



RoboScout DTC: Human–Machine Teaming for Autonomous and Intelligent Assessment in Mass Casualty Emergency Response

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RoboScout DTC Team



41 past and present members:

- 15 graduate students
- 10 undergraduate students
- 3 faculty assistants
- 5 professors
- and more!

Spanning multiple institutions in University System of Maryland:

- University of Maryland, College Park
- UAS Research and Operations Center
- University of Maryland School of Medicine

RoboScout's Performance:

- Challenge Event 1: Top University Team, 3rd Overall
- Challenge Event 2: Top University Team, 2nd Overall
- Challenge Event 3: TBD

Autonomous Robotic Triage in Mass Casualty Incidents

- Medical Triage in Mass Casualty Incidents
- DARPA Triage Challenge - Systems Competition
- RoboScout DTC - Technical Approach
- Real-world Deployment
- Conclusions and Future Directions

Medical Triage in Mass Casualty Incidents



Example of an MCI, Columbus OH, Nov'23
(The Columbus Dispatch, November 14, 2023)



Medical triage during a mass casualty incident
(DARPA, <https://www.emdocs.net/pem-playbook-mass-casualty-incident-mci/>)

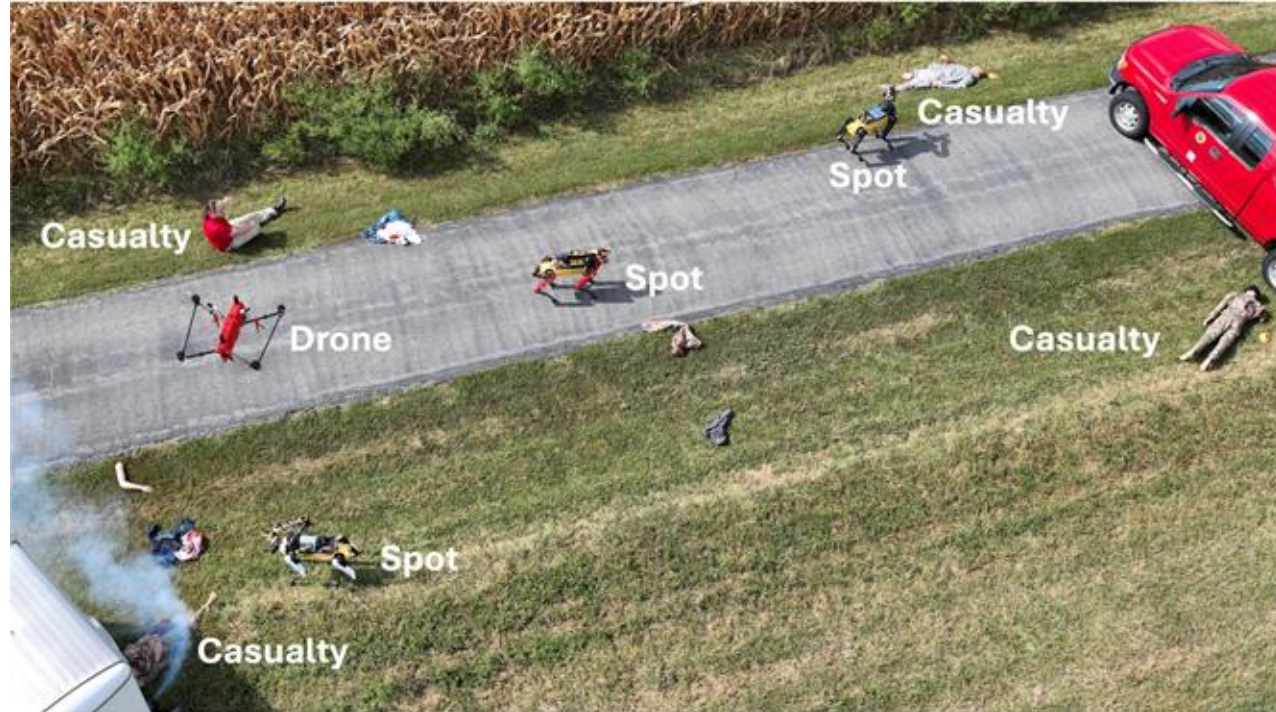
Autonomous Robotic Triage in Mass Casualty Incidents

Why employ robots?

- Faster situational awareness
- Force multiplication
- Detection of unsafe areas

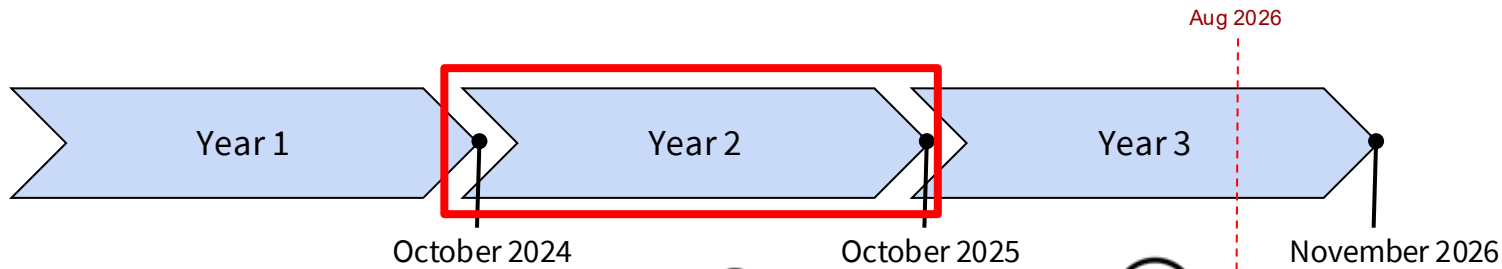
When & where their deployment makes sense?

- Unsafe environments (e.g. CBRNE)
- Big search areas
- Not experienced personnel



DARPA Triage Challenge (DTC): Systems Competition Track

The System Competition Track of the DARPA Triage Challenge aims to promote the development of non-contact robotic platforms that can assist emergency medical services in quickly and accurately performing triage of casualties during MCIs.



3-Year DARPA Challenge:

- ~10 funded and unfunded teams compete in yearly Challenge Events
- Day & night Courses per Challenge Event

Course constraints:

- 20-40 casualties
- Up to 5 aerial and/or ground robots
- 20-30 minutes
- Up to 15000 sq ft arena

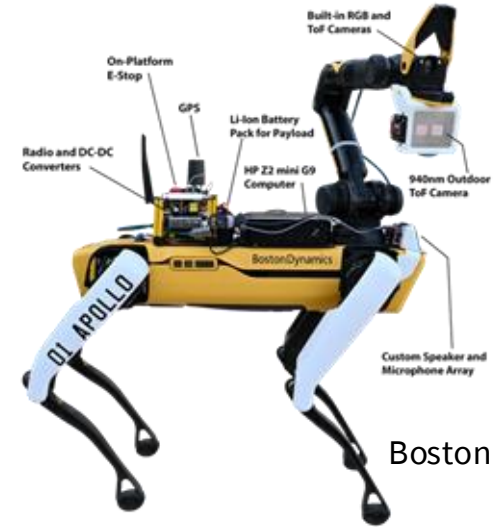


Icon credits: flaticon.com

<https://triagechallenge.darpa.mil/>

RoboScout DTC - Hardware

- HP Z2 mini G9 workstation (Intel i9-13900K CPU, an NVIDIA RTX 4000 Ada Generation GPU, and 64GB of RAM)
- Mini-OEM radio (Doodle labs)
- Emlid M2 multi-band GPS
- 4K color camera fitted with Basler blaze-101 Time-of-Flight (ToF) camera
- RØDE GO II directional microphone and ReSpeaker Array v2.0
- FLIR Boson thermal camera
- IWR6843 radar (Texas Instruments)



Boston Dynamics Spot



Chimera UAV

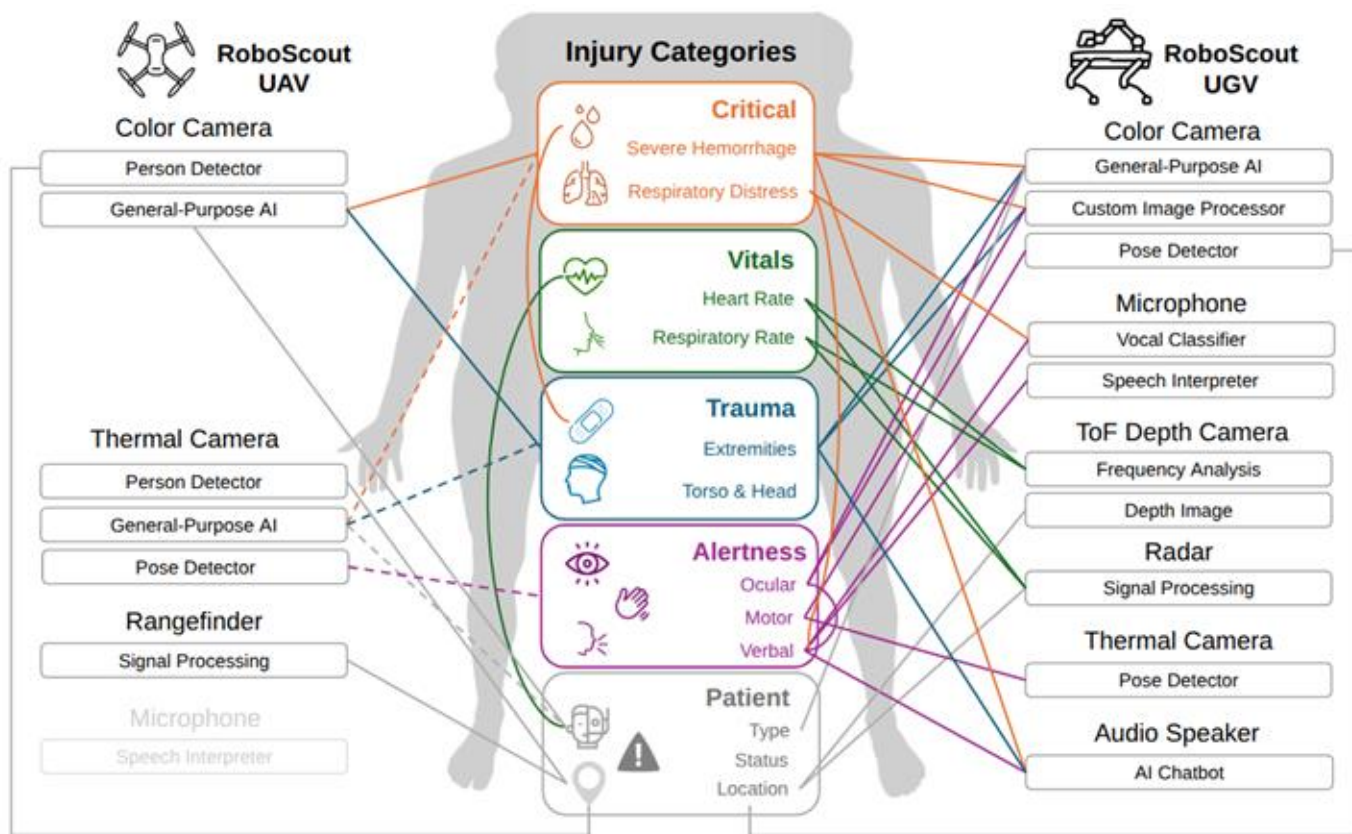
- Echopilot AI Rev 1D carrier board with Jetson Orin NX compute module and PX4 flight controller
- 2 x ARK RTK GPS
- 4K color camera
- FLIR Boson thermal camera
- Rangefinder
- Silvus Mesh Radio

Real-world Human-Machine Teaming Deployment

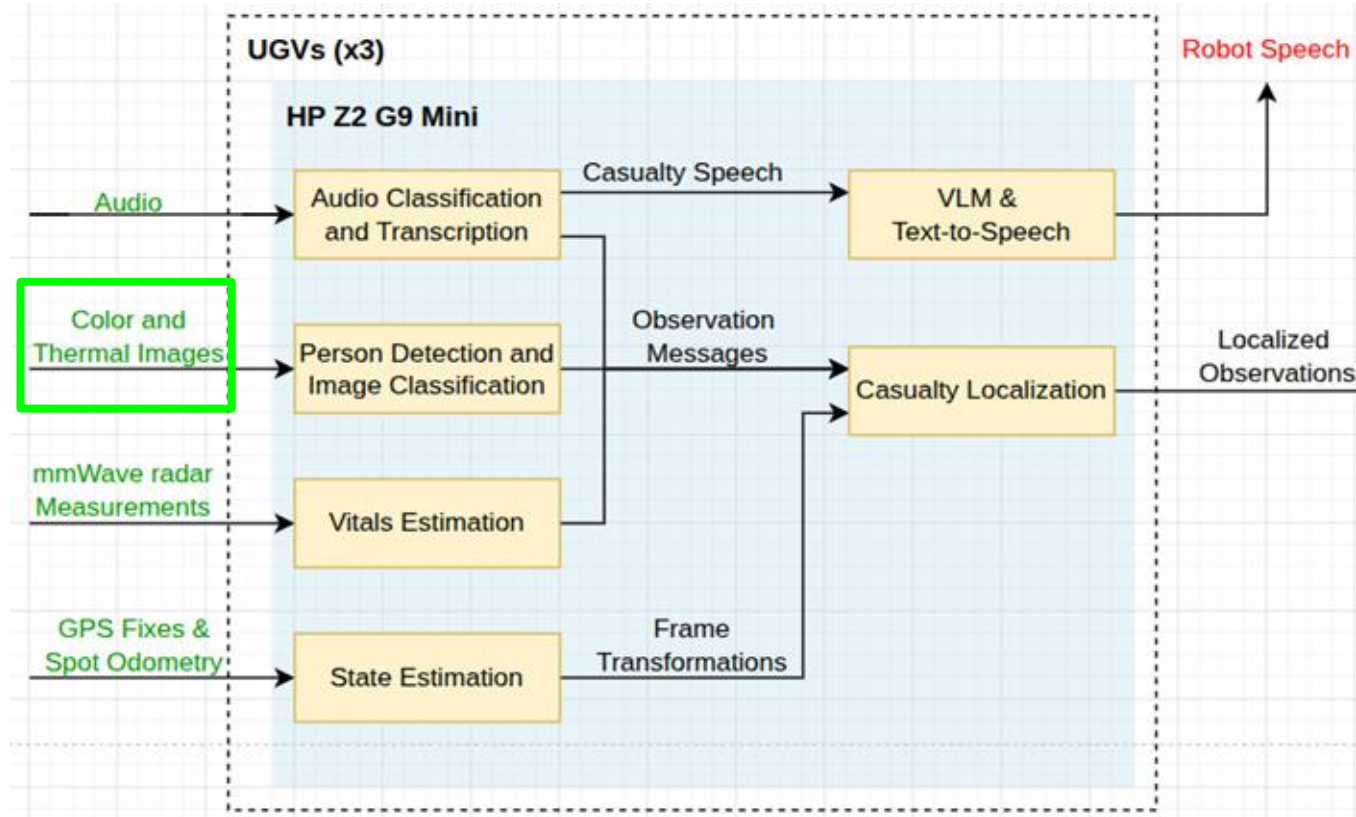


DARPAtr: Experience the DARPA Triage Challenge in 360°

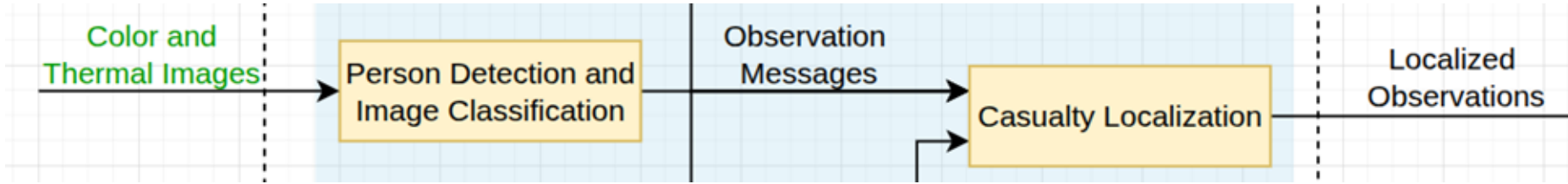
RoboScout DTC - Sensors and Inference



RoboScout DTC - Casualty Injury Estimation

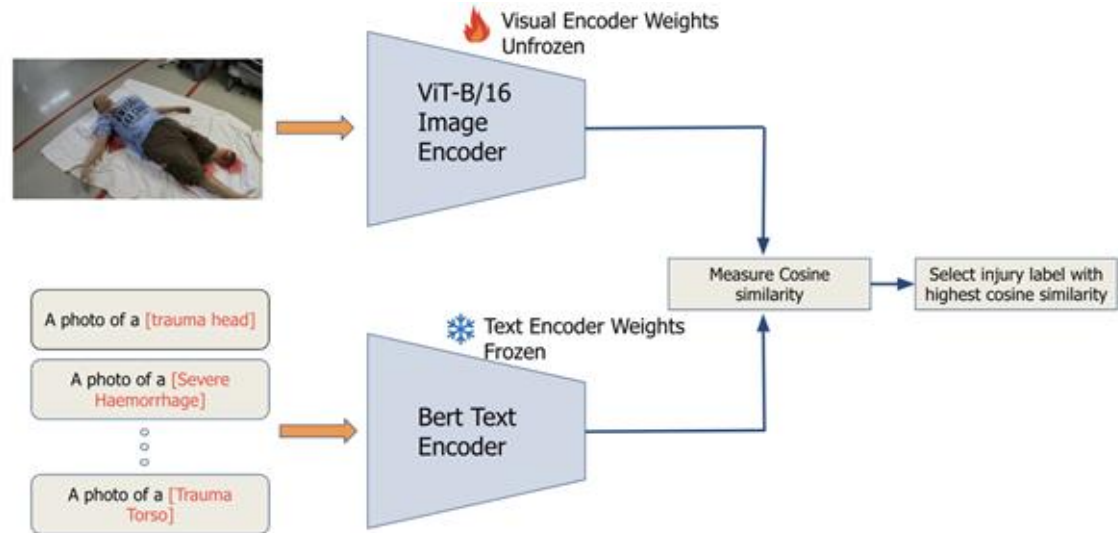


RoboScout DTC - Casualty Injury Estimation

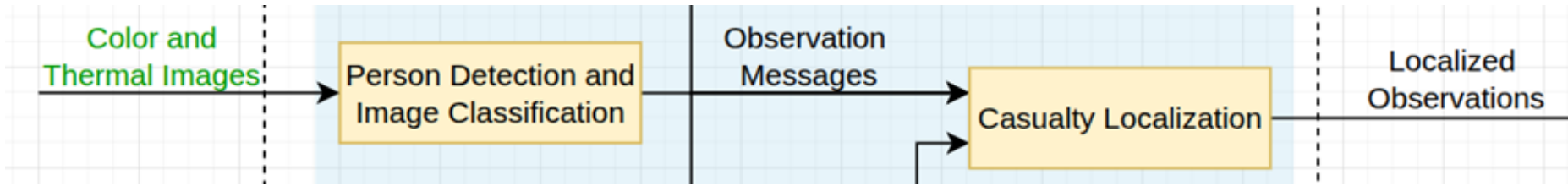


- Fine-tuned supervised classifier (CLIP)
- Zero-shot vision-language model (VLM)

Incorporating LLaVA enhances robustness by mitigating potential biases introduced during fine-tuning of CLIP.



RoboScout DTC - Casualty Injury Estimation



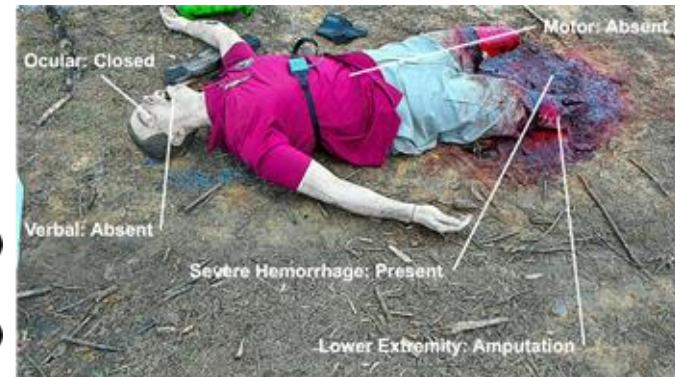
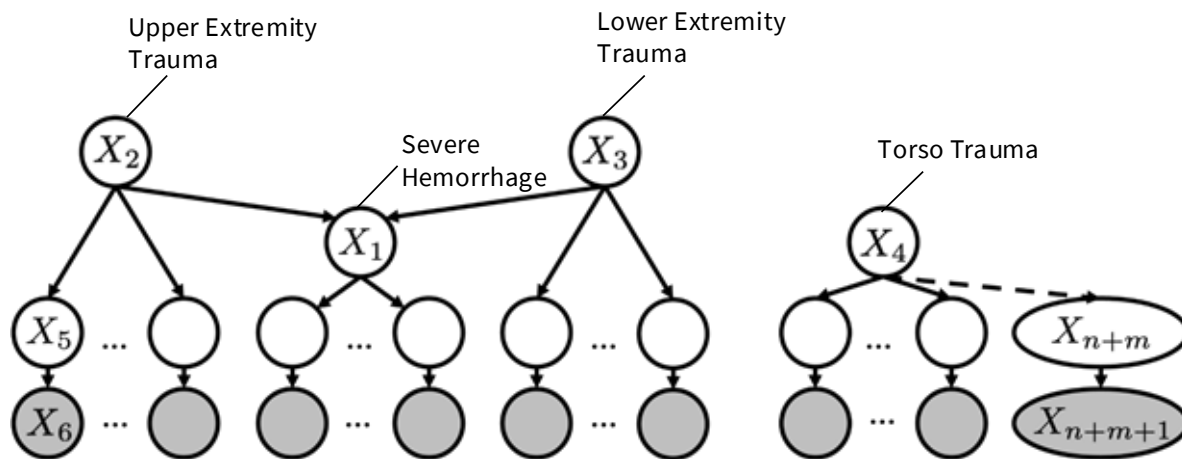
- Fine-tuned supervised classifier (CLIP)
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RoboScout DTC - Probabilistic Inference Engine

Probabilistic inference engine combines results from image and audio classification, and vital measurements. Exports triage category of casualty.



Z. Bortoff, S. Poojari, K. Baxevari, J. Gaus, C. Titus, A. Ashry, D. Paley. "Towards Distributed Robotic Casualty Assessment using Multimodal, Non-Contact Perception and Probabilistic Inference", *ICRA'26*

Real-time Injury Assessment



RoboScout DTC Medic Interface

Rain Tech's Health, Awareness, Intelligence, and Logistics (HAIL) Platform:

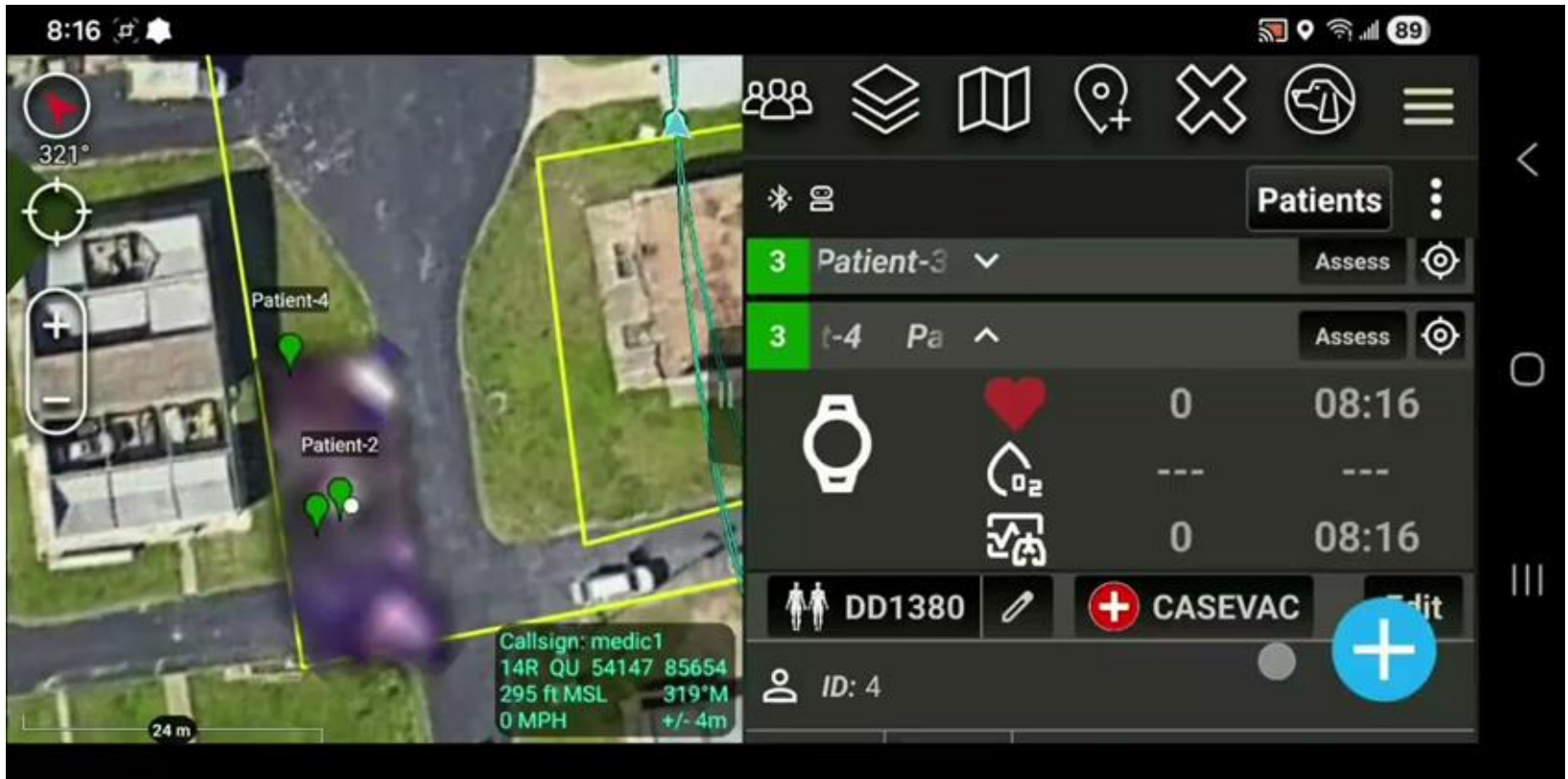
- ATAK-integrated medical situational awareness
- Sensor/Hardware agnostic
- Works over hybrid edge networks: IP radios, goTenna mesh, EVERYWHERE Comms satcom
- Peer-to-peer syncing for DDIL/edge environments

Supports:

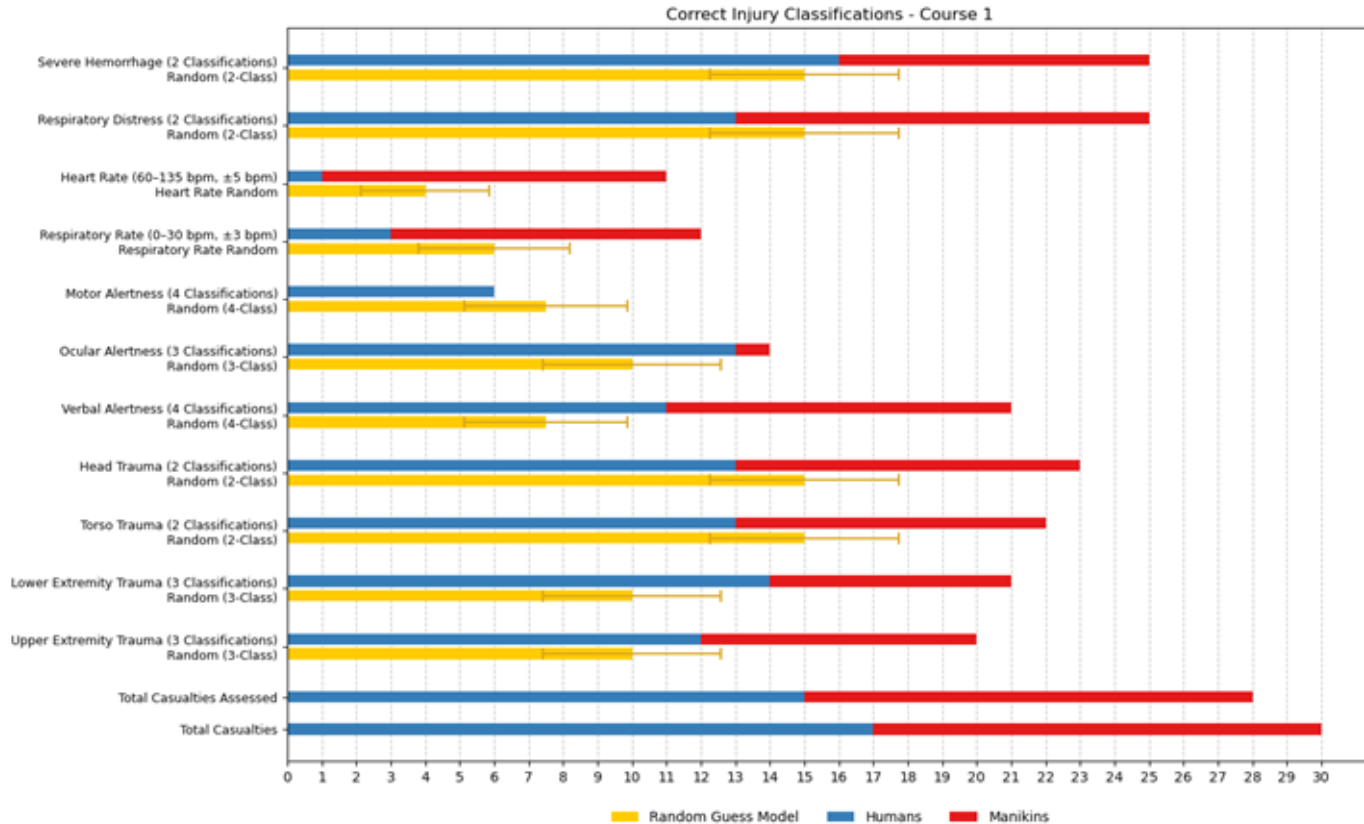
- Real-time team health monitoring and alerting
- Digitally documenting and sharing casualty care
- Digitally-aided requests for evacuation



RoboScout DTC - Medic Interface (Early Example)



DTC Challenge Event 2 - Overall Performance



Ongoing and Future Work

In preparation for DTC Challenge Event 3

- Advance UGV navigation autonomy in clustered and low-visibility environments
- Keep expanding and diversifying our training datasets to improve model accuracy
- Improve medic user interface to simplify operations on the field

Concluding Remarks

- Heterogeneous robotic fleet can be used in mass casualty incidents to detect, localize, assess and report casualties.
- RGB imagery is adequate to assess injuries during daytime, however a more broad sensor configuration is necessary for low-visibility conditions.
- Accurately presenting casualty locations and triage status on the medic interface can provide actionable insights that can potentially increase lives saved.



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Thank you

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