A Virtual Assistant for Space Situational Awareness

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INTRODUCTION

Virtual assistants such as Alexa/Siri are now routinely used for everyday tasks.

The objective of our work is to design and develop a **virtual assistant for space situational awareness (VIRSA)** to support command and control decision-making during space operations.

VIRSA is a domain-specific assistant that leverages existing artificial intelligence techniques to perform tasks that are time-sensitive, data-intensive, recurring, or otherwise challenging.

BACKGROUND – DARPA HALLMARK PROGRAM

"DARPA's Hallmark program seeks to develop revolutionary tools and technologies to plan, assess, and execute U.S. military operations in space"[1]

Phase I: Testbed & Tool Development and Evaluation

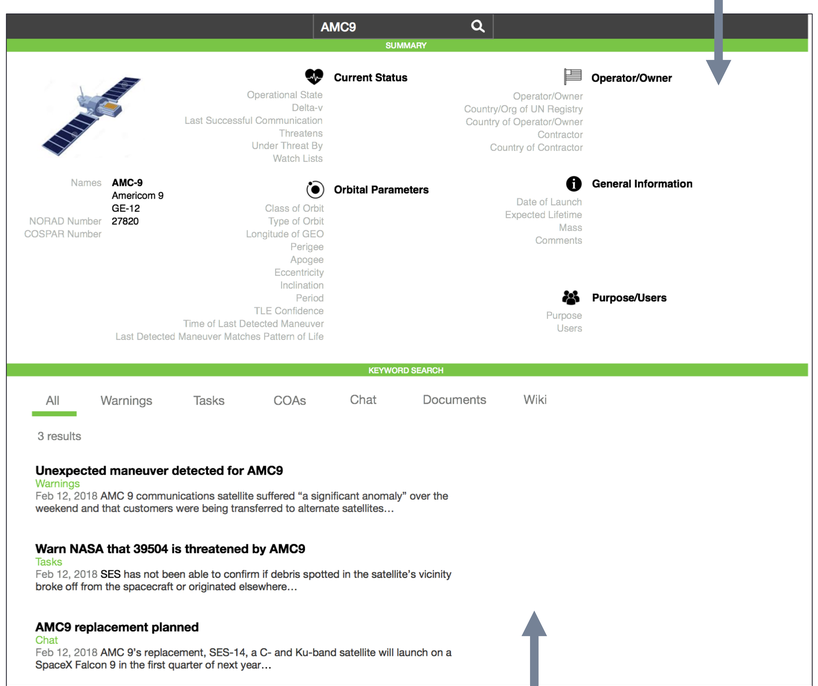
- Different teams developed ten **tools** (including VIRSA) that visualize and analyze data to support decision-making during space operations.
- Two **testbeds** use different technology stacks and APIs to support running scenarios, access to data, deploying tools, and communication between tools.
- Testbeds paired with a **cognitive evaluation** team measure performance and guide future work.
- **Evaluation events** allow operations personnel to test the environment, using the tools and data provided to make real-time decisions during scenarios.

[1]www.darpa.mil/news-events/2018-01-09a

INITIAL FEATURE SELECTION

1. Generated list of candidate features from stakeholder documents.
2. Held interdisciplinary design session to prioritize features for feasibility and impact.
3. Reached consensus on two highest ranked features.

RSO Summary: at-a-glance summary of key information about a resident space object. Operators can use this information to quickly assess a situation, solve problems in the face of unexpected events, dynamically re-plan, and anticipate implications of potential courses of action.



Keyword Search: addresses the need to perform efficient searches across many tools and data sources (currently a pain point for operators).

FUTURE WORK

Answer questions and perform tasks:

- What RSOs could support tasks assigned to AMC-9?
- Add 42063 to the HVA watchlist.
- Show the checklist for a missed maneuver warning.
- Find existing COAs relevant to the most recent warning.
- How do I perform a reachability analysis?

Perform dynamic filtering:

- Show all USAF missile defense sats in GEO.
- What ground assets can view TDRS-12 right now?
- What RSOs can the Guam ground station see?
- What asset is scheduled to view TDRS-12 next?
- What RSOs were in the vicinity of TDRS-12 since the last successful communication?

Automatically respond to anomalies:

- Perform diagnostic investigation based on the anomaly information and summarize results.
- Search for replacement assets when an RSO is found to be non-mission capable.
- Prompt user to investigate pre-identified workflow questions when warnings are received.

CONCLUSION

VIRSA illustrates how existing techniques can be applied to create virtual assistants for complex domains such as space operations.

- An important first step in designing VIRSA was to identify the highest impact features to develop.
- During the course of development and evaluation, additional features were identified to be pursued in Phase II of the DARPA Hallmark Program.

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