

Pandora Vision



Progress Report for:

Augmented Reality Telepresence

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Introduction

Manufacturing has been moving towards automation using heavy robotics. In order to perform maintenance duties or monitor operations, individuals are increasingly required to step into hazardous environments. The ART system provides a sense of presence to the users and eliminates the need to step into hazardous environments.

The prototype for the ART system consists of 3 subsystems: Head-Controlled Stereoscopic Camera (HCSC), control system, and a Virtual Reality (VR) device. The HCSC system operates in a remote location and captures and transmits images to the VR device. The VR device then provides a 3D stereoscopic view of the remote location where the HCSC is located to the user.

Schedule

Pandora Vision's original schedule was carried out without any delay until the hardware assembly milestone due to complications that were unforeseen. Thus, more time had to be allocated to finish this milestone, and other milestones have been postponed to later dates. The demo date for presenting the ART system has been scheduled for December 12th of 2014. Given the updated presentation date, we are on track to complete the prototype model in time for the demo. The following dates and milestones represent the new tasks to be completed by the demo date.

- November 24th, 2014: Hardware Testing
- November 24th, 2014: Software Implementations
- December 2nd, 2014: Software Testing
- December 5th, 2014: System Integration
- December 11th, 2014: System Testing and Debugging

Finances

Pandora Vision received \$500 from Engineering Science Student Endowment Fund (ESSEF) towards funding the development of the ART system's prototype model. To date, we have spent \$375.24 of the budget for purchasing the required project parts. As originally planned, the remainder of the company's budget is set aside as contingency and intended to oversee any unforeseen costs. The Pandora Vision team has also agreed to personally contribute financially in case of any extenuating circumstances.

Progress

User meetings have been occurring on a weekly basis, and have increased since the middle of October. We have also timely submitted all the documentation required till now.

Head Controlled Stereoscopic Camera (HCSC)

For the prototype model, the HCSC system must transmit two H.264 video encoded streams to the Graphical User Interface (GUI) on the control system. Due to high data rates, a multimedia framework called Fast Forward Media Picture Experts Group (FFMPEG) was used to perform the H.264 encoding on the captured video feeds. However, it was found that H.264 encoding by FFMPEG is CPU intensive and perhaps not the best solution for transmitting data. After some research, we found another multimedia framework known as Gstreamer which performs H.264 encoding without depending on the CPU of the Raspberry Pi. We expect to get the first video stream transmitted by November 21, 2014 to allow for integration and modification necessary to transmit the desired data.

The mechanical design for the HCSC system is completed and we created a 3-D Solidworks model for the design with accurate dimensions for all the components. Implementation of the mechanical design of the HCSC will be completed by November 21, 2014. While testing the mechanical design in Solidworks, an additional battery pack was required to power the servo motors, which the original design did not account for. We modified the mechanical design of the HCSC system to account for the additional component.

Control System

A GUI has been designed and partially implemented for the ART system, allowing for communication between an android device and the HCSC using buttons to start and stop communication. For the communication to operate successfully, two sockets are used to connect between the Virtual Reality (VR) device and PC. Currently, the head orientation data collected by the VR device can be transferred to the HCSC system successfully using the socket communication. The image transfer still needs to be implemented as per the schedule which we hope to complete by November 21, 2014.

The GUI has a Start, Stop and Reset button for the user to be able to control the ART system. The GUI is developed using the Java Swing library and has event handlers for creating button functionalities. The Start and Stop button functionalities have been implemented but the Reset button functionality still needs to be developed. While testing the start functionality the tester found that the GUI would freeze until a connection had been established providing a subpar user experience. The issue was caused by the GUI thread of execution waiting for a connection from the VR device. After isolating the issue, a separate thread was used to establish a connection and resolve the issue above.

VR Device

Due to time constraints the definition of VR device was limited to a cellphone with an android operating system and an application built by the Pandora Vision team, but the production model is expected to work with to an Oculus Rift.

We have completed collecting and transmitting the orientation data to the HCSC. Achieving the data transmission was not originally that easy as no member of the Pandora Vision team has had experience developing an android application. The experience barrier was noticeable as the initial implementation would constantly cause the GUI to freeze. The solution was to send the orientation data in a different thread but android blocks access the orientation from any other thread than the main thread. So a producer consumer model was implemented to solve the above issue.

One last issue that arose was related to the developer compiling their java application on an apple Macbook Pro but the server was running on a PC. The terminating line characters were different between the two operating systems causing only a single byte to be read from the android phone. Compiling and running the server on the same platform resolved the issue.

Remediation

We are currently a week behind our original schedule. Fortunately, our demo date is scheduled 12 days later than our planned date, which remediates for some of the slippage due to unforeseen issues that could potentially occur.

The Pandora Vision team has been sub-divided into two groups of two, and an additional member who contributes to both groups. One group is responsible for completion of the HCSC system while the other is responsible for the completion of the control system.

The assembly of the individual components of the HCSC system are still in the process of being completed, which has held back the integration of the HCSC system with the control system. Therefore, the additional team member who contributed to both groups is now solely focused on helping the HCSC group to complete assembly of the HCSC system. With the additional member, we expect to complete the assembly of HCSC system by November 24th, 2014. The control system group is currently on schedule and is confident that they will complete their respective tasks by the deadline of November 24th, 2014.

Conclusion

The Pandora Vision team is pleased to conclude that the development of the ART system is going according to plan. The financial standing of the company has been assessed as positive with the remaining budget left as contingency to be used when required. In terms of the development of the ART system, all of the team members are currently working to finish individual components followed by integration and system-level testing is to begin by the end of this week. The extra time should allow for remediation of any unforeseen problems. The Pandora Vision team is confident in presenting a fully functional prototype model of the ART system on December 12 of 2014.