FRI Fall 2016 Proposal

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October 1, 2016

1 Introduction

The University of Texas attracts thousands of tourists every year, and perhaps the most interesting building on campus is the Gates-Dell Complex. It would be advantageous to able to tour the building without having to physically travel to the university and developments in telepresent technology could allow people to do just that. There is a system in place for giving virtual tours of the GDC called Virtour, but it lacks several key features that make tours valuable to tourists. Specifically, the ability of the users to easily influence the path of the tour and a system to provide relevant commentary during the tour. In addition, there is opportunity for improvement on the user interface of the web app. There are design improvements to be made and minor errors to be corrected. Specifically, a major design improvement that can be made is an update to the landing page. As of now, the user is initially met with a list of available robots. Instead, a map of the GDC with live robot locations could provide a better user experience and give the user a quick understanding of where the robots are.

2 Background and Related Work

2.1 Robot-led Museum Tours

The concept of utilizing the web to give virtual tours has been studied in the past. A museum in Germany experimented with a robot giving tours via the web[1] and later expanded their work and enabled users to give feedback in real time.[3] These studies are over a decade and a half old and use outdated technology, but there is something to be learned from their approach to human-robot interaction (HRI) and the techniques for user participation over the web.

2.2 Virtour

The Virtour system[2] , designed and implemented by Patricio Lankenau, is a interactive web app that enables users to experience the GDC telepresently. It currently has the capability to stream live video feed from the robot's camera and keep an up-to-date position on a map. It also has the ability to allow a

"leader" to give high-level commands to the robot. To provide an interface for communication with the robots, Virtour runs code on the robot as well.

3 Issues with Virtour

3.1 General Bug Fixes

While Virtour is perfectly operational, there exists significant room for improvement. There are currently 7 issues listed on Github and noticeable UI issues on the site. Currently, the site indicates that no robots are available in text while simultaneously displaying robots that are available. The app also fails rather ungracefully when the DNS server can't be pinged and occasionally displays ping failure notifications when a ping failure didn't occur.

3.2 Unscalability

Another concern is the stress of scaling video streaming on the robot. Virtour uses roslibjs to stream video directly from the robot to the client. If 100 clients were using Virtour simultaneously, the robot would stream the same content directly to each client. Since robot CPU time is valuable and should be used for higher priority tasks, this is a problem that must be addressed.

3.3 Not Very Tour-Like

Lastly, Virtour doesn't give very good tours in terms of dispensing information about the building. It mostly wanders from door to door, or, if it is being controlled, visits specific locations. A major element of tours is the guide explaining significance of what is being toured. Virtour is lacking this capability.

4 Live location mapping and CMASS

A good way to start the reimplementation of Virtour is remodeling the landing page. A viable replacement for the listing of robots would be a map that shows the robot's locations in real time. Since the robot's possible locations span multiple floors, this would have to be taken into account with an option to change between floors and some notification of if there are robots on other floors. Virtour communicates directly with the robots to determine location, and only communicates with the robot that it's currently connected to. In order to display live robot positions, there needs to be a way to communicate with all the robots at the same time. This summer, I created CMASS, which does exactly that. A few processes run on the robot which periodically send location data, along with other diagnostics, to a server. The data can then be accessed through an API-like system. This enables Virtour to not only keep accurate real-time positions, but also allows additional data like who is logged

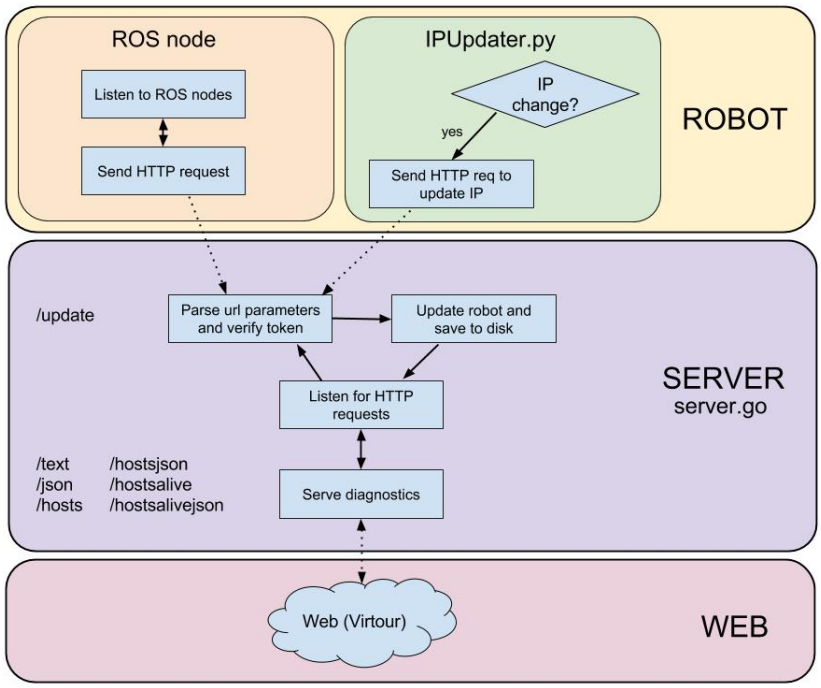

Figure 1: The structure of CMASS

into the robot and what programs the robot is running to be display in real time as well.

5 A More Tour-like Tour

5.1 Relevent Commentary

The objective of giving more educational, interactive tours is the second item that this project would address. The simple solution to the educational aspect would be to provide relevant commentary when the robot is in certain positions. There are already systems for determining robot location in terms of rooms and landmarks, so integrating with that would be a good idea.

5.2 Shared user control

To address the issue of user control, testing would need to be done in order to determine the best way to keep users engaged while also maintaining tour quality. The study mentioned above tried a few approaches like allowing users to directly control the robot, queue locations, or vote on destinations. Directly control could be hazardous to both the robot and the people in the GDC and

queueing locations could be exploited to degrade the experience of the tour, so, as a first estimate, users voting on destinations seems like the best solution.

6 Concerns and Ethics

6.1 Notification of Streaming

While the robot is being tested in the laboratory, the people it comes in contact with are used to its presence and are generally consenting to be streamed. However, when the robot is in common places, like the atrium, the assumption that everyone is consenting should not be made. There should at least be an clear indication that video is being streamed. The addition of LED light strips to the robots could offer a solution- blinking red lights near the camera or something similar could alert nearby people that they are possibly being watched.

6.2 Intrusion of Privacy

Another ethical issue is the intrusion of semi-private spaces, such as other labs or classrooms that are in use. While they could be points of interest for online users, the disturbance that it would cause researchers and students would make it unjustified. A normal tour wouldn't intrude on these spaces, neither should Virtour.

References

[1] W. Burgard, A.B. Cremers, D. Fox, D Hähnel, G. Lakemeyer, D. Schulz, W. Steiner, and S. Thrun. Experiences with an interactive museum tour-guide robot. *Elsevier*, 15.

[2] Patricio Lankenau. Virtour: Telepresence system for remotely operated building tours.

[3] D. Schulz, W. Burgard, D. Fox, S. Thrun, and A.B. Cremers. Web interfaces for mobile robotics in public places. *IEEE Robotics and Automation Magazine*, 49.