

EgoEMS: A High-Fidelity Multimodal Egocentric Dataset for Cognitive Assistance in Emergency Medical Services

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Overview

- Emergency Medical First Responders and Firefighters Have Access to Substantial Amount of Data at the Incident Scene
 - Cognitive Assistance Requires Understanding Activities of Responders from their Perspective
 - Egocentric view and multimodal data provide rich information for a cognitive assistant to understand, provide feedback and guidance
- EgoEMS: First Egocentric Multimodal Dataset for EMS Procedures with over 20 hours of data
 - Simulated High-Fidelity Emergency Scenarios
 - Realistic emergency scenarios *performed by actual responders* with diverse EMS certification and expertise levels
 - Open-source Data Collection System
 - Easily replicable low-cost multimodal data collection system
 - Multitude of Annotations
 - Fine-grained activity annotations with synchronized speaker-diarized transcripts, and CPR quality ground truth.
 - Benchmarks
 - 3 main benchmarks highlighting cognitive assistants' potential tasks

Dataset

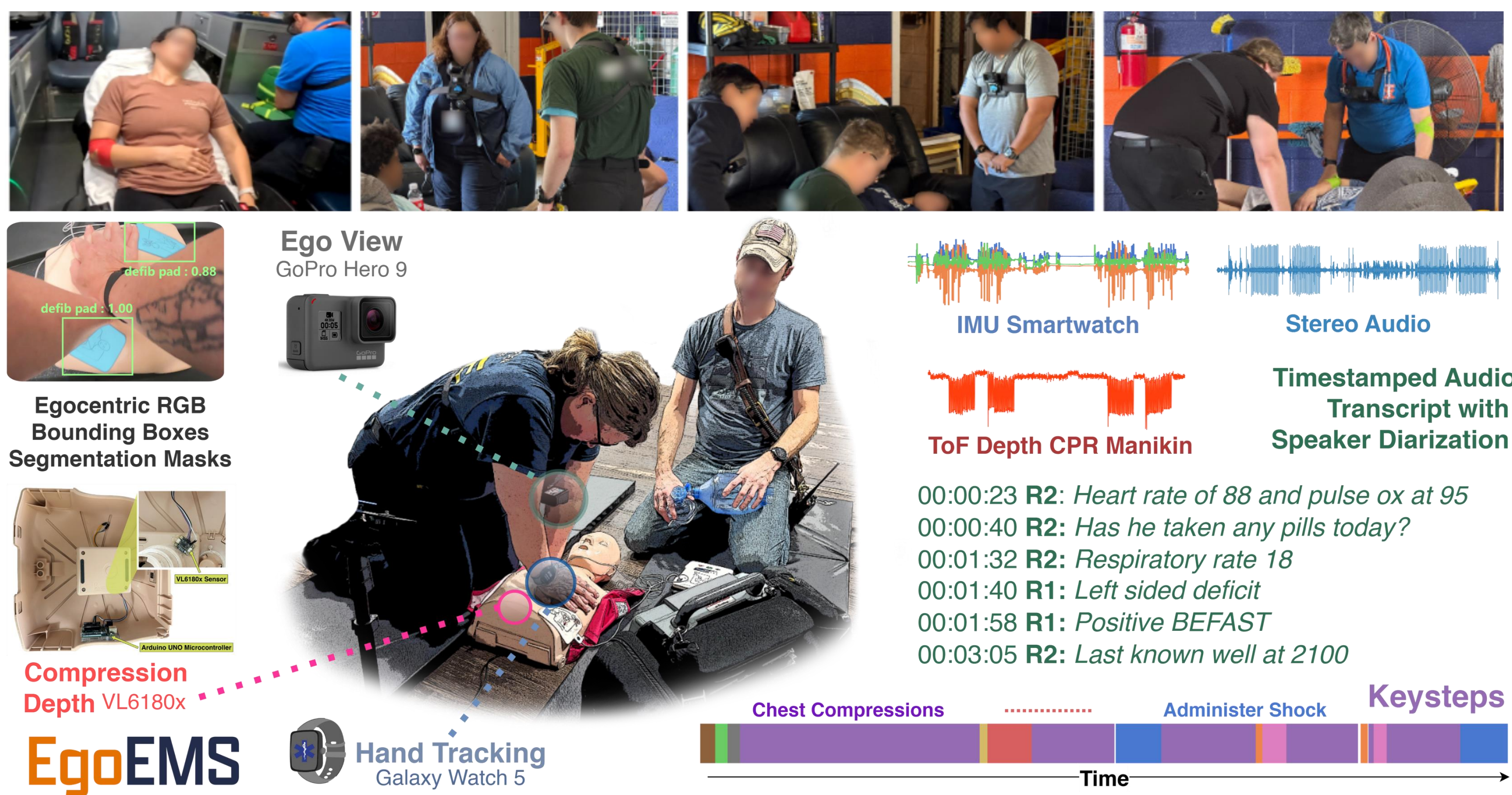


Figure 1: High-level Overview of EgoEMS Egocentric Multimodal Dataset

EgoEMS Scenarios & Taxonomy

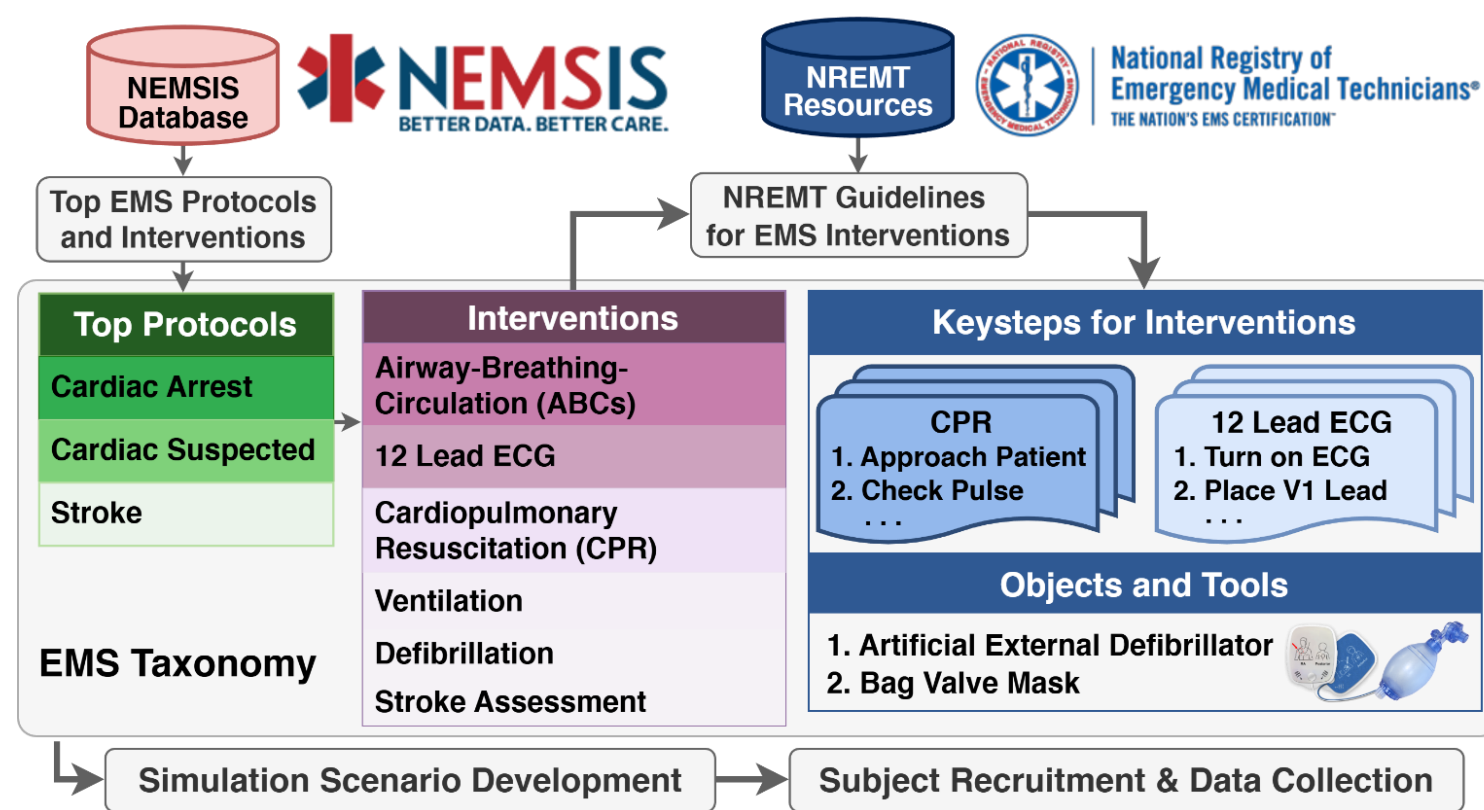


Figure 2: Methodology behind the Taxonomy

Open-source Multimodal Data Collection System

- Egocentric Video & Audio
 - GoPros remotely controlled
- Hand Movements
 - Smartwatch IMU data
- CPR Ground Truth
 - Compression rate and depth
 - Custom low-cost hardware (ToF)

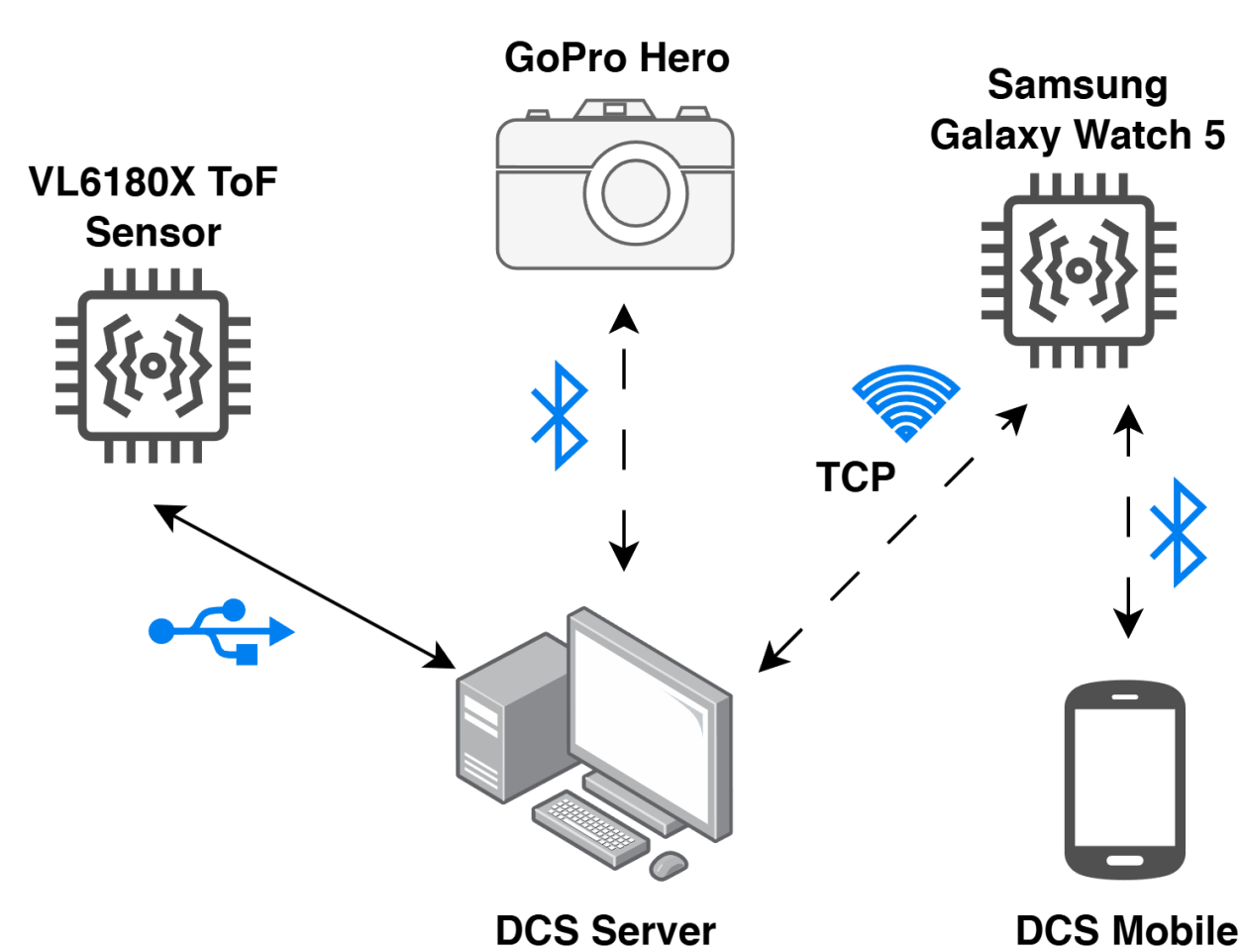


Figure 5: High-level Architecture of the Data Collection System

Annotations

- 67 Keysteps covering 9 Interventions
- CPR Compression Ground Truth
- Object Bounding Boxes for Key Medical Objects
- Speaker Diarized Timestamped Transcripts

AI-Assisted De-identification Pipeline for Privacy Preservation

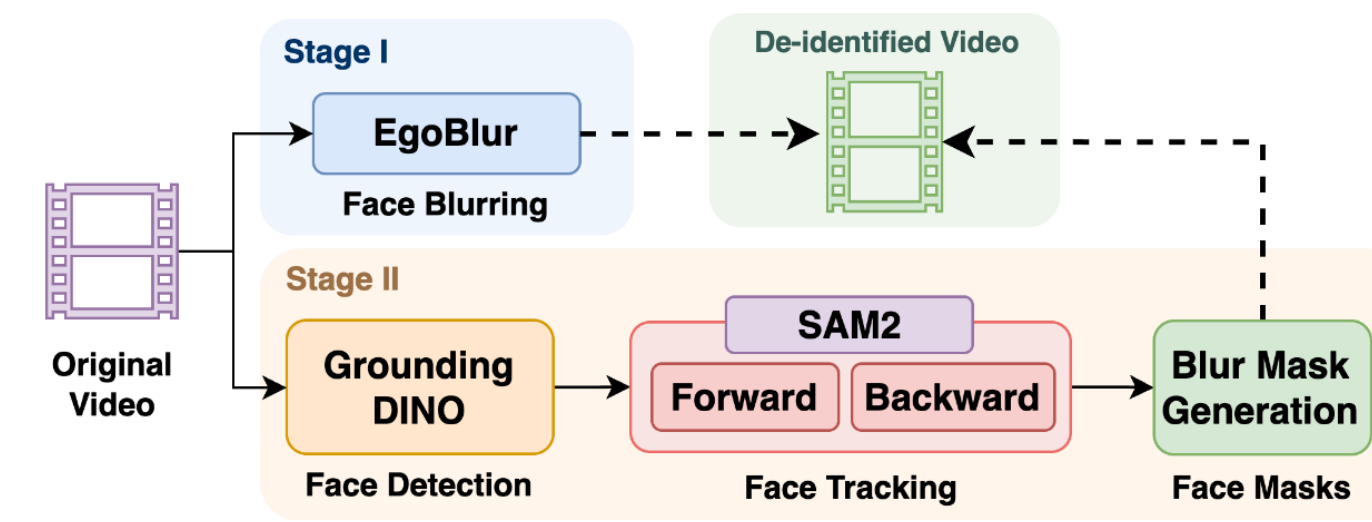


Figure 3: AI-based Video De-identification Pipeline

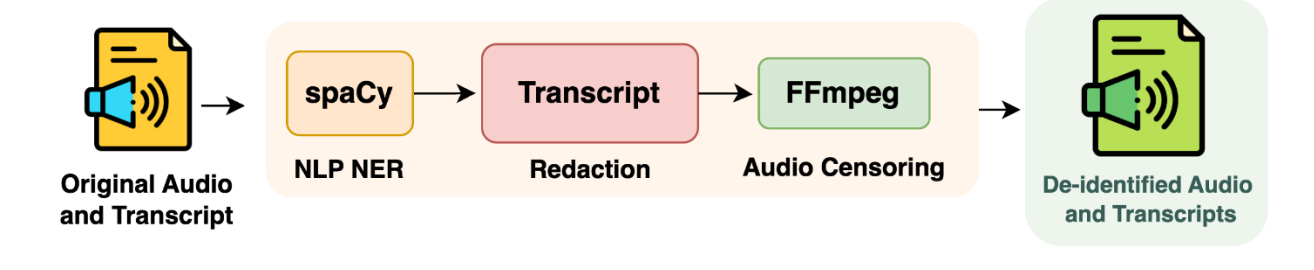


Figure 4: Automated Audio De-identification Pipeline

- Semi-automatic Video De-identification for Faces, License Plates and ID Cards
- Automated Audio Censoring of Identifying information

Benchmarks

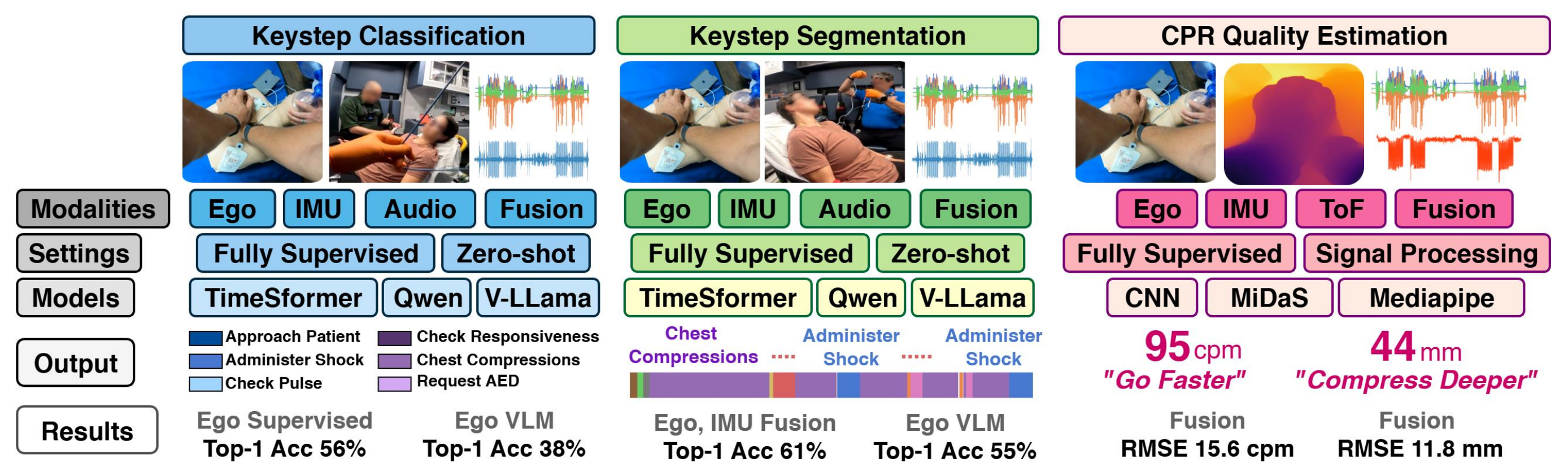


Figure 6: Overview of Main Benchmarks

- Keystep Classification
 - Classify EMS procedural keysteps from multimodal data segment
- Keystep Segmentation
 - Online recognition of keystone and boundaries in streaming data
- CPR Quality Estimation
 - Online recognition of compression rate and depth to provide feedback

Experimental Results

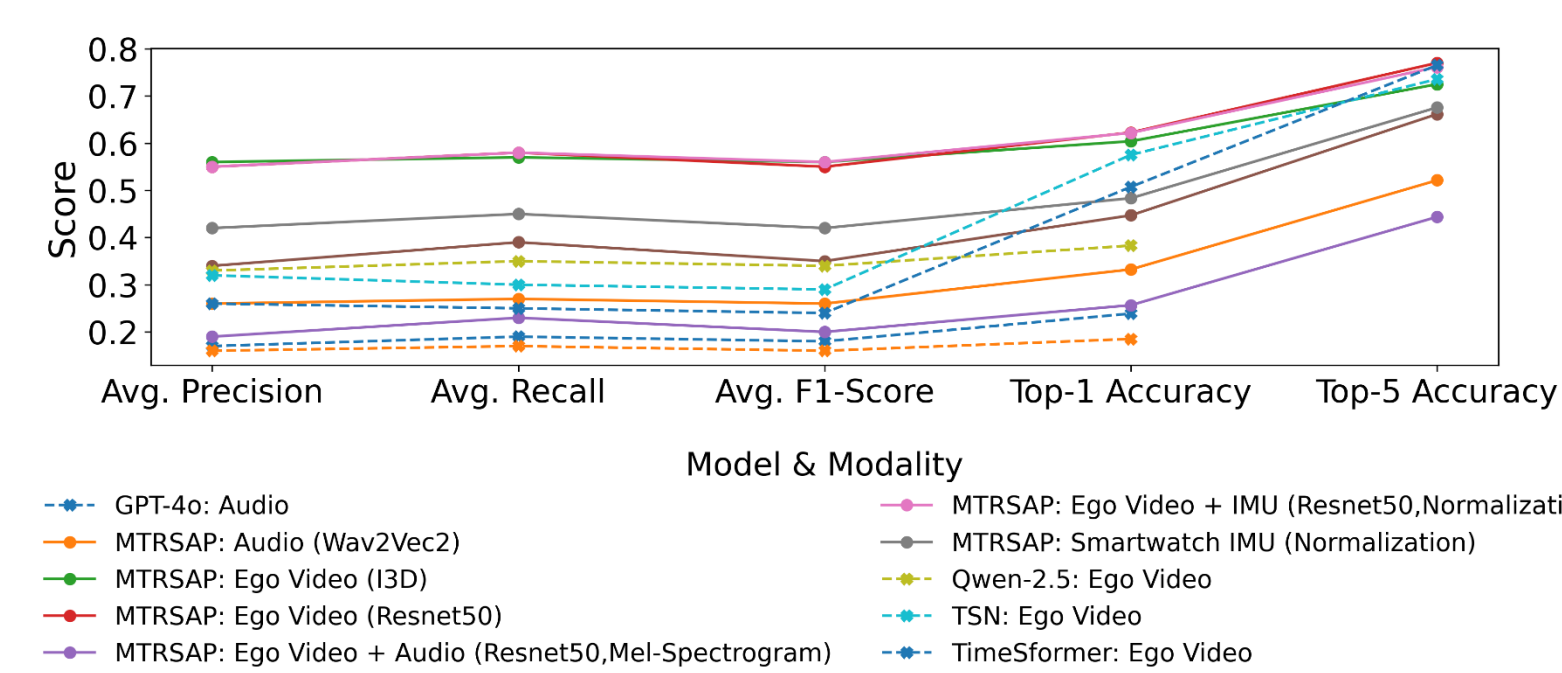


Figure 7: Keystep Classification Performance

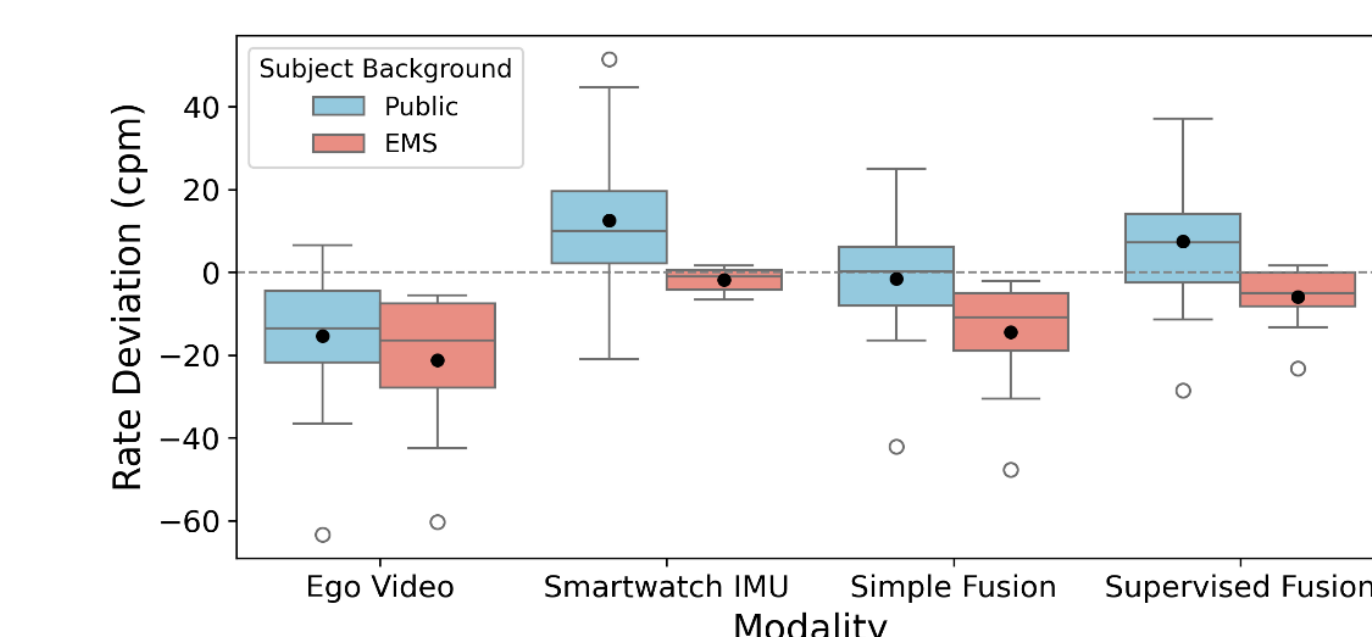


Figure 9: CPR Rate Detection Performance

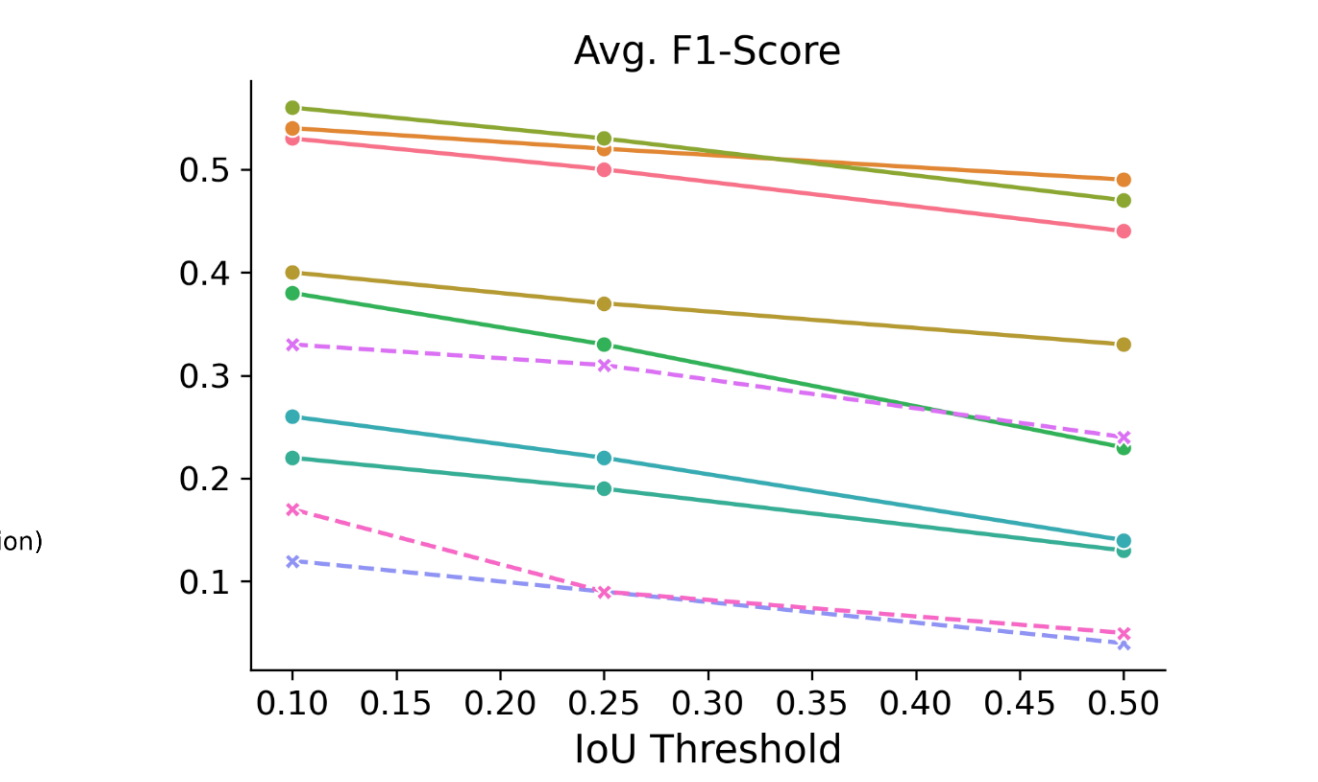


Figure 8: Keystep Segmentation Performance

Metric	Fully manual	Semi-supervised
Time (hrs)	66*	1
IoU (↑)	0.76	0.76
Center difference % (↓)	11.67	2.18
Width difference % (↓)	2.18	5.24
Height difference % (↓)	5.24	

Figure 10: Semi-automatic Object Detection Pipeline Accuracy

Future Work

- Improving Real-time Keystep Recognition Using Multimodal Data
 - Current SOTA methods lack sufficient performance for reliable cognitive assistance
- Multi-person Activity Recognition
 - Extend activity recognition to multi-person, role-aware settings using multimodal (vision-audio) cues

Public Safety Partnerships



Acknowledgements

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EgoEMS