The Heroes Behind the Heroes of Apollo-11: Role of STEM

John H. L. Hansen, Lakshmish Kaushik, Chengzhu Yu, Abhijeet Sangwan
Center for Robust Speech Systems, Eric Jonsson School of Engineering, The University of Texas at Dallas, Richardson, TX 75080, USA
{john.hansen, abhijeet.sangwan, lakshmish.kaushik, chengzhu.yu}@utdallas.edu

Abstract

During Apollo-11 project, countless scientists, engineers, technicians worked behind the scenes to ensure that both the solutions and the execution of the detailed flight plan was a success. It is our goal to create an interactive application that allows users to explore NASA's archive of Apollo missions. The application is specifically aimed at younger users, on the purpose of engaging K-12 students, inspire them to grow interest to get into scientific fields of study, and promote the positive nature of the space program.

Approach

Our system has been developed using NASA's Apollo program, which are among the most complex operations executed from scientific, technological and operational perspectives [2]. A typical mission lasted between 7-to-10 days, and vast quantities of data such as audio, video, pictures, telemetry, etc. were collected. Audio data consists of 29 simultaneous tracks of data, which includes space-to-ground communication, back-room loops, flight director loop, public affairs officer loop, etc. The sheer complexity of information makes it hard to narrate the story of one of the greatest achievements of mankind. Through Apollo Archive Explorer (AAE), we wish to provide simple access to complex information. A new web-based platform is designed, where the user has the ability to choose the level, depth and kind of information they wish to review.

The proposed tool uses mission time to collate multiple sources of information in a single framework. By doing so, every piece of information in the system is mission-time-tagged. At the highest level, two types of information have been attached to the mission timeline, namely, raw and processed information. By raw information, we refer to mission related audio, video and image data that is typically available online in the public domain. Additionally, we have also developed a specialized 30-track head as shown in figure 1 which digitizes audio to extract audio channels from the original 30 track analog tapes of Apollo mission shown in figure 2.

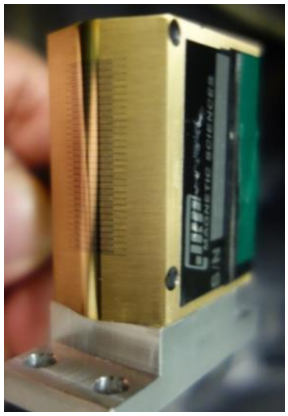

Figure 1: 30 Track Head

Figure 2: 30 track Analog Tapes

We have completed digitization of 19,000 Hours of audio data from Apollo 11, Apollo 13 and Gemini missions. This enormous audio archive is the first of its kind of an organized missions based speech data.

On the other hand, time-tagged processed information of the audio data is generated for analysis in the entire mission timeline. Given our research background in audio, speech and text processing, many parameters related to behavior [1], sentiment [5], topic, conversation turn-taking [3], Laughter and filler [6], speaker voice characteristics, etc., are generated from audio. However, the tools architecture is general, and would allow other researchers, users and enthusiasts to add their own information tracks. For example, the tool could be incorporated into STEM curriculum for K-12 students in various subjects such as astronomy, physics, engineering, etc. Course developers could design projects, assignments, illustrations, etc. using context from the mission. By time tagging this information, a new interactive learning experience would be created for the students. It is also possible to develop a kiosk version of the proposed system for museums, where visitors receive an interactive experience and can explore various aspects of the Apollo mission that is suitable to their interest. It is useful to note that although the current system is populated with Apollo data, it is possible to use the system with other missions as well.

Results:

An interactive web experience platform was created where users could scan mission time and across Apollo audio along with other metadata (such as images, videos, etc.) on a web browser. This system was exhibited at the Perot Museum (Dallas, Texas) during Engineers in an attempt to engage K-12 students and to promote STEM education. We participated in the Engineers Week presentation at Perot Museum wherein a web based display interface was developed which would guide viewers to go through an interactive visualization that uses audio, videos, images and games to educate and motivate them in STEM streams.

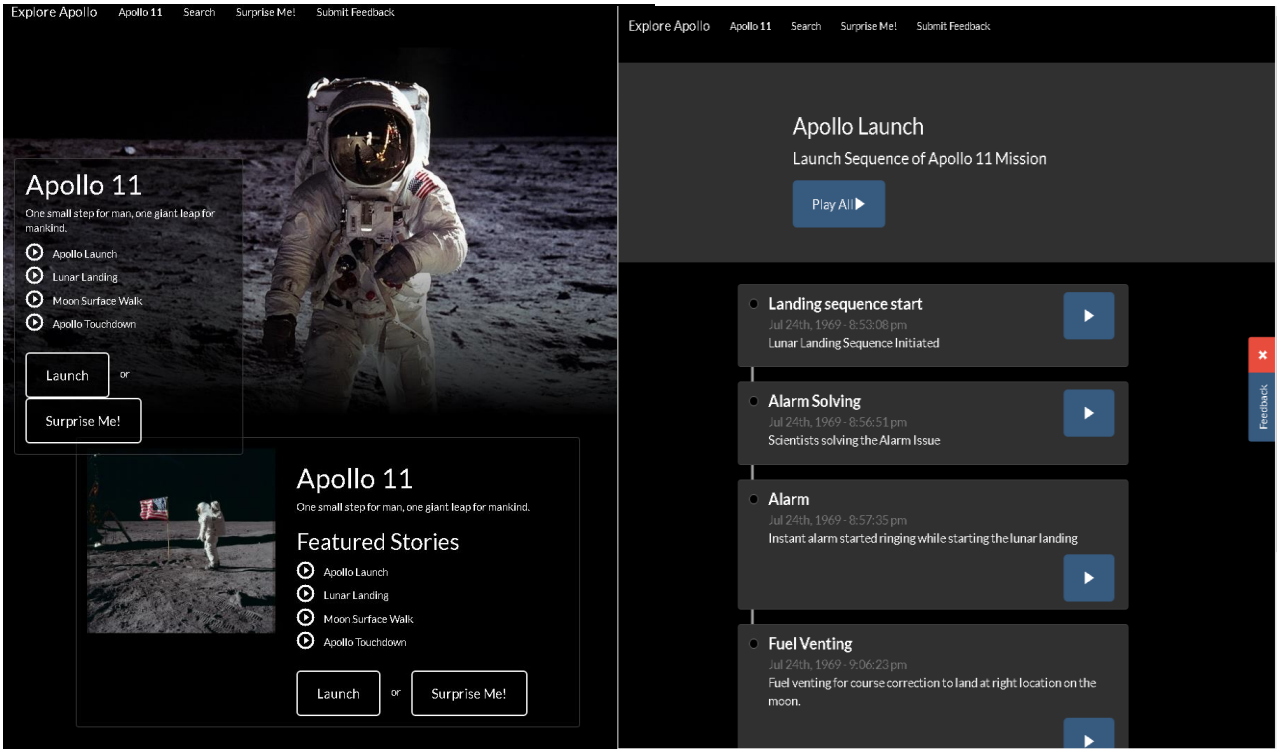

Figure 3: Interactive Web page of the Apollo Archive Explorer https://app.exploreapollo.org/

Out of many parameters that can be extracted using speech, the chord diagram in figure 4 shows the interaction analysis between speakers during a conversation.

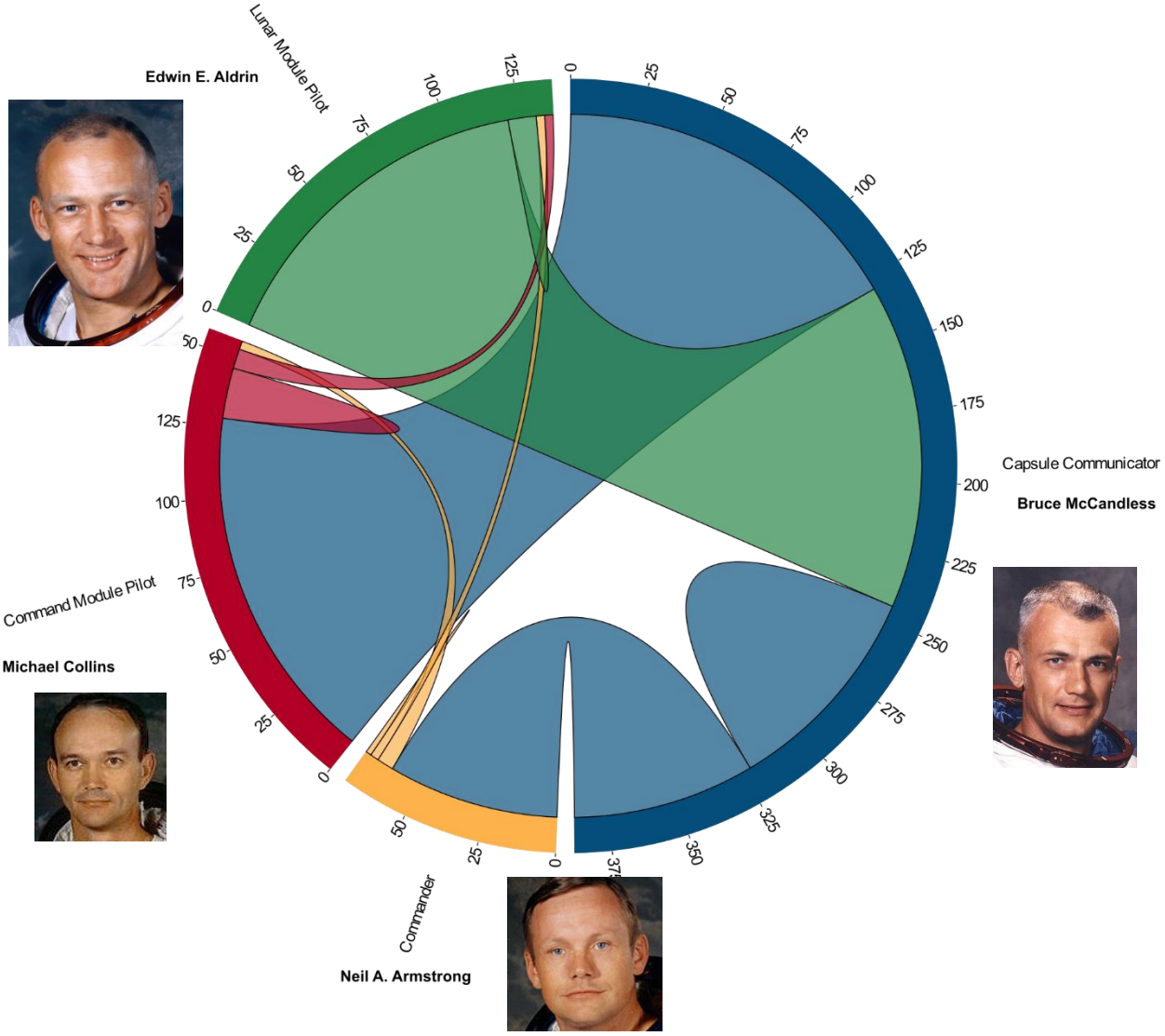

Figure 4: Chord Diagram showing Interaction analysis across speakers.

This diagram shows the quantitative interaction between speakers in a very lucid way for inter-speaker dynamics understanding.

Conclusion:

The interactive platform for exploring NASA's archive of Apollo-11 mission, provides a pleasant environment to young students, to understand the role of science, technology, engineering and mathematics (STEM) perspectives of one of the largest engineering achievement in human history.

References:

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John H.L. Hansen

John H. L. Hansen (IEEE Fellow, ISCA Fellow) received the Ph.D. and M.S. degrees in electrical engineering from the Georgia Institute of Technology, Atlanta, GA, USA, in 1988 and 1983, and the B.S.E.E. degree from Rutgers University, College of Engineering, New Brunswick, NJ, USA, in 1982. He received the honorary degree "Doctor Technices Honoris Causa" from Aalborg University, Aalborg, Denmark (April 2016) in recognition of his contributions to speech signal processing and speech/language/hearing science. He joined the University of Texas at Dallas (UT Dallas), Erik Jonsson School of Engineering and Computer Science in 2005, where he currently serves as the Jonsson School Associate Dean for Research, as well as a Professor of electrical engineering, and also holds the Distinguished University Chair in telecommunications engineering. He previously served as the Department Head of electrical engineering from August 2005 to December 2012, overseeing a four times increase in research expenditures ($4.5M to $22.3M) with a 20% increase in enrollment along with hiring 18 additional T/TT faculty, growing UTDallas to the eighth largest EE program from ASEE rankings in terms of degrees awarded. He also holds a joint appointment as a Professor in the School of Behavioral and Brain Sciences (Speech & Hearing). At UTDallas, he established the Center for Robust Speech Systems (CRSS). Previously, he served as the Department Chairman and a Professor of Department of Speech, Language and Hearing Sciences, and a Professor in the Department of Electrical & Computer Engineering, University of Colorado Boulder (1998–2005), where he co-founded and served as the Associate Director of the Center for Spoken Language Research. In 1988, he established the Robust Speech Processing Laboratory and continues to direct research activities in CRSS at UT Dallas.

Lakshmish Kaushik

He is a PhD candidate at Center for Robust Speech Systems at The University of Texas at Dallas. His research interests include Speech Recognition, Keyword Spotting, Sentiment in audio, Behavioral Informatics.

Chengzhu Yu

He is a PhD candidate at Center for Robust Speech Systems at The University of Texas at Dallas. His research interests include Speech Diarization Speaker Identification and analysis.

Abhijeet Sangwan

He earned his Bachelors degree in Electronics and Communication Engineering from Visveswaraiah Technological University (VTU), Bangalore, India, in 2002. He earned his Masters and Ph.D. degrees from Concordia University, Canada and The University of Texas at Dallas, U.S.A. in 2006 and 2009, respectively. During 2002-2003, he worked for MindTree Consulting where he designed and developed enterprise data warehouse systems for Unilever. He interned with the Human Language Technologies Group at IBM T.J. Watson Research Center, Yorktown Heights in 2008. From 2009, he has been a part of The Center for Robust Speech Systems (CRSS) at The University of Texas at Dallas. His research interests include Automatic Speech Recognition (ASR), Automatic Accent Assessment, and Language Identification Systems. Dr Abhijeet Sangwan is the Chief Technology Officer of Speetra Inc.