

Milestone 2 Report

To: Admiral David Quigley

STARFare Technology: Headquarters

From: Commander Preston Dotsey & Commander Purna Sengupta

STARFare Vessel Ether V76-244, Mission 315-C

STARFare

As we have progressed through the semester and continued to work on our project, STARFare is looking to take flight. Our project, STARFare, is an attempt to create a voice-based interface which can be used by crew members aboard space-faring vessels which aims to replace the current mode of physical interaction currently required by modern day space flight command decks. While coming up with the ideas for a potential project, we both realized we had a shared interest in Star Trek, which provided much of the inspiration for our voice command interface based off of the show's computer. We also had previously worked on a voice-controlled navigation interface in a previous project which helped us to gain even more insight into how we wanted to do this project.

NavAssist

While STARFare has roots in a previous project of ours, NavAssist, we decided to implement some features which we hoped would lead to an easier to understand operational structure for the user. While STARFare and NavAssist shared the same core principles of using voice commands to control systems for navigation, with STARFare the implications of the system working correctly were much more serious as it is taking command of a space-ships flight and communication systems, rather than just functioning as a simple navigation and mapping device like NavAssist did. Due to the increased need for accuracy and the additional operational demand of controlling a multitude of systems aboard a space craft, we realized that the need for accurate voice-interpretation and an increased level of user trust in that accuracy was needed in order to create a successful interface.

STARFare Security Command Central

As previously stated, much of our design inspiration came from the computer interfaces seen in the show Star Trek, leading us to consult visual images from the show, as well as the surprisingly large amount of detailed technical diagrams of technology from the show. We also interviewed several people about their experiences with existing voice interfaces in order to identify what existing problems there were, as well as features that users enjoyed. From our study of the technology from Star Trek, we decided on ensuring that the interface had an accompanying screen that displays information back to the user, as well as relaying messages to

the user through speakers both in the interface, as well as throughout the ship. This was done to try to increase trust in the user by making sure that information is presented to them in a multitude of ways.

From our initial interviews, we identified the major needs of the user when it comes to a voice interface that they need to be able to grow trust that the system is accurate, as current widespread voice interfaces have historically been quite inaccurate, leading to a low amount of trust in voice-based interfaces by consumers. In order to try to instill trust, we decided to make the interface speak out every command it is doing to ensure that the user knows exactly which commands are being executed. Trust in the interface was by far the most important thing for us to address and much of our design decisions are built of fostering trust in the user of the interface. We tried to accomplish this through easy to comprehend visual displays on the device, a built-in system of audio confirmation with commands, as well as a status indicator light to provide the user with a way to quickly visually check for any items which need to be attended to. Trust in the system makes or breaks it, and we tried to design it in a way which makes it.

Prototype Usage Study

The prototype was testing with a focus on usability to identify and improve areas for better user experience. Our study interviewed two individuals with a college education and familiarity with voice interfaces. Both interviews were conducted in the participants homes and the testing script (Appendix) was followed in order to test the prototype.

The participants attempted to carry out specified commands using the prototype without further instruction. The commands were entering red alert, sending communication, and conducting an exterior scan. The usability test was concluded with an exit interview consisting of the three following questions:

1. Is there anything that could be added to provide greater assurance in the accuracy and completion of the computer's execution of the given command?
2. Without prior experience using voice interfaces, are there any steps that you would have found difficult to understand, execute, or unable to use and if so, what knowledge do you have that has assisted you in easily the interface?
3. What might this voice interface be the most useful for as a crewman? Would it also be useful in similar ways as a passenger, or would it differ and how? Is there anything that you find unnecessary, or unhelpful to crewman or passengers?

The participants responses were noted, and testing was completed. Notes, responses, and other observations were then shared amongst the team using a think aloud method. The team determined the portions of data that were necessary for further analysis and possible integration into the updated prototype.

Data Analysis & Discussion

Overall, participants reported that the prototype allowed for a pretty simple interaction process with the voice interface command system. The user's options for executing commands and interacting with the system allow for the task to be completed within a broad range of functionalities.

Task A: *Participant A 25.36 seconds Participant B 29.54 seconds*

Participants reported that the prototype for Task A, to initiate Red Alert, was straight forward and considered the interaction time when designing computer responses since Red Alert is supposed to indicate a threat.

Task B: *Participant A 47.26 seconds Participant B 59.13 seconds*

The option to send a message with a complete voice interface was reported to be very similar to interfaces used in the participants daily lives. Therefore, the ease of use was rated highly during responses. The participants mentioned that users who lack voice interface experience may struggle without the option to have many computer responses or little to no response.

Task C: *Participant A 92.32 seconds Participant B 69.27 seconds*

Participants reported this task to be a similarly useful and straightforward interface for interaction. But for users who are unable to view the screen, it was suggested that the computer registers the user's disability, if they have one, before beginning any interactions.

The participants stated an overall positive experience using the security command central and found it useful that the functionalities accessible tasks prototyped are ones that are interconnected and can also be adapted to include more functionalities for passengers.

From the observations, responses, and feedback, our team has determined that the design changes necessary for the interface should include an option for varying computer interaction and guidance so that all users are able to use the interface regardless of familiarity. With this option, users can request computer guidance to be at maximum or minimum. Maximum settings will report every action taken by the computer interface, including those shown as visually/image-based changes. Overall, the prototype could be improved for more clarity in steps and how realistic interactions will look. The main focus of prototype improvements should be computer interactions and responses with the user and the clarity and consistency of the tasks included in the prototyped interactions.

Task 1: Red Alert

Activating Red Alert

- When the user wants to activate Red Alert, the steps are as follows below:
 - User speaks the code command "Computer, activate Red Alert."
 - The computer then begins Red Alert activation.
- After Red Alert is activated, the computer switches the status indicators from green to red and changes the top bar to red.
- All exterior sensors are locked and the console switches to Red Alert mode.
- Security screen are intended to check the ships contents and personnel aboard.
- Security status updates and messages will be displayed on the systems screen. The user can use the computer to send messages in plain text format.
- User can also select an option displayed on the security system by voice command.

Task 2: Send Communication

Sending an Outgoing Message

- User will first speak a command to signal intent to send a message.
- Computer, send a message to (name of intended vessel).
- The interface will then confirm the message destination. User will respond yes or no.
- The computer will then prompt the user to speak their message. As the user recites their message, the computer will display the recorded message on the computer screen.
- User states "Message concluded" to signify that their message is complete.

Task 3: External Scan

Performing an Exterior Scan for Anomalies

- In order to initiate an exterior scan, user will speak the command "Computer, initiate exterior scan."
- Computer will verbally confirm it is initiating an exterior scan and the display screen will switch to its scanning mode.
- Computer asks for criteria from user for scan (libraries, warehouses, etc.) and user will specify what metrics they want the scan to include.
- Computer begins scan for anomalies (biologics, transmissions, etc.)

Task 4: External Scan Results

Reviewing Scan Results

- After the scan is complete, a tone will play and the computer verbally returns the user the the scan to complete.
- Results of scan are displayed on message screen, and anomalies are highlighted in bold.
- The computer then verbally speaks out anomalies if they are important and asks the user if they would like to perform further scans.
- User will either confirm they want to perform more scans and the steps will repeat, or they can ask the computer to end further scans.

Task 5: Send Communication

Sending an Outgoing Message

- User will first speak a command to signal intent to send a message.
- Computer, send a message to (name of intended vessel).
- The interface will then confirm the message destination. User will respond yes or no.
- The computer will then prompt the user to speak their message. As the user recites their message, the computer will display the recorded message on the computer screen.
- User states "Message concluded" to signify that their message is complete.

Task 6: External Scan

Performing an Exterior Scan for Anomalies

- In order to initiate an exterior scan, user will speak the command "Computer, initiate exterior scan."
- Computer will verbally confirm it is initiating an exterior scan and the display screen will switch to its scanning mode.
- Computer asks for criteria from user for scan (libraries, warehouses, etc.) and user will specify what metrics they want the scan to include.
- Computer begins scan for anomalies (biologics, transmissions, etc.)

Task 7: External Scan Results

Reviewing Scan Results

- After the scan is complete, a tone will play and the computer verbally returns the user the the scan to complete.
- Results of scan are displayed on message screen, and anomalies are highlighted in bold.
- The computer then verbally speaks out anomalies if they are important and asks the user if they would like to perform further scans.
- User will either confirm they want to perform more scans and the steps will repeat, or they can ask the computer to end further scans.

Task 8: Send Communication

Sending an Outgoing Message

- User will first speak a command to signal intent to send a message.
- Computer, send a message to (name of intended vessel).
- The interface will then confirm the message destination. User will respond yes or no.
- The computer will then prompt the user to speak their message. As the user recites their message, the computer will display the recorded message on the computer screen.
- User states "Message concluded" to signify that their message is complete.

Task 9: External Scan

Performing an Exterior Scan for Anomalies

- In order to initiate an exterior scan, user will speak the command "Computer, initiate exterior scan."
- Computer will verbally confirm it is initiating an exterior scan and the display screen will switch to its scanning mode.
- Computer asks for criteria from user for scan (libraries, warehouses, etc.) and user will specify what metrics they want the scan to include.
- Computer begins scan for anomalies (biologics, transmissions, etc.)

Task 10: External Scan Results

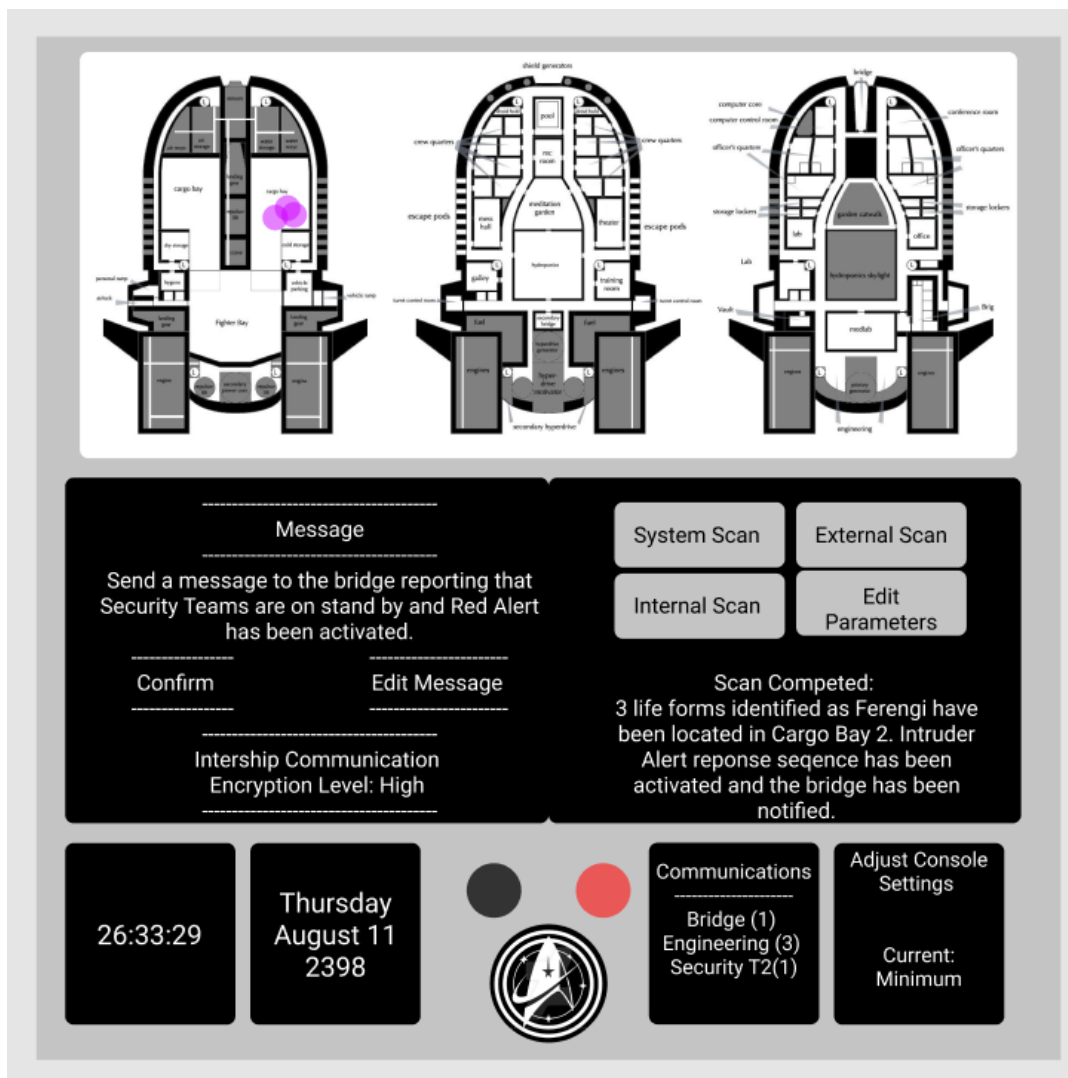
Reviewing Scan Results

- After the scan is complete, a tone will play and the computer verbally returns the user the the scan to complete.
- Results of scan are displayed on message screen, and anomalies are highlighted in bold.
- The computer then verbally speaks out anomalies if they are important and asks the user if they would like to perform further scans.
- User will either confirm they want to perform more scans and the steps will repeat, or they can ask the computer to end further scans.

Updated Prototype

The prototype update made based on usability testing was to add in a computer voice interaction setting component that allowed users to first select the level of response and communication they would like from the computer. If they have used the system before, the computer will default to the last used setting if the starting command is not related to the setting. The updated diagram and prototype task scenarios are included as an additional change intended to be integrated into the user script and final prototype diagrams in the near future.

The security command console shown on the left includes updated features and functionalities for all three prototyped and tested tasks. The user-computer interactions, scripted below, provide an example of how features such as the two computer response panels, the communications center, and the console settings can help improve the usability of the tasks.



Task A: Red Alert Activation

User: "Computer, please begin voice interaction sequence with response setting medium."

Computer: "Hello Commander Dotsey, please begin."

Dotsey: "Send a message to the bridge reporting that Security Teams are on stand-by and Red Alert has been activated."

Computer: "Confirm message on screen."

Dotsey: "Confirmed"

chime Computer: "Message Sent"

chimeComputer: "Message Received"

Dotsey: "Computer, reduce voice interaction sequence to minimum"

Computer: "Initiated."

Dotsey: "Computer initiate internal and external system scans."

chime to indicate initiation of scan

Computer: "Scan Completed."

Task B: Internal Communication

User: "Computer, please begin voice interaction sequence with response setting maximum."

Computer: "Hello Commander Sengupta, please begin by stating a command."

Sengupta: "Computer, Activate Red Alert. Voice authorization Commander Purna Sengupta."

Computer: "Red Alert Sequence initiated; voice command authorization confirmed."

Computer: "The ship's status has now been changed to Red Alert. All ship's crew and personnel have been notified. All exterior doors are sealed and locked with command level authorization. Consoles and all other ship systems have also been switched to Red Alert mode. Security scans have been initiated for internal and external scans. A systems security report has also been initiated and you will be alerted upon completion. Are there any other actions in need of execution at this time Commander?"

Sengupta: "That is all, Computer. Stand-by for further command."

Task C: Internal Intruder Scan

User: "Computer, please begin voice interaction sequence with response setting minimum."

Computer: "Identity confirmed: Ensign Mac"

Sengupta: "Computer, Activate Red Alert. Voice authorization Ensign Mac."

Computer: "Red Alert Sequence initiated; voice command authorization confirmed."

Computer: "The ship's status has now been changed to Red Alert. All ship's crew and personnel have been notified. All exterior doors are sealed and locked with command level authorization. Consoles and all other ship systems have also been switched to Red Alert mode. Security scans have been initiated for internal and external scans. A systems security report has also been initiated and you will be alerted upon completion. Are there any other actions in need of execution at this time Commander?"

Sengupta: "That is all, Computer. Stand-by for further command."

Appendix

1.1 User Script

Hello and thank you for agreeing to participate in our usability testing of our upcoming product today. First of all, I wanted to introduce ourselves and our project, STARFare. This project has been developed by the owners of the technology, Preston Dotsey and Purna Sengupta. We are both Computer Science Majors at CU Boulder and were recently tasked to create a new user interface for a technology of our choice and we decided to create an interface for navigation and systems control aboard a space-faring vessel. The interface is operated through user voice commands and is intended to allow a crew member aboard a spaceship to be able to control the various systems on the ship through voice-interaction, as well as to be able to attain systems statuses, interact with messaging and data analysis systems and relay information between the user, the ship, and other related parties to the ships flight plans.

We intended to create a system in which the crew no longer has to physically interact with the systems, allowing them to carry out their desired operations in a fast, safe and accurate manner. Where you come in as our tester is to help us gain a better understanding of how the systems feel to operate and for us to identify what parts of our prototype are successful and what parts of it may need to be improved. In order to find this out we are going to show you our prototype and ask you how you would use it to carry out three separate tasks which we think are crucial to the success of this project. We will then use your input to help reshape our prototype to be as efficient and effective as possible.

- 1.) The first task we have for you is one related to the ship's security system. In times of crisis, it can be necessary to set the ship's status into a red alert where extra security measures are enacted. Using our prototype, how would you interact with it to initiate a red alert status?
- 2.) The next task involves the ship's messaging system. While on a space flight, communication is of extremely high importance to ensure that all the needed information to ensure a safe flight can be both received and relayed from the ship. Using our prototype, how would you use it in order to send an outgoing message to another ship?
- 3.) Our last task has to do with using the ship's onboard systems to collect external information. One of our data collecting tools is the use of sensory instruments on the ship to perform an exterior scan which the computer collects data from and then gives the user an interpreted result of. Using our prototype, how would you use our prototype to perform an exterior scan?

Thank you for providing your input about how you would use our prototype to perform these actions. In order for us to gain a better understanding of what we can improve and what is working well, we have three questions for you about the prototype that you just tested for us:

- 1.) What, if anything, would we possibly add to our interface in order to provide greater assurance that the interface has executed your command in an accurate manner?
- 2.) Without having prior experience using voice interfaces, do you think this prototype would be something you could easily learn to use?
- 3.) What tasks could you see this voice interface being the most helpful for if you were to use it? What tasks do you think would be the least helpful?

We just wanted to say thank you so much for taking the time to participate in this usability test for STARFare. We hope to incorporate your feedback to make an even more function interface and we greatly appreciate your help in making this technology the success that we know it will be!