Augmented TELE-ROBOTIC Control

Iván Ojeda, P.J. Campbell, Amy Green
Mentors: Richard T. Stone, Ph.D., Minglu Wang, Jay Roltgen

M.I.A.

MIA is the telerobot being used for this experiment. She is designed for outside/ rugged environments. She has two camera capabilities, GPS, arm capability and skid steering.

Abstract

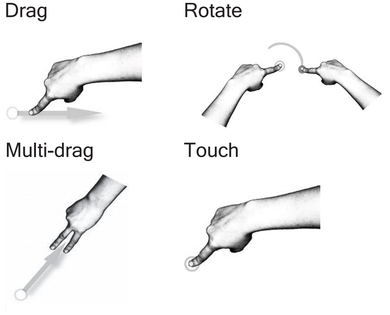
Tele-robotics and Multi-touch Technology

The focus of this research was to test whether a multi-touch interface is more effective than a joystick controller. Customarily, joysticks are used with tele-robotic operations. However, multi-touch interfaces can potentially create a natural experience for the operator, causing an improvement in his/her performance during complicated tasks. Our participants completed search tasks using the two interfaces and we compared the resulting data. Initial results show that the multi-touch interface is helpful in controlling the robot's path.

Background

Multi-touch

Multi-touch interfaces are becoming an increasingly popular form of input. A mouse and keyboard only offers two dimensions of input where multi-touch interfaces enable high-degree-of-freedom interaction techniques. The ability to effectively accomplish tasks correlates with making the experience real as well as immersing the user.

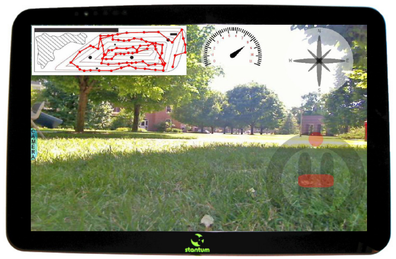


Sparsh UI

Sparsh UI consists of three components: the Gesture Server, an input device driver, and a gesture adapter. The devices transform the gestures and make it relevant information to the client application. It supports basic gestures such as touch, drag and zoom gestures and can extend to user-defined gestures.

Tele-robotics

Teleoperation is a growing field of study. It allows reconnaissance, inspection tasks, identification, search missions, surgical procedures, space exploration and more. Within teleoperation there is telerobotics which allows the operator to control the robotic system off site.



Stantum

The Stantum is the 15" multi-touch display that the participants used in the experiment. The wheel is the multi-touch navigation and direction control. The two lines adjust the speed and move the robot forwards and backwards and the wheel turns it to the left and right.

Methods

Situational Awareness, Human Comprehension

Participants were taught how to work the interface for 5 to 10 minutes. Then they were asked to conduct a search for items that are normally lost.

Lost Items

1. Hot Wheels Car
2. Pacifier
3. Sunglasses
4. USB
5. Golf Ball
6. ID Card
7. Cell Phone
8. Wallet
9. Hair Clip
10. Chapstick

Half of the participants used the joystick controller while the remaining used the multi-touch interface. They had no more than 30 minutes to complete the search task.

During the experiment, we measured the number of errors made by the user, the time for each item found, the number of items found in the allotted time and the number of times the robot hit an object in the field. After the task was completed, we measured the participants's mental workload with NASA TLX and situational awareness using SART.

NASA TLX Mental Workload

Uses six dimensions: mental demand, physical demand, temporal demand, performance, effort, and frustration.

SART Situational Awareness

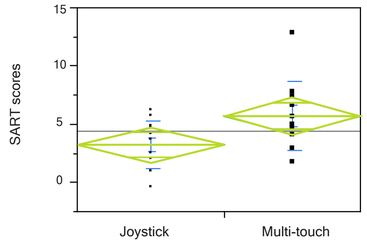
SART has 14 components which were determined through analysis with pilots to be relevant to situational awareness.

Results

Multi-touch vs. Joystick

The data was analyzed using a series of ANOVAs followed by Turkey post hoc comparison tests.

90% of the time, users with the multi-touch interface were less likely to hit obstacles in the field. The results also show that there is no significant difference between the mental workload of the multi-touch and joystick groups. 95% of the time, users with the multi-touch interface had a better environmental perception of the field than those with the joystick controller.



Analysis

These results indicated if the use of the different interfaces is significant (p=.05) in terms of task time, error rate, mental workload or situational awareness. This chart shows the difference in situational awareness.

Future Work

Improvement and Additions

Future work involves improving the design and aesthetics of the interface, fixing is the GPS technology, adding a draw gesture so that the user will be able draw paths and search patterns on the map to follow, incorporate the robot's arm capability and include a pan/tilt and zoom option for the camera.

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY
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