Why did the Robot do That? What will the Robot do Next?

The DoD, federal agencies, and industry are increasingly using robots in important tasks such as search and rescue operations. However, because robot behaviors can be hard to distinguish and understand, users mistrust and often abandon these very useful tools.

Automatic explanations of robot behavior increases users' trust and assurance of the robots.

Automatic explanations of robot behavior, presented in human understandable ways, improve users' understanding, trust, and acceptance of autonomous robots.

Proactive adaptation of robot behavior during execution may enable users to accurately predict what the robot will do next.

Improving the users' ability to understand what a robot will do next increases neglect tolerance – the length of time that users are willing to look away from their robots before they proactively monitor them again. Neglect tolerance is widely used as a measure of trust in robots.

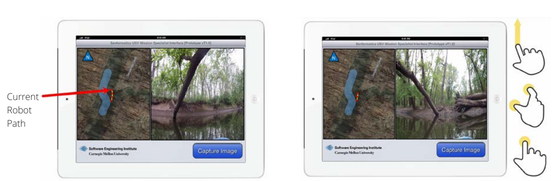
Trust-augmented specialized robot control interfaces improve trust in the system and self-efficacy for the user.

By adding additional information in the mission control interface, such as previous locations, points of interest, and navigational information, users report higher trust and confidence that they can complete the mission.

Improving the trust in autonomous systems is necessary to take advantage of advanced capabilities and become true battlefield force multipliers.

Trust in autonomy is vital to the long term adoption and success of human-robot teams on the battlefield.

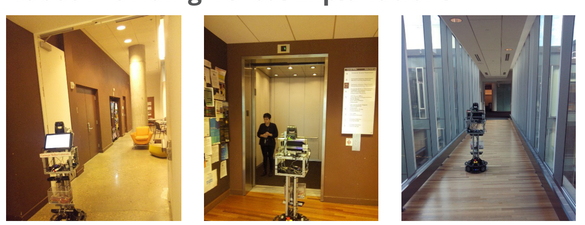
Human Robot Teaming for Unmanned Surface Vehicles



It is hypothesized that users will report greater trust in the robot boat for search tasks.

Users interact with the interface through touch, and the prior path knowledge may aid trust.

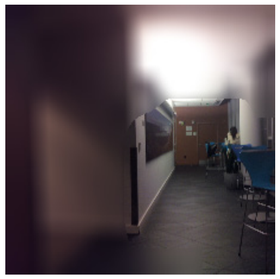
Robot Providing Verbal Explanations



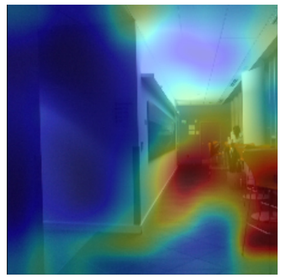
Explanation 1: *"I started from room 3201, I went through the 3200 corridor, then I took the elevator and went to the seventh floor, then I took the 7th floor bridge, then I passed the kitchen, then I went through the 7400 corridor, then I reached room 7416."*

Explanation 2: "*I traveled 26 meters and took 152 seconds on the 7th floor.*"

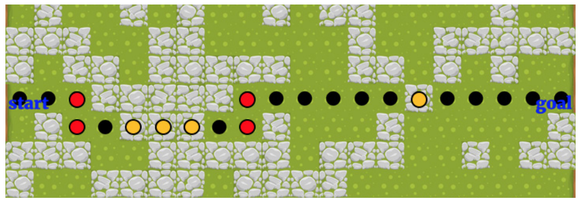
Robot providing non-verbal Explanations



Human view



Robot Overlay



Robots can provide visual indicators to signal intent and articulate its preference. In the upper images you see the robot overlaying the results of the neural network used on the robot. The lower image is a path the robot shows the user to convey its preference to different types of terrain.

Analyzing human gaze to assess robot trust

The more attention paid to an autonomous system, the less we trust it. As automation gains trust, it fades to the background. We looked at gaze tracking glasses as a way to measure amount of time spent looking at the robot when operating. It is hypothesized that as the robot behaves in progressively more predictable ways, humans will watch it less.

Carnegie Mellon University
Software Engineering Institute

Jonathan Chu | jchu@sei.cmu.edu

This material is based upon work funded and supported by the Department of Defense under Contract No. FA8702-15-D-0002 with Carnegie Mellon University for the operation of the Software Engineering Institute, a federally funded research and development center.

DM17-0746
Why did the Robot do That? and What will the Robot do Next?