VR Teleoperation

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Author Note

Student choice report covering the advancement of virtual reality teleoperation developed by the Massachusetts Institute of Technology’s Computer Science and Artificial Intelligence Laboratory.

Overview

MIT’s Computer Science and Artificial Intelligence Laboratory has developed a new method of designing and implementing virtual reality robot teleoperation. The system relies on a virtual reality device such as the Oculus Rift or the HTC Vive, multiple sensor displays, and robot robust enough to complete human tasks. In their case they chose Baxter the humanoid robot from Rethink Robotics. The lab hopes to impact the manufacturing industry and help further expand the possibilities of this relatively new technology.

Applications

The main application that the laboratory sees for this product is allowing blue-collar workers to tele-commute. Most white-collar workers have the luxury of being able to work remotely if necessary, but with many blue-collar jobs a human must be physically present.

By advancing virtual reality teleoperation blue-collar workers would be able to operate machinery remotely to complete tasks. After a bit more progress it would be as if the worker was actually on the manufacturing line themselves if not better. Virtual teleoperation allows for human precision and robotic work capabilities.

How it works

In order to understand exactly what is new about MIT’s approach a little of bit of knowledge on teleoperation design is necessary. Prior to now the two main design models were the direct model and the cyber-physical model. The direct model had the user’s vision directly coupled to the robot’s state and was limited to a single perspective. An issue with this is it created a delay in signal that could lead to major simulation sickness. The cyber-physical model separates the user from the robot and the user interacts with a virtual copy of the robot and the environment. The drawback of this approach is it requires much more data and a specialized environment to map all these interactions.

With these design strategies in mind it is to be noted that MIT’s implementation is somewhere in between the two models. The basic premise of the product is the human space is mapped into the virtual space and then the virtual space is mapped into the robot’s space. This level of communication provides a sense of co-location and significantly reduces simulation sickness. Instead of extracting 2-D information from each camera, building a full 3-D model of the environment, processing, and redisplaying the data, this product relies on the human brains capability to create such environment from 2-D images. The spheres and hand controls are integrated to control the robots motor functions depending on the hand attachments. As previously mentioned the robots view and side angles allow the human brain to have a 3-D image without having to rely on an actual 3-D mapping.

Cool Features

This product allows the user to feel like they are “inside the robot’s head”. This is such a unique and interesting experience that one would only think possible in movies. Another cool feature is the development team found that video game users learned to use the system more quickly and effectively. As a video game user this excites me because that means the controls and design are intuitive enough and relatable enough to video games. Lastly the performance of the robot impresses me. In the video provided the robot is able to perform very precise actions such as picking up screws and even using tools such as a stapler. If it is capable of doing these tasks so early in development I am eager to see where it will be in a few years.

Strengths and Weaknesses

A major strength as mentioned above is that this technology allows robotic work capabilities with human decisions behind the wheel. A robot can withstand many conditions a human cannot and can do so with more efficiency and no possible injury. With the human mind in charge there is no necessity to develop a robust AI or even perfect conditions. The human can use reasoning a simple robot or even AI cannot. Even in its early stages humans were able to tele operate the product from hundreds of miles away which could lead to companies hiring operators all over the world. When this product was measured against competitors it performed significantly better in almost every way. This means that this current implementations is promising enough to continue research and development. As I see it currently these robots would be easily scalable and extendable after a bit more progress to any manufacturing job.

A few weaknesses of this product is it in the early stages of development. This a bit scary since there is a no idea where the progress will go or anymore will be yielded from the project. Another weakness is it is rather costly to implement since the Baxter robot unit alone is $22,000 for the base model. This doesn’t even account for the virtual reality device or the cost of setting up an optimal environment. The last weakness is as it stands conditions have to be set up correctly for this product to function. In future implementations I hope less tailoring of the environment will be necessary.

Simulator Sickness

While the direct model of teleoperation leads to major simulator sickness the incorporation of the cyber-physical model has cut down on simulator sickness significantly. I would rank it about a 3-4 which is low, and would probably be comparable to the Google cardboard.

Similar Applications

The major applications that this product would directly compete with is general manufacturing machinery. These are typically meant for predefined tasks in specialized environments. They often times require human supervision and adjustment constantly. In my eyes MIT’s design is the logical next step. That would integrate the two seamlessly. Another product I see competing with the product is robotic arm operations assistants. These arms help during surgery and provide precise actions in small spaces. The only issue with these from the research I conducted is that they are prone to malfunction and many have been recalled due to this fact. Also they have a rather small skillset and again only have predefined functionality. With MIT’s product the robot could, in future implementations, do anything a human could do but better.

Conclusion

I have high hopes for this product and its future. I hope that the team makes significant process that can allow blue-collar workers to tele-commute. In my opinion this would lead to significantly less human injury in the workplace and allow for even more efficiency and productivity. This idea sounds like something straight out of a movie and I am quite excited that technology has gotten to a place to allow such innovation and change.

References

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