Counter Improvised Explosive Device System with Pattern Recognition and Human in the Loop

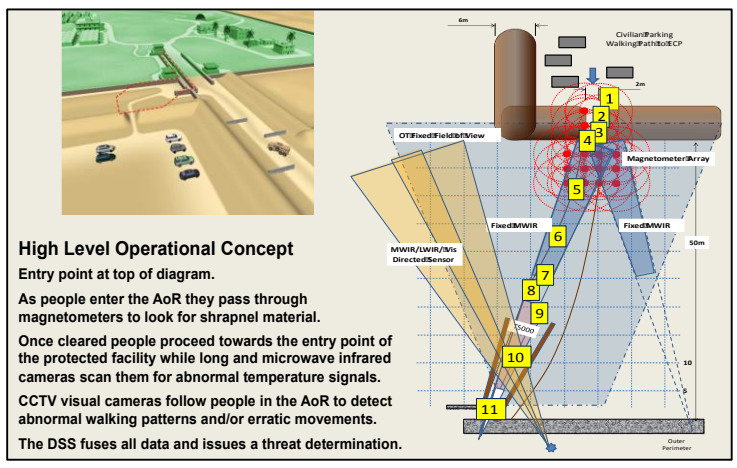
Jorge Buenfil, Ph.D. Student, ARDEC

Research Task / Overview

- Investigate ways to insert artificial intelligence into traditional systems.
- Develop effective pattern analysis for the detection targets to quickly recognize their presence.
- Enable machine learning to further refine the pattern analysis to recognize previousy unknown classes of targets.
- Investigate how to engage human operators so that they do not lose focus on the task and are quick to respond to emergencies.

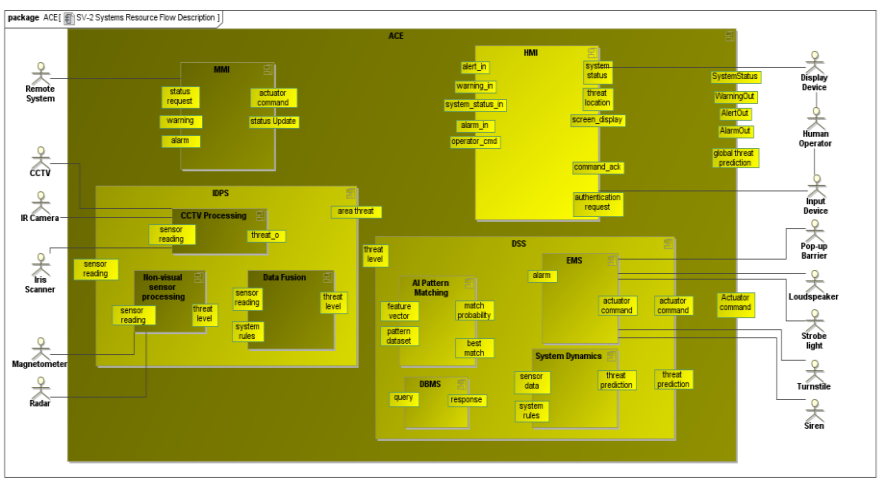
Goals & Objectives

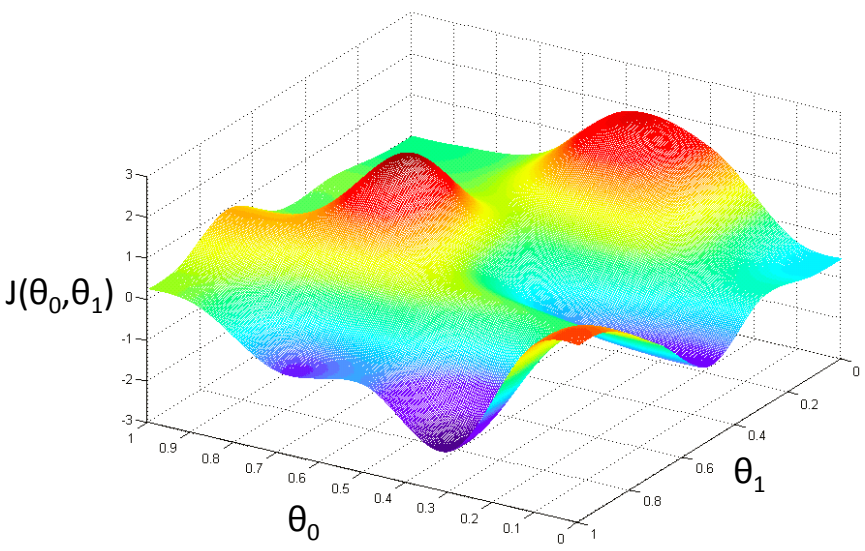
- Improve IED interdiction/mitigation
- Reduce manpower requirements
- Enable linking of individual systems for wide-area monitoring



Data & Analysis

- Sensor data from multiple sensor platforms is continuously analyzed to match signal patterns.
- Target features are evaluated independently first, then correlated to obtain a full evaluation of probability of presence of target.
- Dynamic systems models provide temporal context to instantaneous data analysis.
- Thresholds determine whether warning or alarms are warranted by the data analysis.
- Close matches are sent for confirmation to a human operator to implement supervised learning.





Methodology

- Determine most significant features of target devices.
- Create a feature vector to represen device signatures.
- Train pattern database with known device signatures to populate feature vectors.
- Validate pattern database with a separate set of training samples.
- Apply Normal Equation to produce a multivariate regression formula to fit the target signatures in the database.
- Evaluate new sensor data to determine match to a particular target signature.
- Compare result to thresholds for supervision/warning/alarm.
- Communicate and take action.

Future Research

- Generalization of methodology to apply to other domains, such as air traffic control, submarine area denial, ballistic defense, cyber defense, etc.
- Addition of non-supervised learning abilities.

Contacts/References

Researcher:
Jorge R. Buenfil
Systems Engineering Directorate
U.S. Army Armament Research, Development and Engineering Center (ARDEC)
Jorge.R.Buenfil.civ@mail.mil