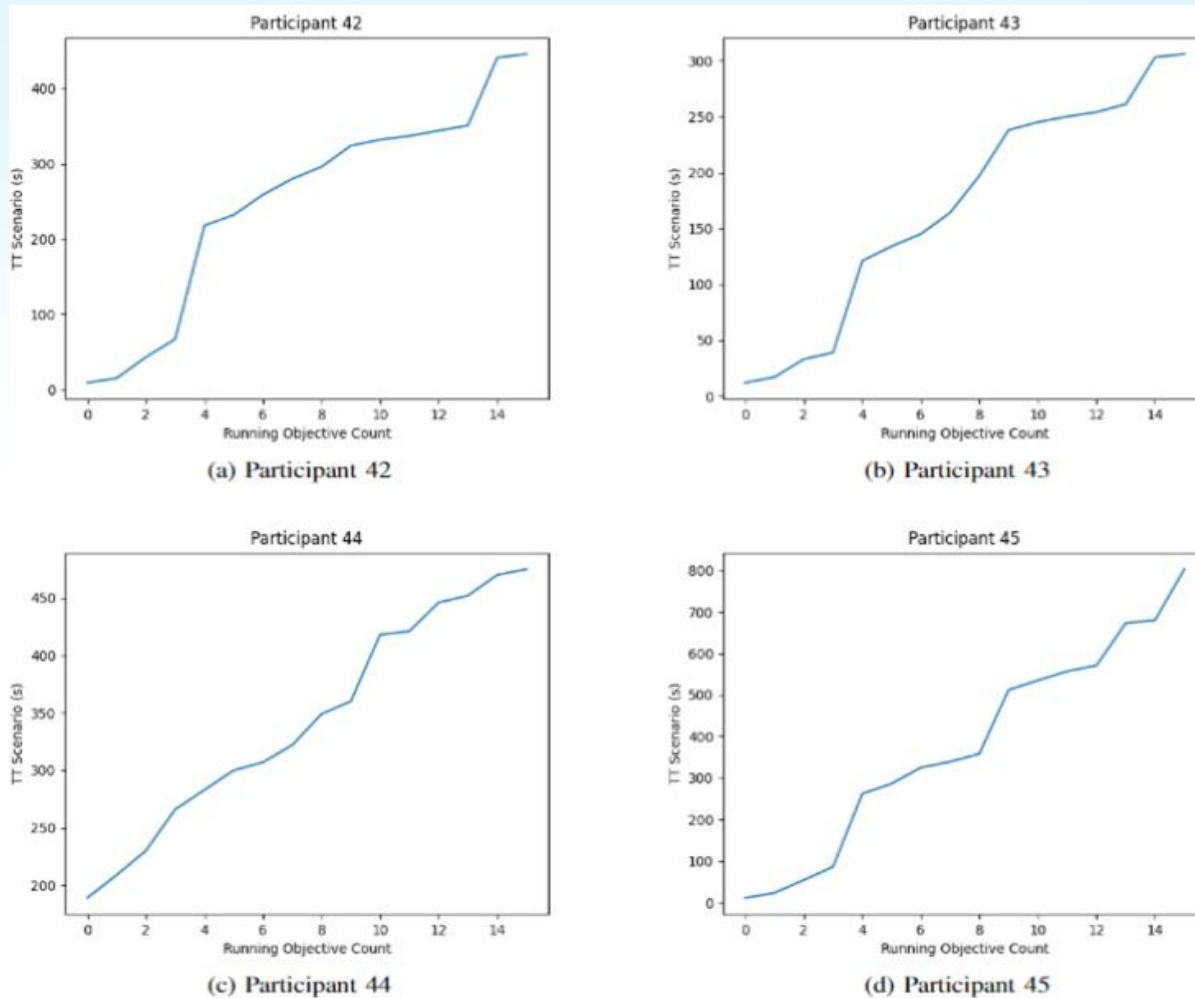


Fig. 3: Hostage Rescue (Autonomous Mode)

Fig. 10: Total Experiment Time vs Hostages Rescued

# EXPERIMENTAL RESULTS

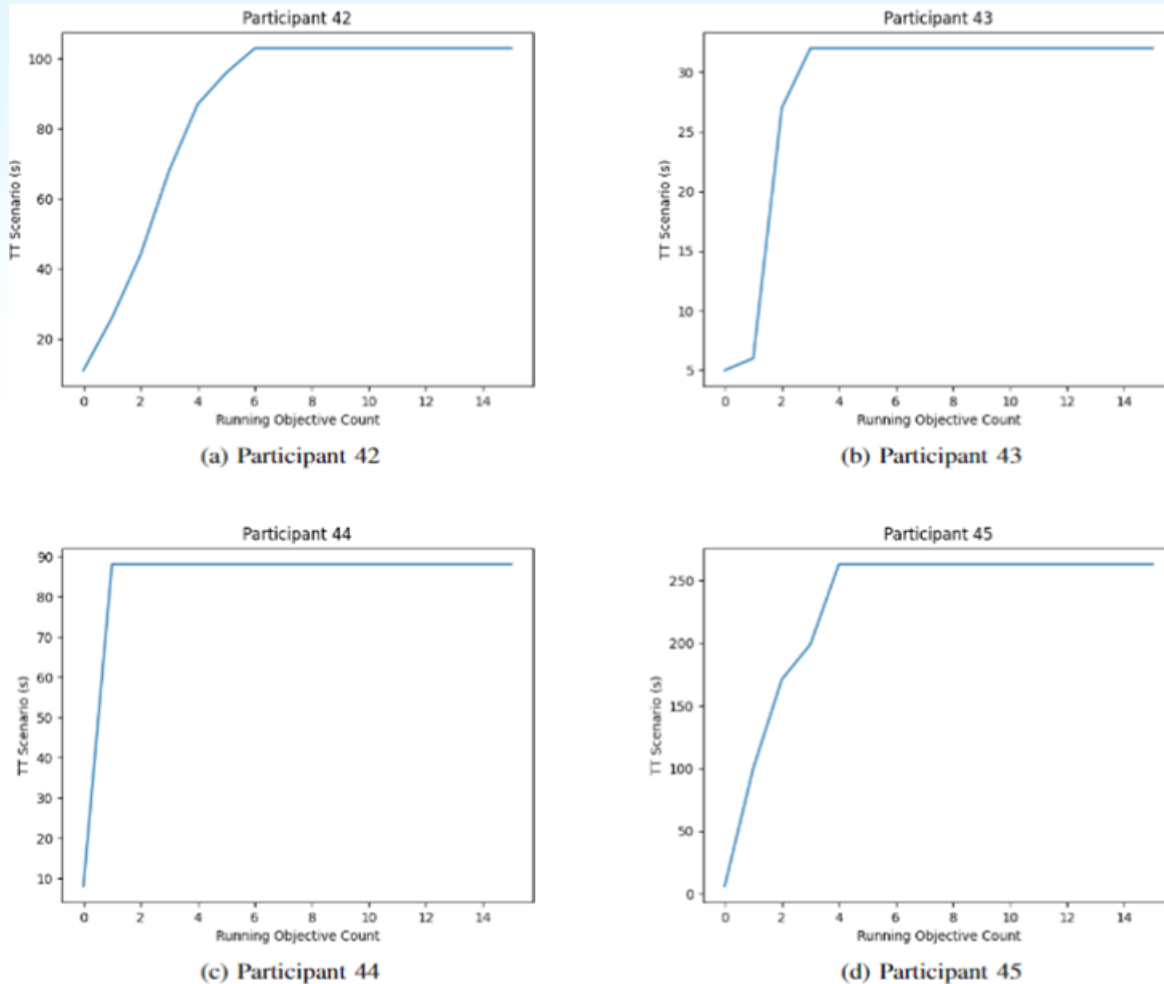


Fig. 11: Total Experiment Time vs Hostages Spotted

# EXPERIMENTAL RESULTS

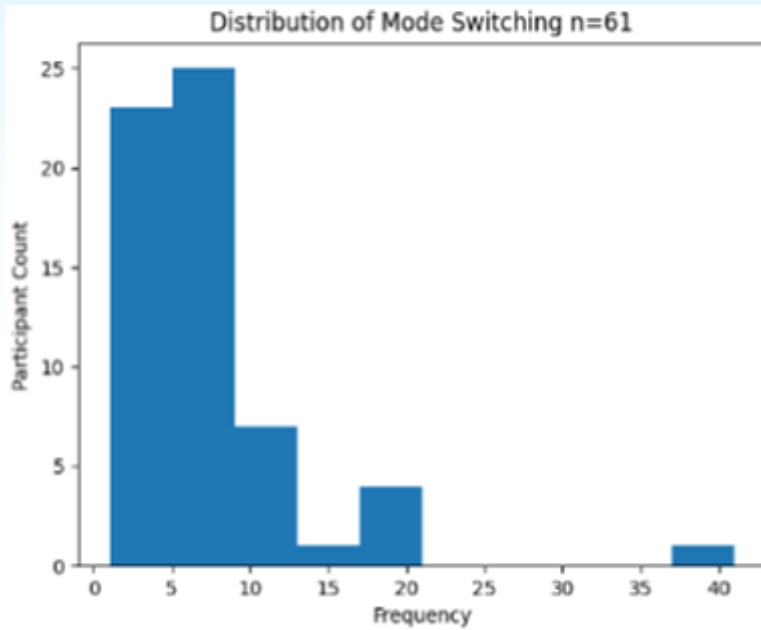


Fig. 12: Participant Mode Switching Frequency

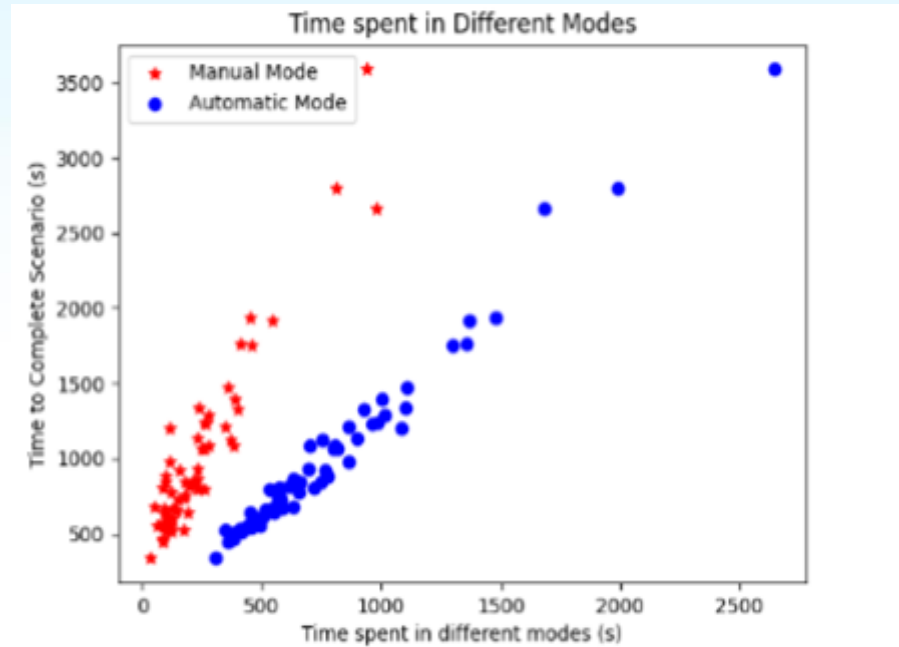


Fig. 13: Time Spent in each mode of operation

# EXPERIMENTAL RESULTS

TABLE I: Summary of CSAR mission completion participant statistics for different modes of operation

Statistics	Distribution of Time (seconds)		
	<i>Total Time</i>	<i>Autonomous mode</i>	<i>Manual mode</i>
mean	1005.951	771.066	234.885
std	595.545	417.787	193.421
min	338	306	32
25%	641	502	108
50%	812	641	180
75%	1200	898	266
max	3586	2648	978



# CONCLUSION

- We present a novel study based on SAR scenario where Human-AI teaming is encouraged and interactions measured.
- We found participants engaged with the autonomous system ~25% of the total experiment time.
- Further studies will introduce additional autonomous features and human factor evaluations using this platform to evaluate Explanation Products and Processes preferences.

# THANK YOU!!

For any questions about our work, please contact the authors at  
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