Emergency Response Team Assistance (RTA)

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Problem Statement & Solution Approach

Imagine you get to the site with other firefighters. You can see some people running and hear more people yelling for help from distance, but **you have no idea where they are or how to get to them**…

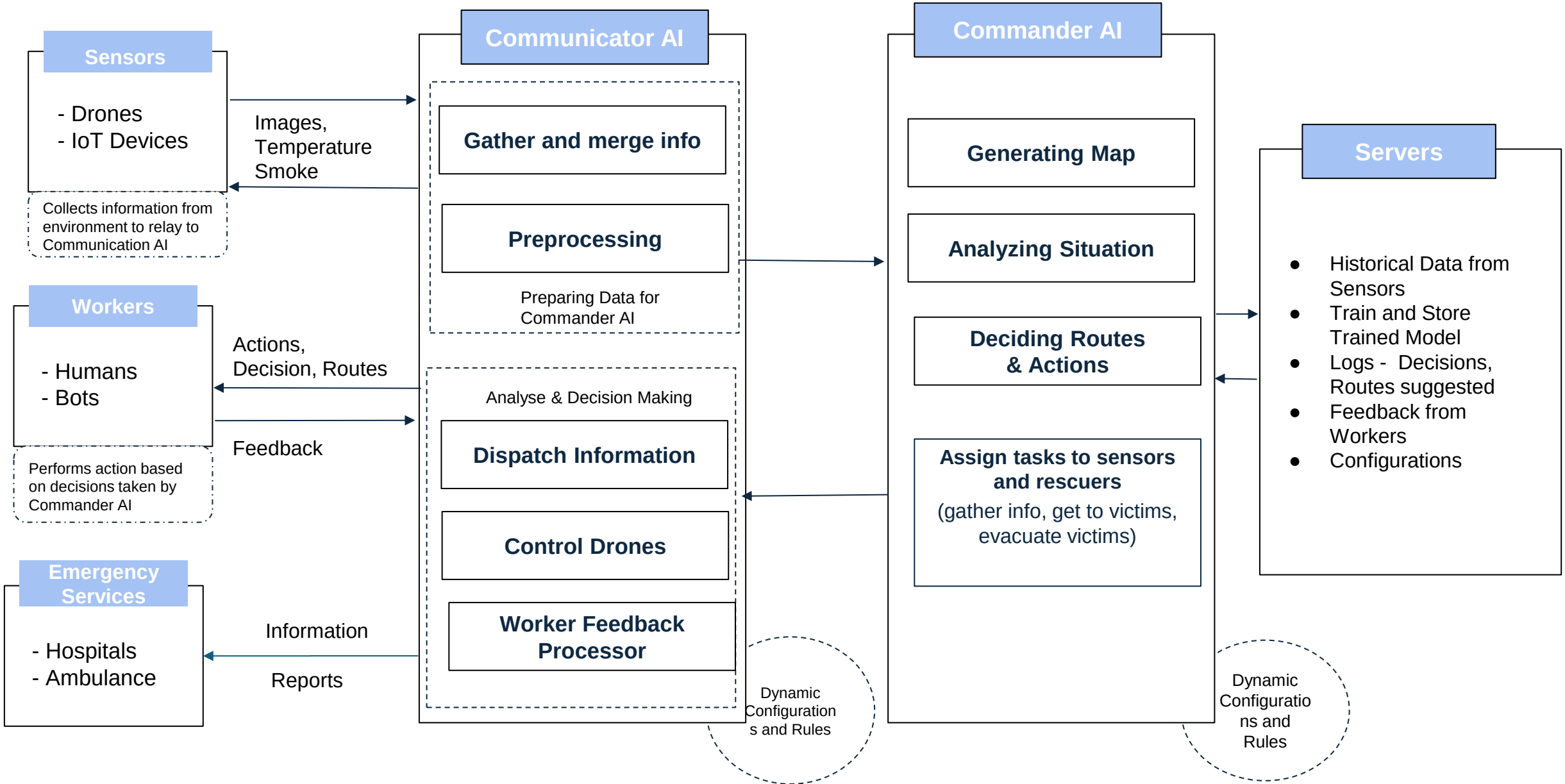
→ You and the team deploy drones to gather more information, but you can only see a small region and **the information is hard to merge**, which **make rescues dangerous and time-consuming**…

→ You wonder if you could get **a clear, consolidated, up-to-date view** of the entire disaster and **be given precise instructions on how to save lives**…

Our solution —— An AI system that:

- Automatically collect and consolidate information
- Update information as time lapse
- Give **clear, robust, and ethically sound** instructions to **save more lives**

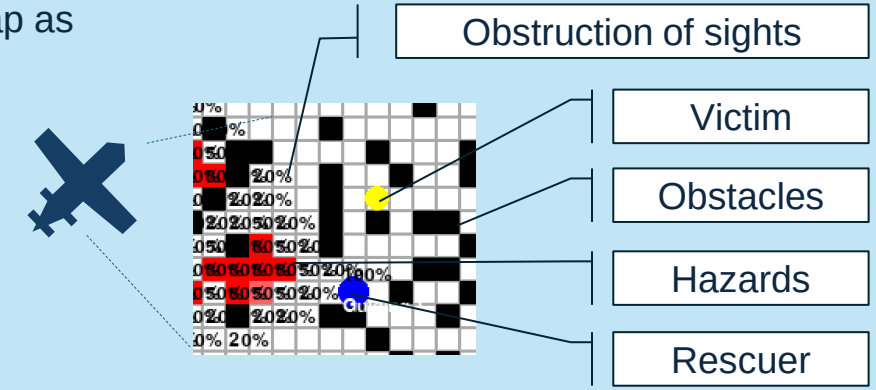
Technical Architecture



Sensor AI: How do we get information

Information From Unmanned Drones / Vehicle

- **Location of obstacles**: The sensor can automatically identify the obstructions such as a fallen tree or collapsed wall. These obstructions will then appear as in our stimulation map.
- **Location of hazards (fire)**: Our sensor will be able to identify the location of fire by flame or smoke.
- **Location of obstructions of sights**: Smoke that block sight of drones and human beings.
- **Severity of the fire**: The gas sensor on our drones will be able to detect fire-emitted pollution and visualize the fire severity by color density: bright red represents more severe fire
- **Location of the victim**: Our sensor will be able to identify the location of victims and draw on the stimulation map as

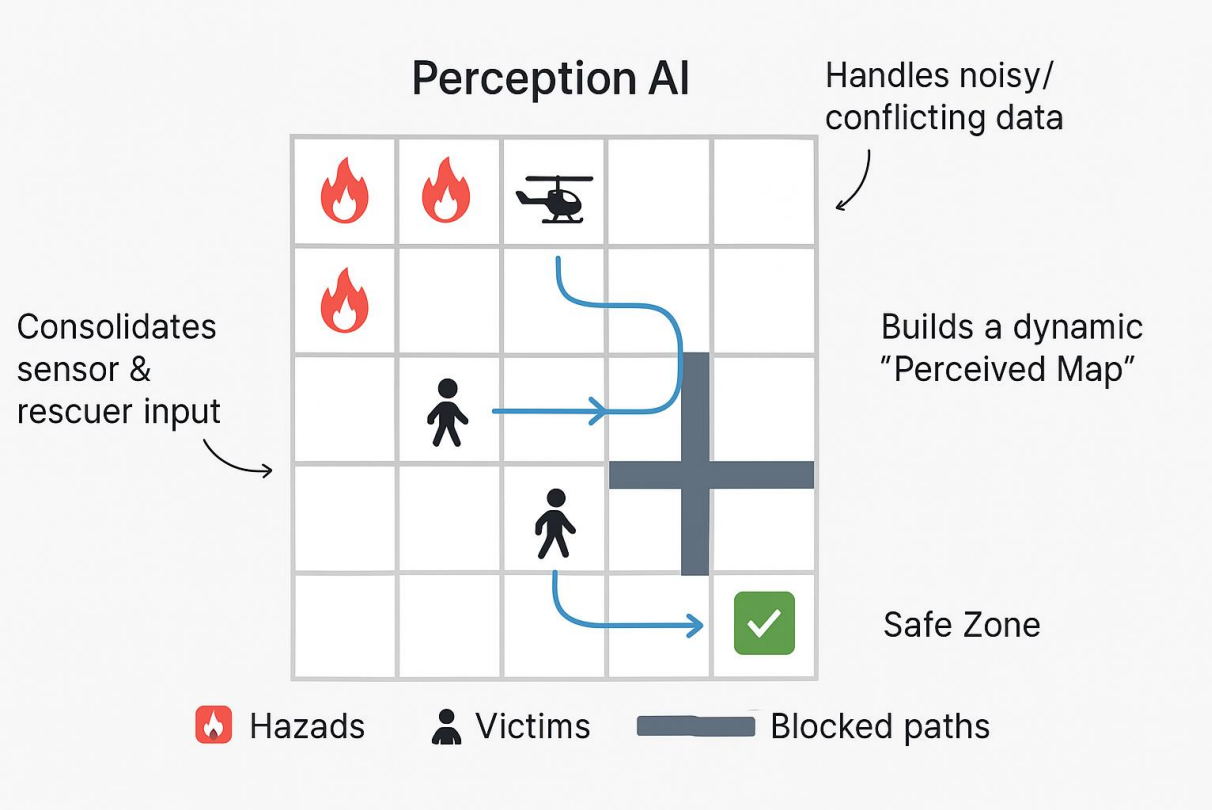


Information From Rescuers (Rescuing Bots or Firefighter)

- The Rescuers have a more clearer sight than drones/ vehicle, and they will report the information different from the one they received from the AI system.

Communicator AI

A Perceived Map : How do we know what is currently going on?



Perceived Map

- Consolidates sensor & rescuer input
- Handles noisy/conflicting data
- Builds a dynamic “Perceived Map”

Map Key Functions

- Marks hazards, blocked paths, victims
- Updates with real-time environment changes
- Highlights safe zones & optimal routes

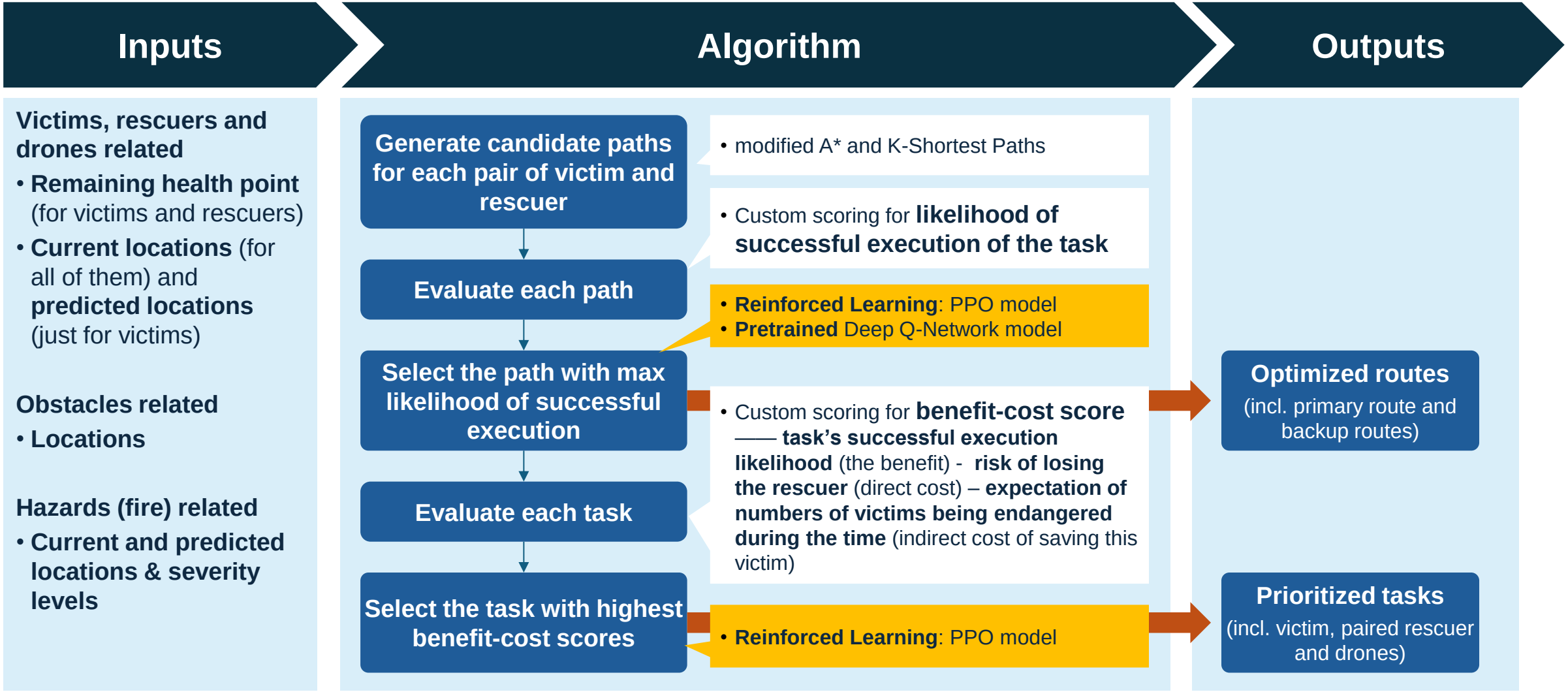
Certainty Layer (Unique Feature)

- Confidence level per object
- Sensor type, distance, timestamp
- Context-aware (e.g., smoke, obstruction)

Why It Matters

- Improves decision-making under uncertainty
- Enables adaptive task assignment
- Helps rescuers respond effectively in chaos

Commander AI: How do we give instructions?

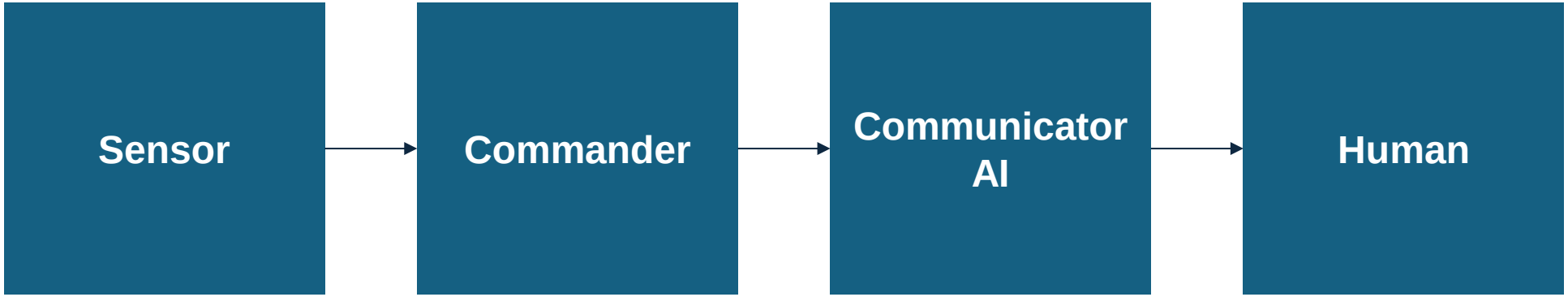


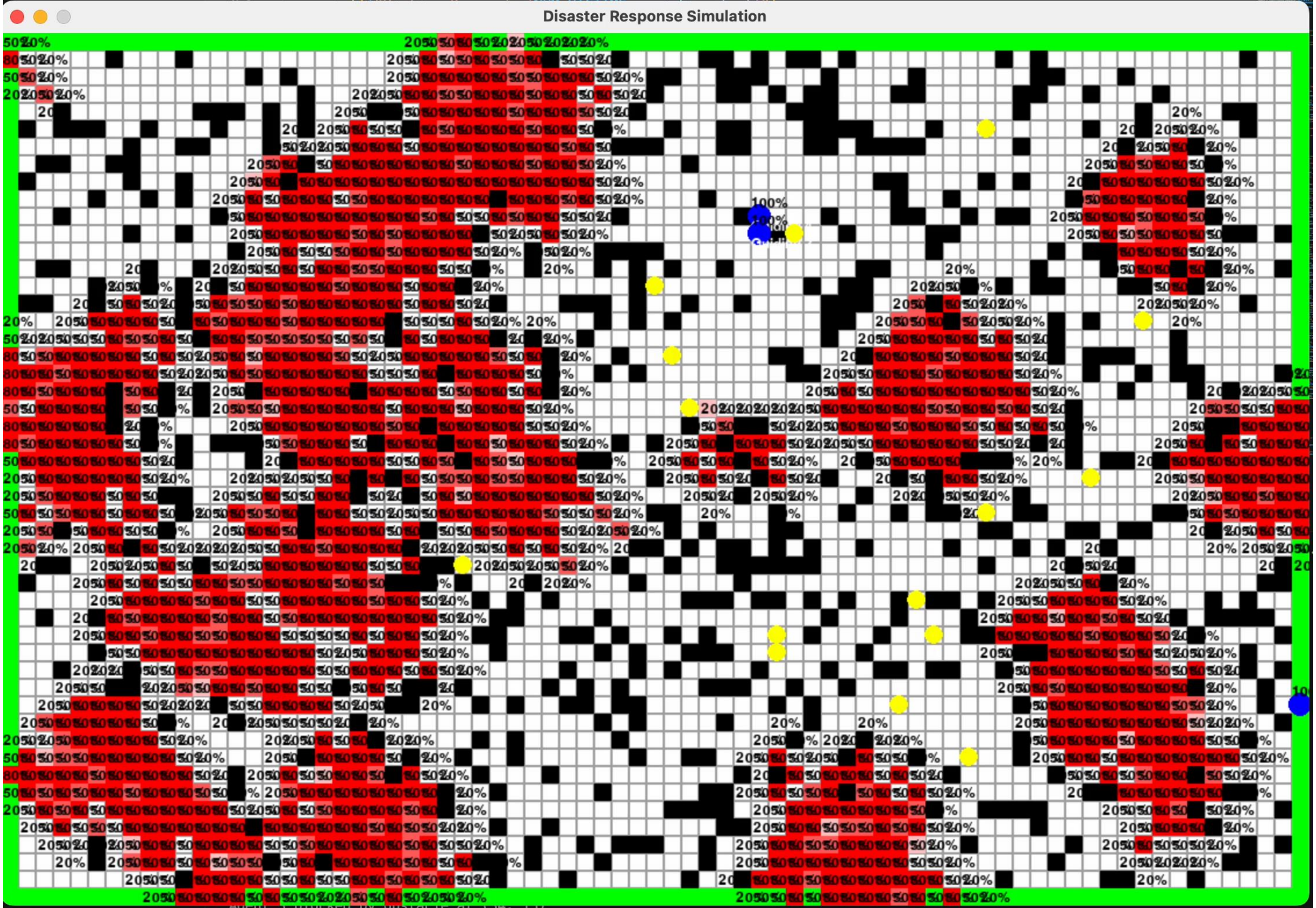
Second AI: How could we resolve ethical issue?

Our decision-making process from the commander takes serious consideration of humanitarianism. However, there are few inevitable ethical issues:

- Our approach is utilitarian—aiming to save the greatest number of lives by prioritizing those in most danger who are least likely to self-rescue. This can inadvertently lead to neglect of individuals who might not score as high on these metrics, even if their rescue is equally important from a human rights perspective.
- Although we tried our best to mimic the real-world setting, hazard levels and victim conditions can change rapidly in reality, and the algorithm's static snapshot might not always reflect the real-time situation.

Our mitigation strategy focuses on involving human intelligence including consulting with experts.




Disaster Response Simulation

Perceived Information

```
Agent 3 blocked by obstacle at (34, 13)
Agent 3 blocked by obstacle at (36, 15)
Agent 4 blocked by obstacle at (36, 15)
Agent 3 blocked by obstacle at (36, 14)
Agent 3 blocked by obstacle at (34, 15)
Victim reached safety at (0,12)
Victim reached safety at (58,0)
Agent 3 now guiding victim at (41,16)
Agent 4 now guiding victim at (42,20)
Agent 4 now guiding victim at (44,14)
Victim 30 died in hazards.
```

Information Exchange

Commander Instructions

```
Agent 4 moving along rescue path: [(73, 4), (72, 4), (71, 4)]
Victim reached safety at (8,49)
Victim reached safety at (61,0)
Agent 0 detected obstacle/hazard at (23, 7). Recalculating clear path.
Agent 0 new clear path: [(24, 7), (24, 6), (24, 5), (24, 4), (24, 3), (24, 2), (24, 1), (25, 1), (26, 1)]
Agent 1 moving along rescue path: [(1, 8), (0, 7)]
Agent 2 moving along rescue path: [(66, 49), (65, 49)]
🌀 Agent 3 has no victim. Exploring to (0, 21)
```

Results Report

```
Baseline Simulation Ended after 406 rounds
Victims Rescued: 31
Victims Lost: 19
Agents Survived: 0
Agents Lost: 5
```

Our Unique Advantages

Realistic Pain-Points

Impossibility for Being Fully Prepared

+

Fast-Changing Environment

+

Irrational Victim Response

Robust Solutions

Drones + Dynamic Intelligence
(Real-time & Predicted)

+

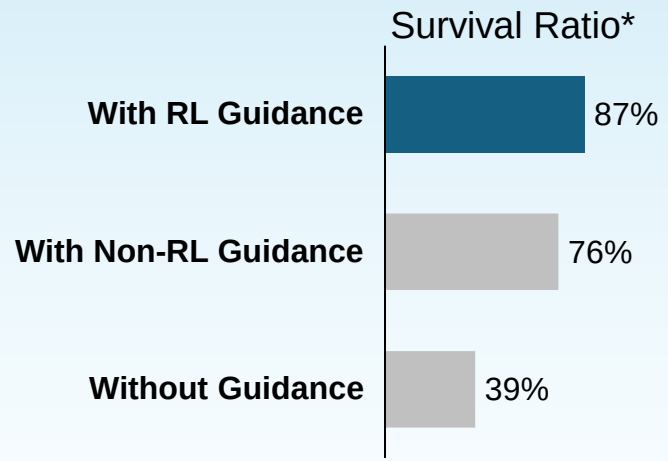
Maximize Likelihood of Successful Execution

+

Focus on Rescue Team / Drone's Execution (Routes*)

Smart Algorithm

Reinforced Learning on New Developments



* Based on results of 20 simulations for each scenario

Learning and Future Improvement

Learning

- **AI assumes a critical role in rapidly evolving circumstances**. Individuals must analyze substantial intelligence prior to making informed decisions, a task that is challenging, if not unfeasible, without AI.
- **Interaction constitutes a bottleneck in AI implementations**. Humans and other systems can process only a limited quantity of information, especially during emergencies; therefore, the exchange of information must be accurate and concise.
- **One can never be overly prudent in handling life**. AI may render ethically questionable decisions and act recklessly in disaster responses; therefore, it is imperative to incorporate a secondary AI and human authorization to guarantee the precision and ethical integrity of AI recommendations.

Roadmap for Scalability

Augment Impacts Via Expanding Use Cases

Saving more lives and helping more organizations will augment its impacts as well as verify its business outlook.

Guidance	• Integrate with **ground robots / vehicles, underwater robots**
Supply Logistics	• Send **drones and vehicles** to transport food, medicines, and other supplies
Information Sharing	• Expand channels to cover **victims, media, and victim families**
Medical Treatment	• Assist **remote treatment, information gathering & treatment preparation**.
Psychological Comfort	• Comfort yet-rescued victims to **minimize trauma**

Expand Data Sources

To support further applications enlargement

More sensor types and identification abilities functions, like camera, thermal imagery, sound

Human-provided info, like social-media, 911, hotlines

Private devices, like smart watches