Urban International Design Contest

Jacksonville Transportation Authority - Ultimate Urban Circulator

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Executive Summary

Florida Polytechnic University represents the Jacksonville Transportation Authority (JTA) on their Ultimate Urban Circulator (U2C) Project as a part of the Urban International Design Competition (UIDC). The project's focus is connecting people and places around downtown Jacksonville by improving and expanding the current Skyway system. The U2C System Plan recommends extensions to reach existing and planned development allowing it to function as a true circulator system, and connecting to the larger public transit system, including local buses, bus rapid transit (BRT), and future commuter rails. Additionally, JTA plans to use emerging technology such as Autonomous Vehicles (AVs) to transport passengers seamlessly from the elevated platform to the at-grade street level roadways. JTA believes autonomous vehicle technology has the greatest potential for meeting the desired requirements of the U2C project such as:

- Providing a higher frequency service
- Supporting street level extensions in dedicated transit lanes
- Allowing for cheaper operating costs
- Offering flexibility for both passengers and for future expansion

Purpose of the Project

In December 2015, the JTA Board of Directors approved a resolution to modernize and expand the existing Jacksonville Automated Skyway Express (Skyway), and recommended the development of a Skyway Modernization Program. The goal of the program was to create a path forward for the Skyway by incorporating vehicle technology, and developing a strategy to expand the system to connect to more communities and business developments in the future. The project team evaluated current and emerging technologies, analyzed where people travel now, and their

mobility needs for the future; evaluated development plans; and, gathered community feedback. As a result, the Skyway Modernization Program recommended transforming the Skyway into a new, Ultimate Urban Circulator (U2C) system. The U2C program goal focuses on utilizing the existing Skyway system and expanding the area it serves while incorporating emerging autonomous vehicle transit technology.

Why did we select this project?

In the spring of 2017, we had the opportunity to study autonomous vehicle technologies in an Autonomous Vehicles class taught by Dr. Dean Bushey. Throughout the course, we learned about lidar and visual sensor technologies, sensor fusion, computer vision, programming of robotic systems, and the basics of machine learning as it applies to self-driving cars. Our project was to design, build, and program a scale-model autonomous vehicle, capable of navigating a challenging city course in full autonomous mode. Additionally, we learned about the legislation, infrastructure, and problems associated with AV technology. Coming out of the class, we were motivated to work in

the AV area, and were eager to apply our knowledge to other projects. During the end of summer, Dr. Kevin Salzer, from JTA, asked us if we were interested in working on an autonomous project with the City of Jacksonville to model their planned new Skyway U2C system. We accepted the challenge, eager to learn about the U2C project, to apply knowledge of autonomous systems, and to represent the Jacksonville Transportation Authority in the UIDC competition.

Figure 1
Focus area for the UIDC model

Figure 2.1

Figure 2.2
Existing Elevated Skyway

Options for Upgrading the Skyway

As seen in Figure 2.2, the Skyway system is elevated above ground. Figure 2.3 shows the current center beam design that would need to be removed in an autonomous vehicle solution. JTA is considering 3 solutions:

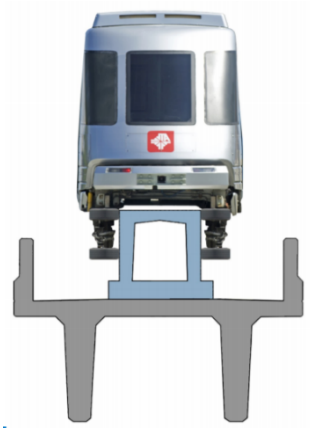

Figure 2.3

1. Keep the beam and replace with similar vehicles
2. Replace the beam and replace with a new vehicle
3. Remove the beam and use autonomous vehicles

Option 1 would be medium cost, and require few modifications to the Skyway system. In addition, the service life of the vehicle is estimated to be up to 30 years with high reliability and potential for high-frequency use. However, this option has limited operational flexibility, and thus is not a viable option for street-level operations. Another major concern is that, like the current vehicle, it would be a special purpose vehicle with the potential for reduced maintenance and spare parts support over time.

Option 2 would have a similar service life, but these vehicles could travel with higher capacities at higher speeds. However, the option would require heavy modification of the existing system, leading to a high construction cost. In addition, the option also has limited operational flexibility and is not a viable option for street-level operations.

Option 3 vehicles may have a short-term service life, but they do not require a long-term commitment to the technology as Option 1 and 2 require. The vehicles could offer a high level of flexibility to change vehicles later on, potentially providing for a more cost-effective vehicle. Additionally, these vehicles can be operated on the street, which allows the U2C to extend past the elevated Skyway path. However, autonomous vehicle technology has numerous unknowns and is relatively unproven in the current marketplace. At-grade extensions would require dedicated lanes and likely an operator in the near-term. This option would likely have significant conversion costs. Infrastructure and operating system conversion would be highly disruptive to operations.

Based on research, meetings, and surveys with multiple companies and customers, JTA determined that the preferred vehicle for the U2C would be a Shared Autonomous Vehicle (SAV), similar to those seen in figures 3.1 and 3.2. While the current application might be limited, AV technology is expected to advance in a time frame that would allow the U2C to have the take advantage of the advanced technology. The operational flexibility provides high capacity and high frequency service. Extensions are more cost-effective and can be at the street level or elevated, and flexibility is critical for the system to reach existing, emerging and planned residential, employment and retail centers.

Figure 3.1

Figure 3.2
Conceptual rendering of new Autonomous Vehicles

What would be the environmental and transportation effects created?

The proposed U2C system will achieve the purpose of a downtown circulator system by:

- Providing high-frequency service and accessibility
- Offering service flexibility
- Provide for extensions that can be elevated or at the street level

Additionally, the U2C extensions plan to connect the Skyway to emerging development in Riverside, Jacksonville Sports Complex, The Shipyards, and San Marco. These extensions are shown in figures 4.1 and 4.2 and would link the Downtown region to nearby, popular neighborhoods and allow people in the Downtown core to reach employment, residential, retail, medical and educational centers and reduce the number of car trips.

Figure 4.1

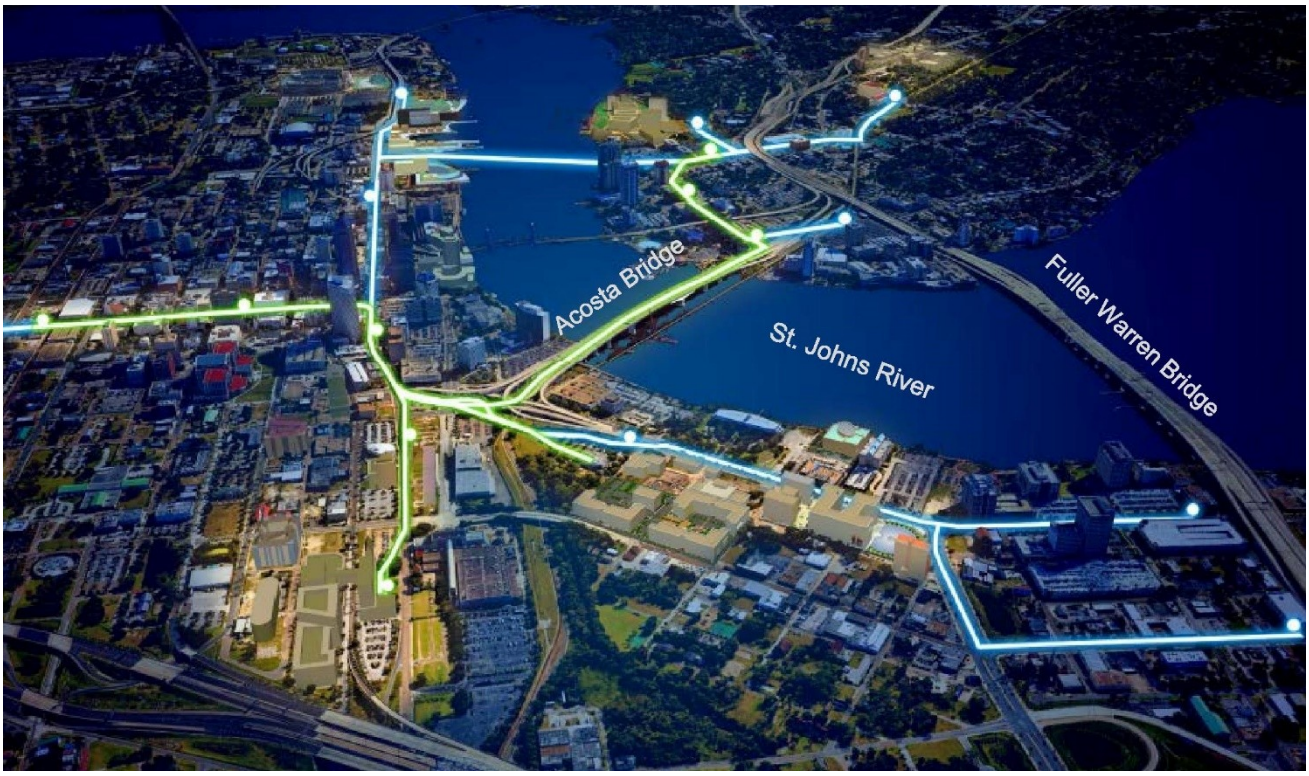

Figure 4.2
Existing Skyway and Potential Extensions

Currently, the maximum capacity for skyway vehicles is 56 passengers. JTA plans to replace these vehicles with smaller AV shuttles that hold 12-15. Four of these vehicles would replace one skyway vehicle. Once the vehicles are able to reach surface level in phase II the system will be able to reach the nearby neighborhoods on regular streets. Furthermore, AVs allow JTA to have a larger fleet of vehicles that arrive more often and travel further to drop off customers closer to their destination (street level access). This will allow for more dynamic routing allowing the system adapt to changing rider needs. Today's ridership is 5000 passengers per day. The current system serves many places people want to travel to, but it does not connect many residences. The will reach many residences in the nearby neighborhoods. This is expected to increase ridership. In the future, AVs have the potential to be cheaper to call a car to drive you than owning a car.

Conclusion

The purpose of U2C is to seamlessly connect people from their homes to Jacksonville. The current skyway system transports thousands of passengers a day. However, it does not connect people to their residences. JTA plans to change that with autonomous vehicles. AVs play a crucial role in this area because it provides a way to reach more people than the existing Skyway system by utilizing street level access. Additionally, it allows a cheaper way to expand the system, which will potentially result in more riders and reduce the total number of car trips. A concern for customers is wait times; the existing Skyway system has a wait time of around 6 min. With AVs, JTA aims to strategically utilize the cars to show up more often resulting in shorter wait times. With the advent of AV technology, JTA will soon be able to implement their new transportation system and be a model for other cities to follow.

Images and Video

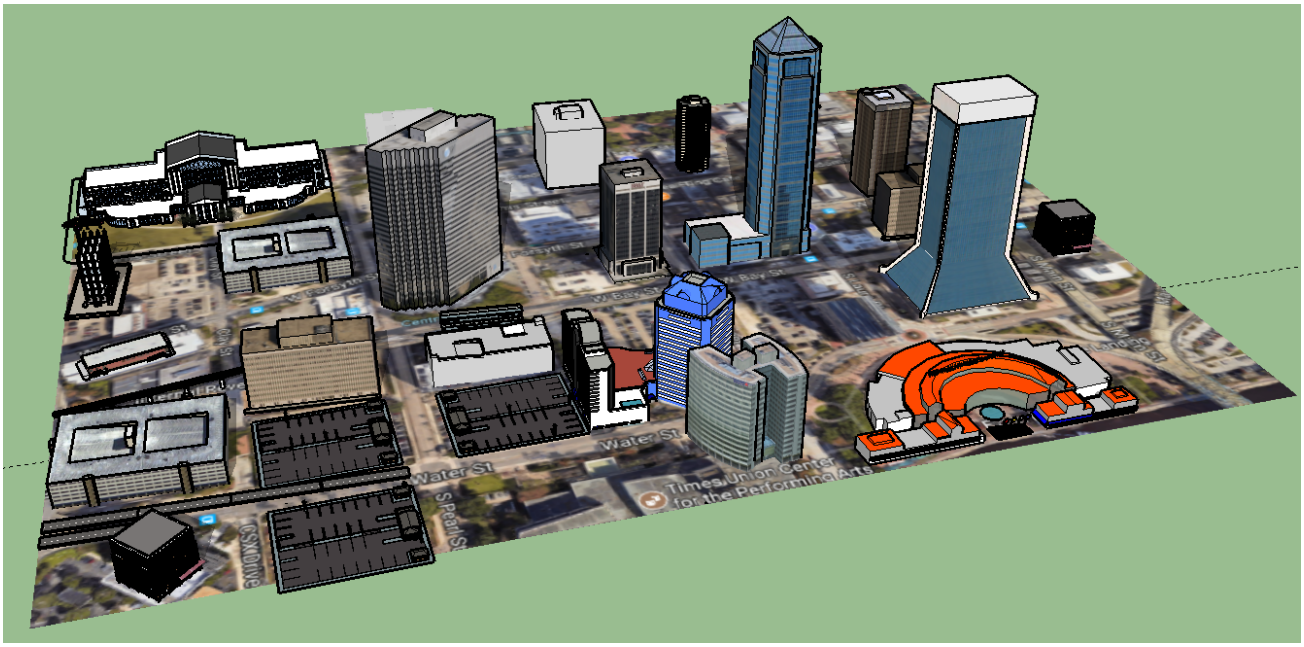

Figure 5.1

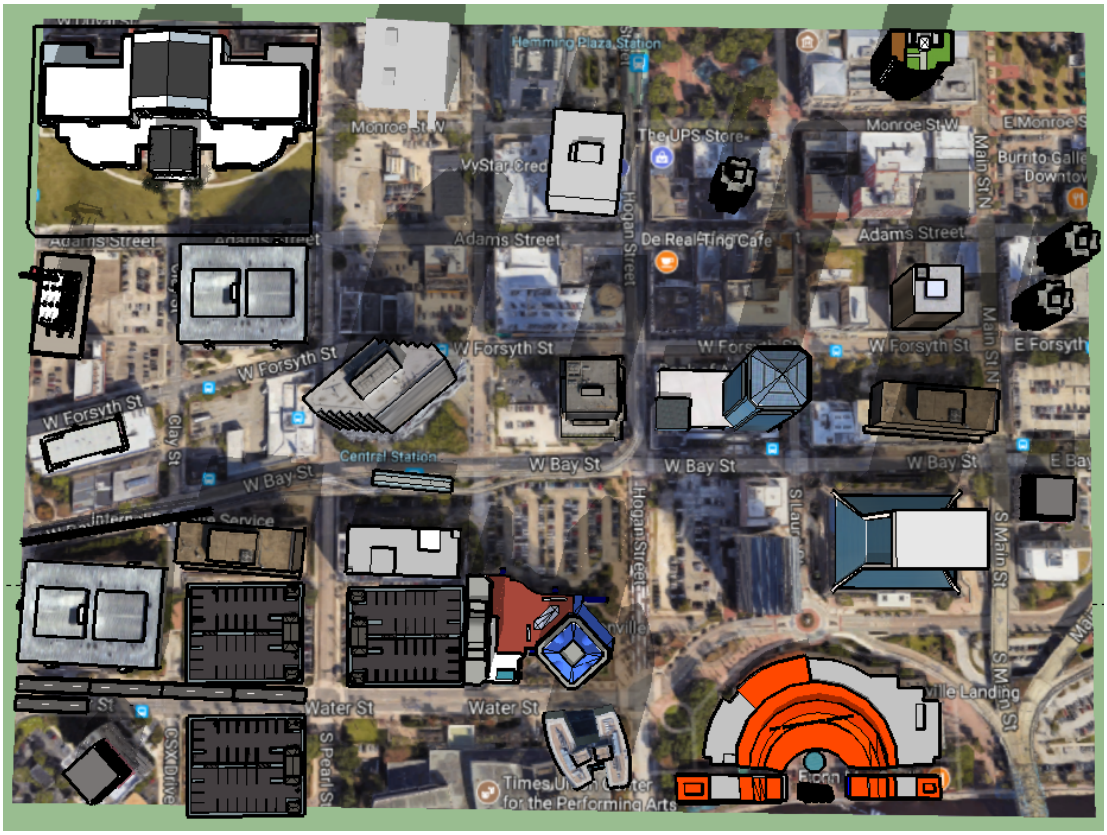

Figure 5.2
3D Renderings of Jacksonville

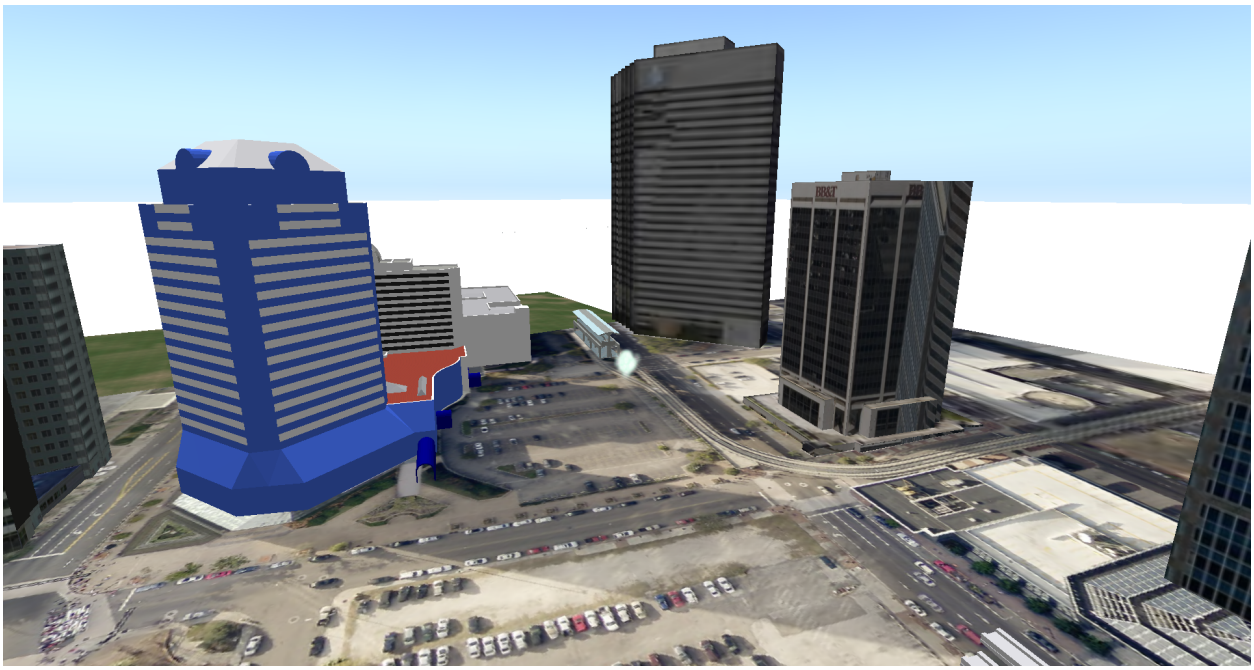

Figure 6.1

Figure 6.2

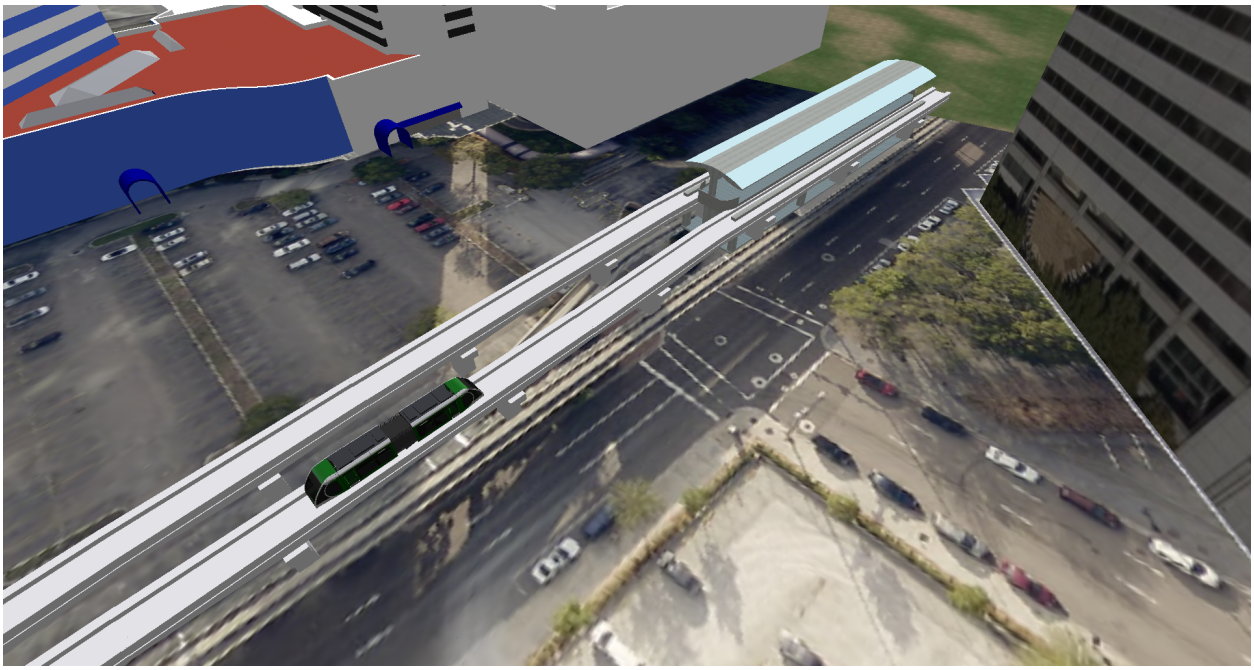

Figure 6.3
Conceptual rendering of U2C