Interfacing the NAO Robots Using The Oculus Rift

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Projected End Date: December 1st

Summary

1 Abstract

The project aims to gather video feed using the Aldebaran NAO robots on board video cameras and transfer them to a Node.js server application using UDP. The video feed will then be transferred and displayed to the Oculus Rift. The accelerometer data from the Oculus Rift will then be transferred to the Node.js application and move the NAO's head according to the outputted accelerometer data.

2 Business Profile

The context of the project falls within remotely controlling a robot where a human may otherwise not be able to do so. This can also include additional situations where current analogous methods are not sufficient. This can include delicate space operations where crew members may not be able to see the exact problem or insuring repairs are done with the precision of a human where humans are not able to safely travel out. Stakeholders in this project include but are not limited to; industrial workers, space launch companies, companies seeking to further remote communication, and any companies already developing

similar technology. Example of such companies include Red Cross, NASA, Google, and independent researchers. Other stakeholders include any students of faculty in the PCSE department looking into furthering this field of research, including Dr. Flores.

3 Description Scenario

The project uses the upper and lower camera to visualise what the robot would see and displays the resulting video on the Oculus Rift. Byte data is transferred on the local network from the cameras by using User Datagram Protocol. The Node.js server listens and then picks up the byte data and then converts it into an array of unsigned 8-bit integers and then converts it once again into a Base64 string of image data. This resulting image data is then streamed using WebSockets to the client. The data is then displayed by the Oculus Rift by displaying the browser's output onto the Rift acting as a secondary display to the computer.

4 Normative Scenario

The end goal of this project is to display the robots video feed with minimal delay to any user that the robot is sending its video data. In addition to minimal lag when streaming video another goal is to use the Oculus Rift to move the NAO's head like a normal humans' (to an extent that the robot is capable of). This would result in a very desirable product to business markets and consumer markets. Another optimization is to also stream the video directly into the Oculus Rift without using the Rift as an external monitor. Using these optimizations would also result in higher quality video being streamed into the Rift from the robot. This happens due to the way images are currently being processed on the Node.js server. Moving away from this would result in faster image processing. All of the optimizations would result in a user able to remotely see and control the NAO robot.

5 Motivation

The motivation of this project stems from Dr. Flores mentioning multiple use-cases for a technology capable of introducing a new way of "interfacing" with a remote controlled machine. A product such as this one would allow for research in the field of robotics while using software as a basis. Moving this field forward while also being able to contribute to the humanitarian efforts while using robotics is extremely important.

6 Plan of Attack

There are three main objectives wile working on this project. The first objective is to learn about the NAO robot and video streaming while working towards transferring and processing the streamed data. Secondly, to learn about video streaming directly to a device while working towards streaming high resolution lag-less video data. Last is to learn about accelerometer data while using the accelerometer data from the Oculus Rift to move the head of the robot accordingly. In full scope this is a big project and will take time to achieve all three goals. A projection of when the goal number one will be done is the end of September. The projection of goal number 2 is the end of October to November. Goal

number 2 will take the longest to complete as it is improving user experience and fine tuning. Goal number 3 will be completed at the latest the end of November and at the earliest the end of September. This is because goal 3 deals with processing hard numbers given by the accelerometer data, meaning that progress can be slowed down by goal number 2 and by unforeseen computational barriers. An exceptional project would be to ship with all three goals and additional improvements made. A good project would be to ship with goal 1 and 3 complete and with moderate image quality. A decent project would be to ship with goal 1 and 3 complete and with low image quality. On a week by week basis the project would follow the following schedule:

Week of September 14th: Work on receiving UDP packets in a c++ program
Week of September 21st: Work on receiving accelerometer through UDP packets
Week of September 28th: Work on giving motion instructions to the robot
Week of October 5th: Fine tune motion instructions to mimic human movement
Week of October 12th: Work on higher resolution video feed from the robot
Week of October 19th: Work on higher resolution video feed from the robot
Week of October 26th: Optimize outlying tasks from previous weeks
Week of November 2nd: Optimize outlying tasks from previous weeks
Week of November 9th: Optimize outlying tasks from previous week and document code
Week of November 16th: Wrap of and prepare project for software fair
Week of November 23rd: Wrap of and prepare project for software fair
Week of November 30th: Present project and finish any outlying tasks