Towards Cognitive Assistant Systems for Emergency Response

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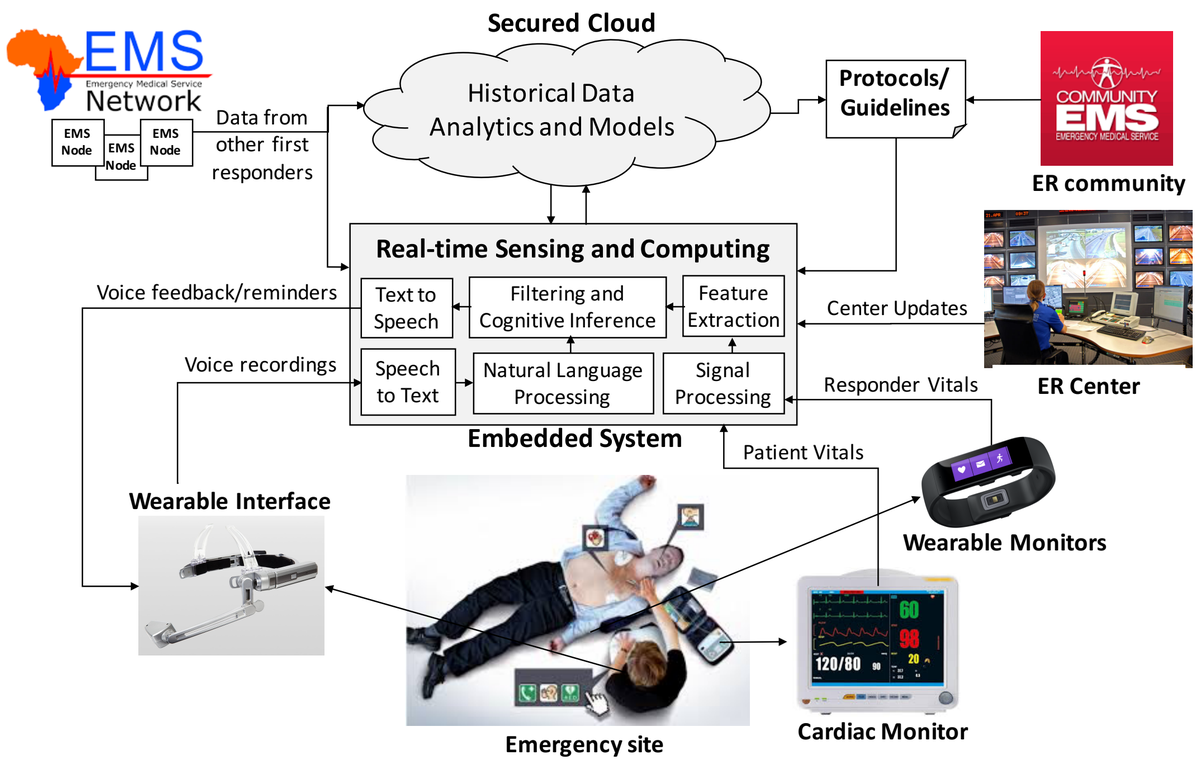
MOTIVATION

- **Emergency medical first responders and firefighters have access to substantial amount of data at the incident scene:**
  - Observations and communications with the center/other responders
  - Sensor data from wearables, mobile, and IoT devices
  - Physiological data from patient monitors and medical devices
- **Challenges in Analysis of Emergency Response Data**
  - **Making sense of substantial amount of data:**
    - Inaccuracies and incompleteness of manually collected data
  - **Cognitive overload:**
    - Significant human cognitive effort required for manual interpretation and logging of data at the incident scene, which could be better used to assess most effective response actions.
  - **Resiliency:**
    - Disconnections due to poor network connectivity or equipment faults may compromise first responder decision making and response.

OBJECTIVES

- **Get the right data, at the right time, to the right person**
  - Real-time collection and analysis of data from incident scene
  - Aggregation of in-situ and public data, e.g., video, audio, social media
  - Providing dynamic data-driven feedback on effective response actions
- **Develop a cognitive assistant system for emergency response**
  - Resilient data analytics
  - Anytime real-time sensing and computing

PROPOSED SYSTEM



Resilient Data Analytics

- Incident Data Collection and Summarization
  - Speech to Text Recognition
  - Natural Language Processing (NLP)
  - Event Filtering and Synchronization
- Cognitive Inference and Assistance
  - Modeling Protocol Guidelines and Knowledge Sources
  - Conflict Resolution
  - Text to Speech Reminders

Real-time Sensing and Computing

- Embedded Architecture for Real-time Data Analytics
- Dynamic Reconfiguration for Resiliency

MAJOR MILESTONES

Task1	**Resilient Data Analytics Algorithms**
T1.1	Develop labeled data sets of EMS incident reports and a target set of EMS protocol guidelines.
T1.2	Design and validation of a framework for modeling and execution of EMS protocol guidelines.
T1.3	Develop speech-to-text recognition and text-to-speech features to target EMS first responder tasks and context.
T1.4	Develop the lexicon of EMS concepts and design NLP algorithms for incident narrative summarization and conflict detection.
T1.5	Integrate the data analytics components and evaluate the performance of cognitive assistant software.
Task 2	**Embedded System for Real-time Sensing & Computing**
T2.1	Design and test the embedded architecture executing real-time data analytics developed in Task 1.
T2.2	Design the monitoring mechanisms for detection of failures and dynamic reconfiguration of computing resources.
Task 3	**Evaluation of System Performance and Resiliency**
T3.1	Develop the testbed by integrating embedded device with a private cloud platform and workload and failure simulators.
T3.2	Evaluate the resiliency and performance of the system in the lab settings using the testbed.
T3.3	Evaluate the prototype system in simulated EMS training scenarios involving first responders.

EXPECTED IMPACT

- **Facilitate automated collection and summarization of EMS data**
- **Reduce stress, increase situational awareness and safety**
- **Enhance EMS training modules and environments**
  - Training first responders in remote rural areas
  - Identifying most effective response actions
  - Assessing performance in simulated scenarios and real operations
- **Provide a powerful bridge to support response to rare mass casualty incidents (MCI)**

PUBLIC SAFETY PARTNERSHIPS

North Garden Fire Department

VDH Virginia Department of Health — Protecting You and Your Environment — www.vdh.virginia.gov

Office of Emergency Medical Services

Thomas Jefferson EMS Council (TJEMS)

References

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- A. Mondol, et al., “MedRem: An Interactive Medication Reminder and Tracking System on Wrist Devices,” *Wireless Health*, Oct. 2016.
- S. Preum, A. Mondol, M. Ma, H.Wang, and J. Stankovic, PreCluDe: Conflict Detection in Textual Health Advice, *Percom* 2017, March 2017.