NASA's Johnson Space Center

Internship Abstract and Final Reflection

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National Aeronautics and Space Administration's Johnson Space Center

Overview of Organization

The National Aeronautics and Space Administration's (NASA) Johnson Space Center, named after Lyndon B. Johnson, is a United States government facility responsible for human spaceflight technology including development of manned spacecraft, astronaut training, and flight operations. Johnson Space Center is located in Houston, Texas with approximately 14,000 employees. Established in 1961, Johnson Space Center played a major role in the moon landings with the Mercury, Gemini, and Apollo programs before taking a major role in the Space Shuttle program. It currently supports the International Space Station and development of the Orion capsule.

Human Interface Avionics

This internship is under the Audio Systems Group of the Human Interface Branch of the Avionic Systems Division of engineering at Johnson Space Center. This group is responsible for designing, analyzing, and testing audio based interfaces between crew and spacecraft. The goal of this group is to make spaceflight safer and easier for the crew by managing effective and reliable audio systems.

Evaluation of Embedded Natural Language Processing Technology

Overview of Project

The primary objective for this internship is the evaluation of an embedded natural language processor (NLP) as a way to introduce voice control into future space suits. An embedded natural language processor would provide an astronaut hands-free control for making adjustments to the environment of the space suit and checking status of consumables procedures and navigation. Additionally, the use of an embedded NLP could potentially reduce crew fatigue, increase the crewmember's situational awareness during extravehicular activity (EVA) and improve the ability to focus on mission critical

details. The use of an embedded NLP may be valuable for other human spaceflight applications desiring hands-free control as well. An embedded NLP is unique because it is a small device that performs language tasks, including speech recognition, which normally require powerful processors. The dedicated device could perform speech recognition locally with a smaller form-factor and lower power consumption than traditional methods.

Survey of Natural Language Processing Technology

Early in the analysis of embedded NLP technology, a survey of NLP technology, embedded and larger scale alternatives, was completed cataloging general information about each technology including capabilities, architecture, target applications, costs, and licensing. It was determined current embedded NLP technology is primarily performing speech recognition at various levels of speech complexity and some speech synthesis. Embedded technology is not yet performing analysis to extract the meaning of language beyond basic recognition.

Test of Speech Recognition Systems

Because it was determined embedded NLP technology is centered on speech recognition, an experiment was designed to compare the performance of various commercial-off-the-shelf (COTS) speech recognition systems to measure their respective accuracy, response time, and power consumption. After some research, it was determined that there is no existing standardized method of evaluating embedded speech recognizers. A test was designed to evaluate the current speech recognition systems under test. An emphasis on repeatability and on the ability to adapt to test future speech recognition system technology was critical during the test development process. The test required the development of a testing system capable of playing pre-recorded speech, recording each speech recognition system's response in a standard format, accurately timing response times, and monitoring power consumption. A testing vocabulary was developed to compare each recognizer's performance with a range of language

complexities and phonetic challenges. So that the tests would be relevant to a future spacesuit design, the testing vocabulary was based on commands that could interface with a prototype suit informatics graphical user interface (GUI) developed by another group. The test recordings will be made of human talkers reading the test vocabularies. When testing, the test conditions will be kept identical between recognizers so meaningful comparisons can be made with the test results.

Result of Speech Recognition System Testing

At time of writing this report, about a month remains of the internship in which testing and analysis is to be completed. Currently recording scripts for each talker are being finalized and the testing system is in development. In the remaining time, development of the testing system will be finished, recordings of talkers will be made, the tests will be administered for the speech recognition systems of interest, and initial analysis of the data collected will be performed.

Professional Development at Johnson Space Center

Experience at a Large Organization

My previous experience has been at very small organizations of just a handful of people. Working for a large government organization, I have learned the importance of effective communication as I have to coordinate with many people across the center as opposed to previous experiences working with a few people within a single building. Johnson Space Center also has many established rules and procedures to ensure safety, to establish consistency and reliability of technologies, and to ensure thorough documentation of all actions. Previous organizations I have worked for did not have the resources to maintain such thorough procedures.

Overall Experience

My experience with my time at Johnson Space Center has been excellent. I have had the opportunity to gain both technical and professional growth working for an organization that has led scientific and technological progress for over fifty years. I will continue to apply the high standards I have learned for Johnson Space Center or any organization I work with in the future.