

Ongoing Work: A Prototype Dataset for Low-flying Autonomous Medical UAS Operations

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Convergent Aeronautic Solutions NASA Project: <https://www.nasa.gov/directorates/armd/tacp/cas/>

Problem

Emergency medical responders have very low situational awareness of the scene before arrival

Unmanned aerial systems (UAS) can provide fast and safe scene assessment, but barriers exist to enabling these operations

2023 Co-design sessions

OUR WORK

To refine concepts, we conducted 10 co-design sessions and gathered input from 13 stakeholders (in addition to ad-hoc NASA stakeholder engagement)

Co-design
Participants:

4

Industry
Players

3

Regulation
Experts (UAS)

1

NASA
SME

1

Search &
Rescue Expert

2

Emergency
Management /
Risk Experts

3

EMS/Dispatch
Providers

Key Co-design Research

Questions:

- What is **truly ‘whitespace’** versus what is **redundant** to industry?
- Where is **industry blocked**?
 - Can't – Needs NASA Resources
 - Won't – ROI Concerns
 - Needs Guidance
- Which **needs of end-users** are not being met?
- Who are **potential partners**?
- What is the **future we want to enable**?
- What is **NASA's role**?

2023 Workshops

OUR WORK

We conducted 2 in-person workshops in 5 weeks to gather NASA stakeholder input and assess the suitability of the concepts for NASA

ANALYSIS WORKSHOP



X1 WORKSHOP



Take-aways from stakeholders

- Aerial perception engines are not currently performant
 - Lack of data from the perspective of UAS
 - Lack of data focused on emergency medical use cases

Deliverables of Aerial Aid

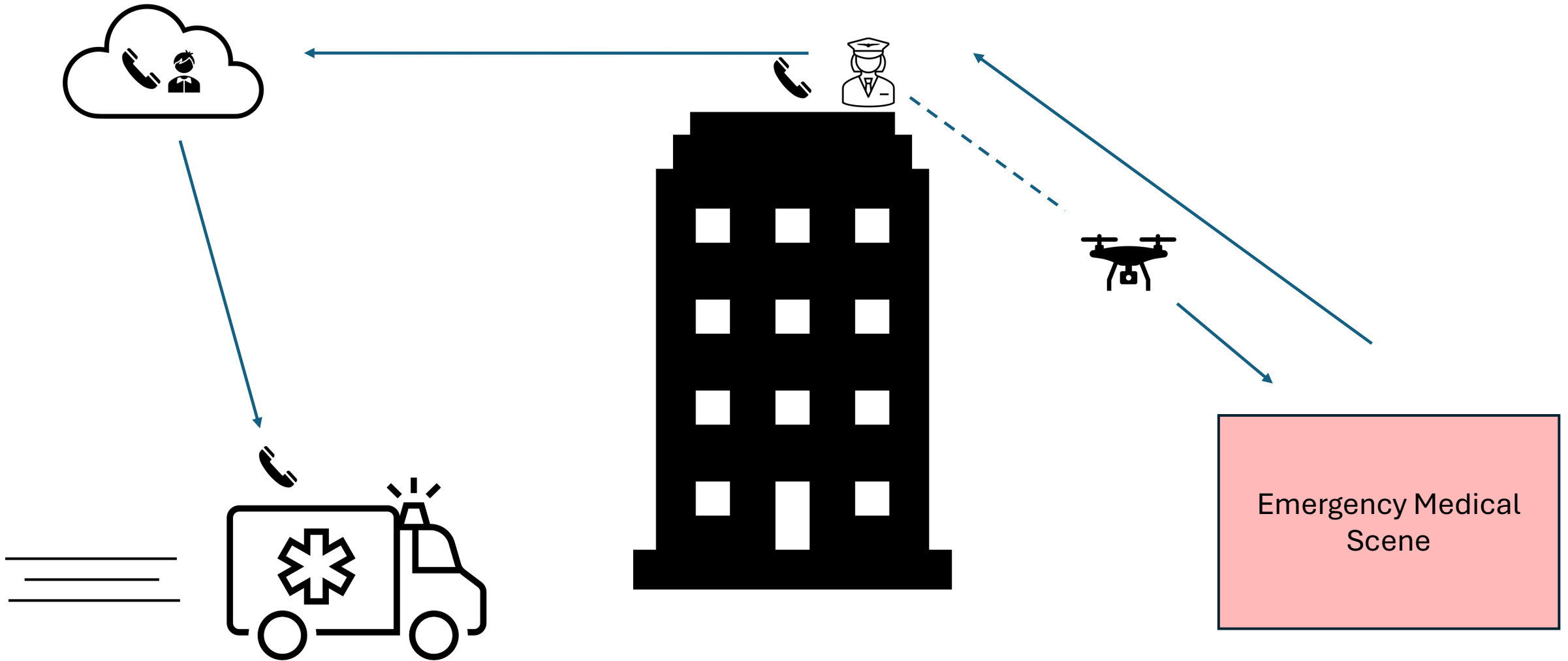
Public release of aerial training data set for medical UAS scene assessment

Feasibility demonstration on COTS model for multi-task perception

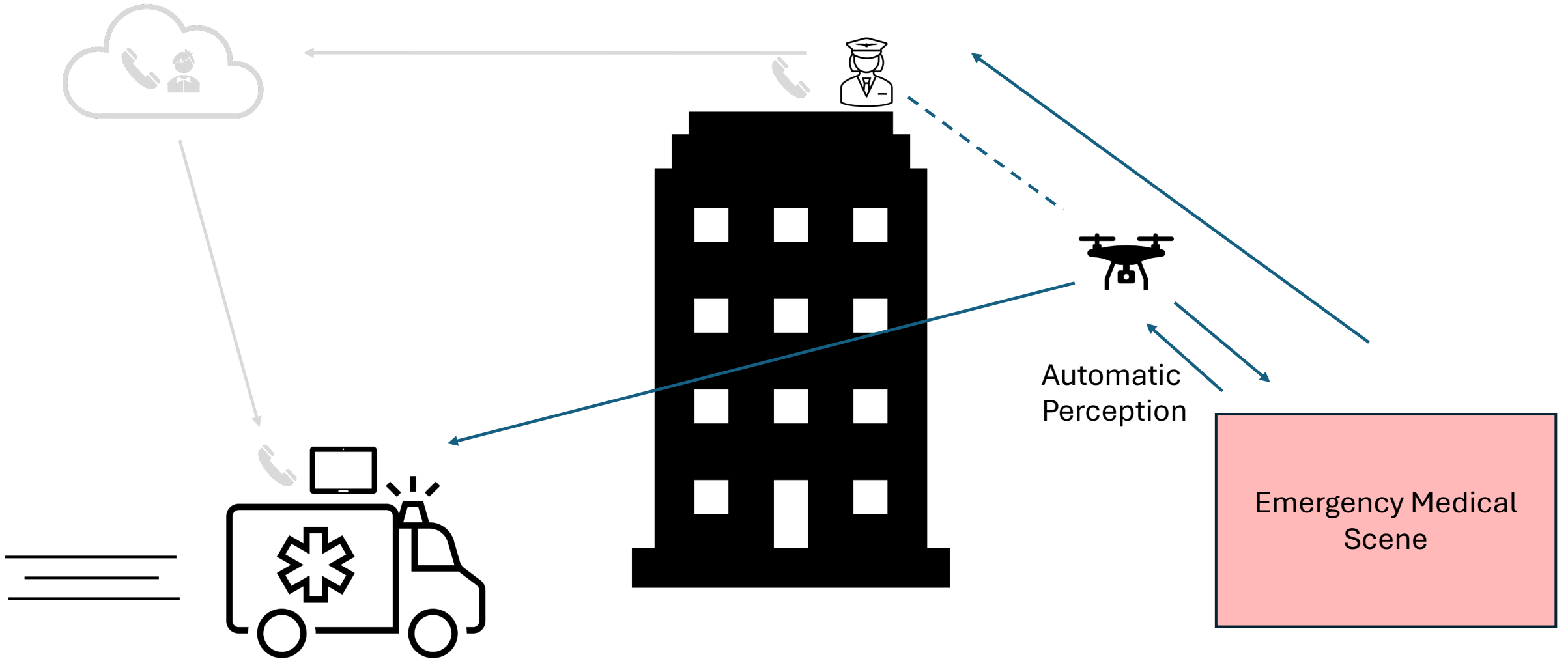
- Human stance
- Subject bounding boxes



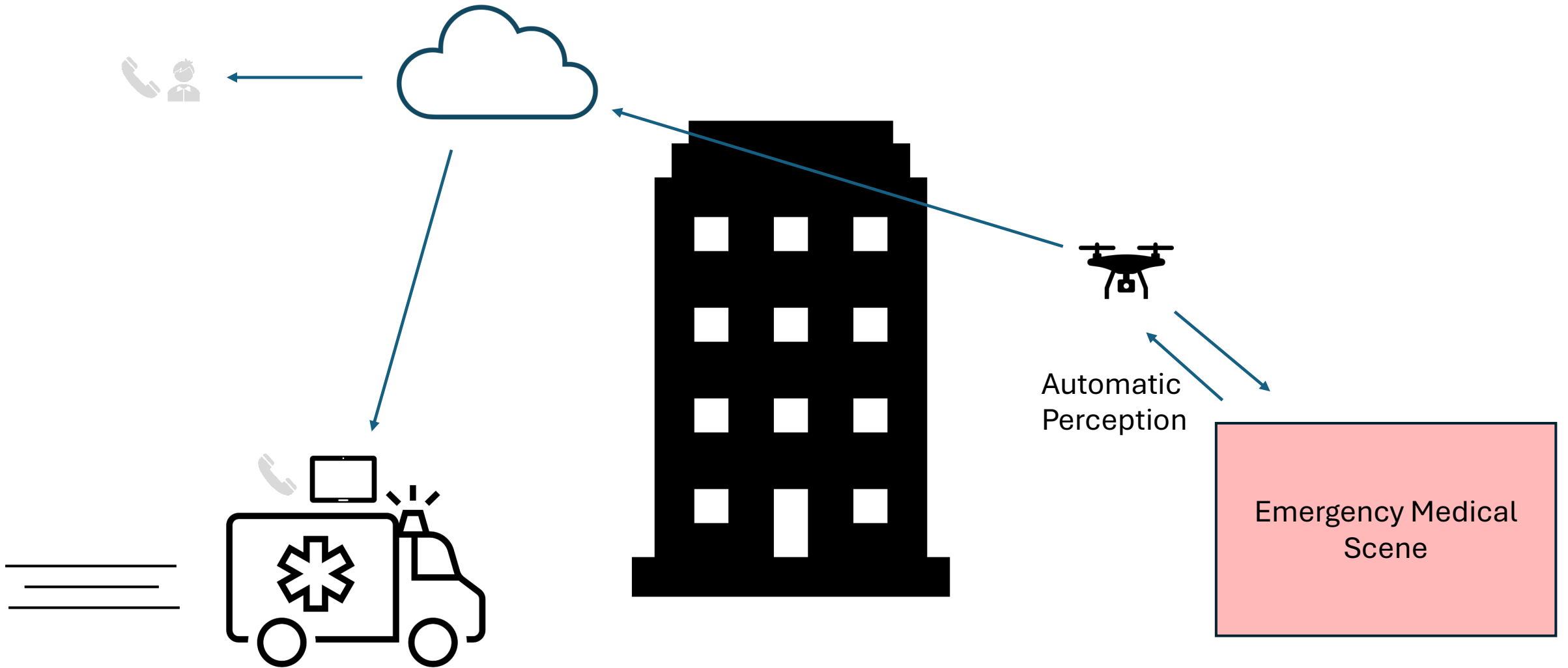
Motivation – current state



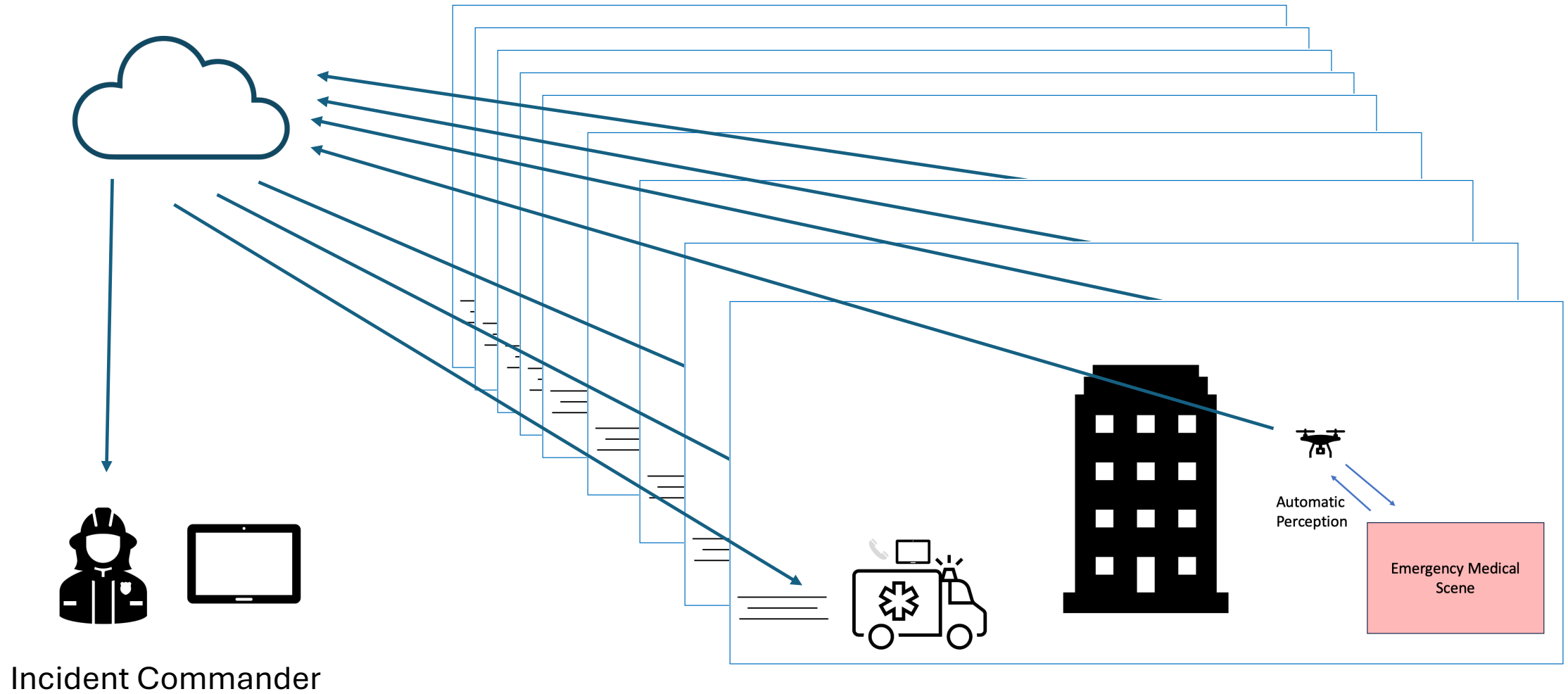
Motivation – near-term



Motivation – long term



Motivation – long term



Building a prototype dataset

- Flight dates at CERTAIN I range:

Date	Status
3/4/24	3 Flights, rain shutdown
3/07/24	5 Flight complete
3/12/24	8 Flights
3/21/24	8 Flights, 2 human participants
3/22/24	6 Flights, 2 human participants

- 30 successful flight tests!
- 318 GBs of video currently, approx. 480 mins



Four stances

Flight test scenarios



“Bike crash”



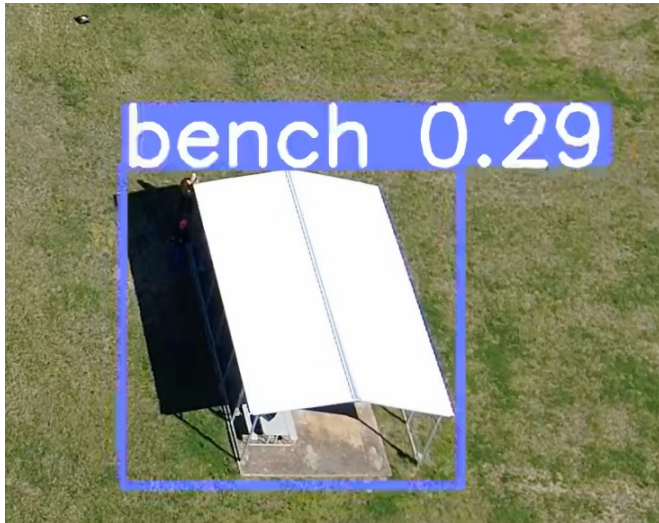
“Difficult camping”

Classification on aerial data

SOA object detection:

- YOLO: “You only look once” real-time object detection

Let's see how ‘out of the box’ YOLO works on our aerial data.



Out of the box



Retrained on human stance data

Human stance data set

- 1597 images Total
 - 1021 standing
 - 347 sitting
 - 230 laying

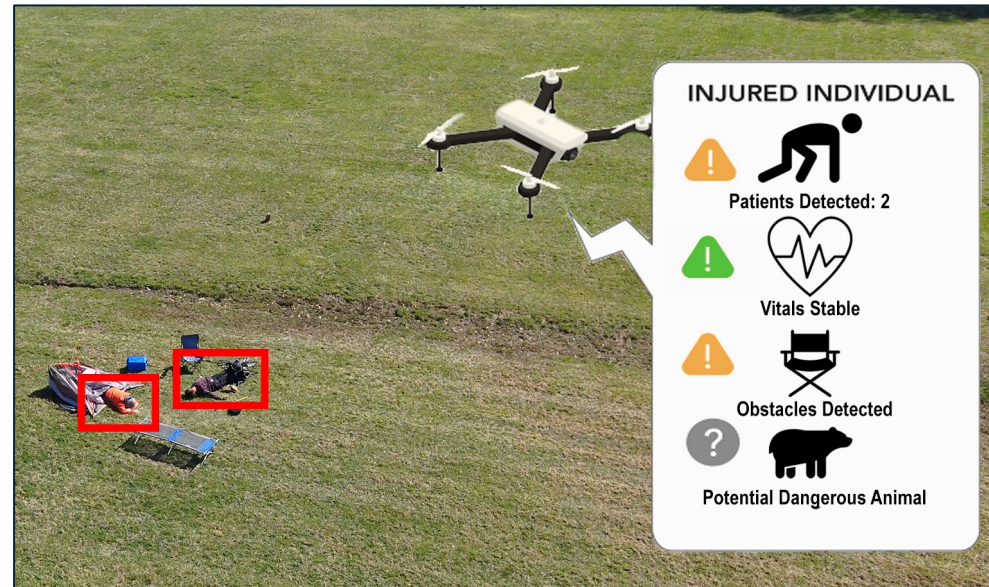
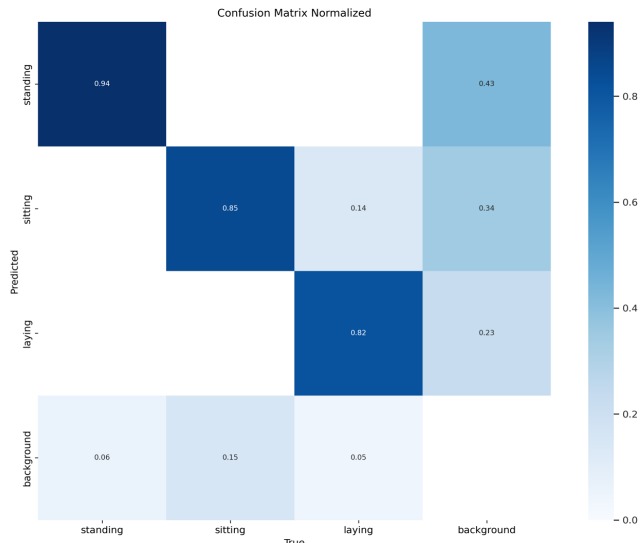
Conclusions and future work

Successful completion of:

- Preliminary data collection for medical UAS dataset
- Demonstration of feasibility in multi-task perception using COTS model trained on our data

There's still work to do!

- Exploring the cost/benefit trade-off of supplementing our data with other publicly available aerial datasets
- Investigating system-level mitigations for rapid classification changes ("thrashing")
- Implementing run-time assurance capabilities to flag unsafe behavior



Classification thrashing