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Inclusive Mobility Model for a University Town: Case of Gainesville City

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I. Introduction

The City of Gainesville is a college town community that is dominated by its university population. The majority of the city's residents are students, who rely on public transit to fulfill their daily commutes. Increasing road congestion showed a declining trend of transit ridership, as the preference of the riders (particularly choice riders) shifted towards use of private modes of transportation. According to City of Gainesville's ridership data, the total yearly passenger trips have declined from about 10.29 million in the year of 2015 to 9.21 million in 2019. The main reason is an inadequate access to public transit services from many areas of the city. Additionally, limited transportation options and the absence of multi-modal integration adds to the problem. This situation leads to inequities and social isolation among residents of different communities specially the vulnerable sections, like elderly and low income. Concerned with the present scenario, researchers at the University of Florida created an inclusive mobility model for the City of Gainesville. The main focus of the inclusive mobility model will be centered on the commutes to and from University of Florida (UF). Researchers aim to create a model that will foster an environment for seamless mobility for the vulnerable populations, mitigate congestion, and improve first mile-last mile connectivity throughout the city.

II. Existing Scenario

As the University continues to boast a top ten ranking amongst U.S. public universities (U.S. News and World Report, 2018) the city of Gainesville will continue to progress and develop in innovative ways. With over 150 new developments approved since 2017 around Gainesville, the current means of mobility will face more pressure. A number of these new developments are in West Gainesville (North Florida Regional Medical Center, Celebration Pointe, etc.) and serve as sources of attractions for leisure, medical, and entertainment trips, but are not equally accessible to all residents throughout the city (Gainesville Department of Doing, 2020). To provide further understanding of the city, the following sections explain socio-economic variables, social variables, and factors related to public transportation and urban traffic.

2.1 SOCIO-ECONOMICS AND SOCIAL VARIABLES OF THE CITY

2.1.1 Income levels/disparities

Prior research conducted at UF indicates that Alachua County, in which Gainesville is located, has a history of disparities (University of Florida, 2018). This research emphasizes areas in Gainesville that have significant disparities regarding housing, transportation, employment, etc. East Gainesville and Haile Plantation neighborhoods are recognized as two differing communities. East Gainesville, predominately populated by minorities, has historically lower incomes, high levels of poverty, limited access to vehicles, and low economic attainment. Haile Plantation is an un-incorporated, newly developed, car-centric, and high-income neighborhood, with a high concentration of White persons. Opportunities for transportation are not equitable among these communities. Individuals within East Gainesville are a majority of minorities, living in poverty, have limited access to vehicles, and a low education (University of Florida, 2018). East Gainesville have different demographics, specifically by race and socioeconomics. In this area, housing prices are lower, and often occupied by low education minorities (University of Florida, 2018). Access to essential services (e.g., grocery stores, medical services) is scarce in the East (Alachua County Community Health Advisory Steering Committee, 2016). The population of East Gainesville is more homeless and owns fewer homes and vehicles, often requiring residents to rely on public transportation for mobility. On the opposite side of Gainesville, Haile Plantation is predominately occupied by educated Caucasian individuals. Many residents are professionals, such as professors, with higher income levels. The home value is higher in Haile Plantation, which leads to a higher tax base and generates disparities among other areas in Gainesville (University of Florida, 2018). Newer

developments, which are critical for educational and employment opportunities, are focused on the West side of Gainesville because the East does not have customers with disposable incomes or attractions desirable for developers.

2.1.2 Isolation

One of the transportation-based disparities experienced by many low-income or rural neighborhoods, like East Gainesville, is the first-mile, last-mile challenge (Boarnet, Giuliano, Hou, & Shin, 2017). A resident may have to travel a few miles from their home to a bus stop to reach a specific destination. Although this distance may be small, a lack of available transportation options may create barriers for everyday engagement in occupations. For example, employment and housing opportunities may be impacted by the lack of transportation options (Kawabata & Shen, 2007).

2.1.3 Elderly population

Florida has one of the highest older adult populations among the nation (Gillen & Dwyer, 2018). Although Gainesville is highly population by working age individuals, 12.8 percent of the Gainesville population was 65 and older (University of Florida, 2018). Older adults report that using transportation is a challenge and requires extra assistance. In fact, the Department of Elder Affairs conducted a survey assessing the needs of 2,000 older adults in Florida (Department of Elder Affairs, State of Florida, 2016). Approximately 47% of respondents state they use personal vehicles, and 18% rely on other modes of transportation (e.g., taxis, vans, special transit, or senior ride services). Alternatively, 22% of respondents stated they rely on family and friends for transportation. Limitations or lack of transportation limited the ability for older adults to get to their medical appointments and pharmacies. With decreased access to affordable transportation options, older adults may face poorer health, social isolation, and reduced quality of life (Department of Elder Affairs, State of Florida, 2016).

2.1.4. Student population

There are two major post-secondary schools in Gainesville, Florida: 1) the University of Florida, and 2) Santa Fe College. According to the U.S. Census for 2018, there were a total of 133,857 residents in Gainesville, Florida (U.S. Census Bureau, 2018). Much of the population of Gainesville consists of students. Specifically, for the 2019 fall semester, there were a total of 56, 567 students enrolled at UF. Of these students, 51, 929 individuals are "on-campus" utilizing Gainesville's resources (e.g., transportation), not including any student that takes classes in online format (University of Florida, 2020). There were 15, 864 students enrolled at Santa Fe College for the 2019 fall semester (Santa Fe College, 2019). Although the focus for the proposed mobility model centers on transportation surrounding UF, there are joint programs between Santa Fe College and the University. Therefore, the researchers felt the statistics of students enrolled at Santa Fe College was an important consideration as they may be travelling back and forth to each campus. Approximately 67,000 students, which equates to nearly 50 percent of the Gainesville population attends UF or Santa Fe College.

2.2 GAINESVILLE RTS

Gainesville RTS is a local area transit corporation that serves the City of Gainesville (primarily the University of Florida and Santa Fe College campuses). Currently there are 58 operational transit routes (city level) with about 1568 transit bus stops in the city (Figure: 1 below depicts RTS routes). The majority of the transit routes cover Downtown Gainesville and UF campus area. Fare for riding the bus service is about 1.5 dollars. Veterans, youths, and persons with disabilities can ride the services for half of the fare. Students of UF and Santa Fe are allowed to have unlimited rides with their student's ID as part of their tuition fees go to RTS. RTS bus services operate all seven days of the week, with headways ranging from 9 minutes to 105 minutes. However, the schedule of the buses keeps changing with respect to the schedule of the classes and holidays. There are ten RTS routes (Campus routes) that operate within the campus of UF. These include "park and ride" and circulator routes. Apart from that, there are 5 routes that serve as "Later Gator Routes" which is a late-night service for safe mobility of students between campuses, downtown, the Oaks Mall and southwest Gainesville.

The University currently offers various alternatives to supplement the existing RTS routes (University of Florida, 2019). However, these modes cater to faculty, staff, and students. The Campus Connector is a free fixed route shuttle that is available throughout the weekdays and offers three separate routes with services ending at 6:30 pm. The Campus Cab is another free service offered during the weekdays that is tailored more for faculty and professional use. This service must be booked in advance and is on a first come first serve basis with services ending at 4:45 PM. For users with mobility related disabilities, Gator Lift is offered from 7:00 am – 11:00 pm but is sensitive to the hours of operation of the University. The other free service, exclusively for students, is the Student Nighttime Auxiliary Patrol (SNAP) which is an on demand that is available from 6:30 PM until 3:00 AM. Zipcar is also available on UF's campus but at a cost. Overall, mobility throughout campus is acceptable, but is still highly focused within the campus boundaries. RTS still serves as the most utilized

mode of transport, but the system is supplemented with alternative modes within the peak weekday hours of operation. More so, all trips made off campus are still highly dependent on RTS. With the University of Florida serving as the main mobility hub, it would offer seamless connections to other areas of Gainesville benefiting both the students and the surrounding residents. This would increase the mobility of students and vulnerable populations who may be transit dependent or unable to drive within the surrounding area.

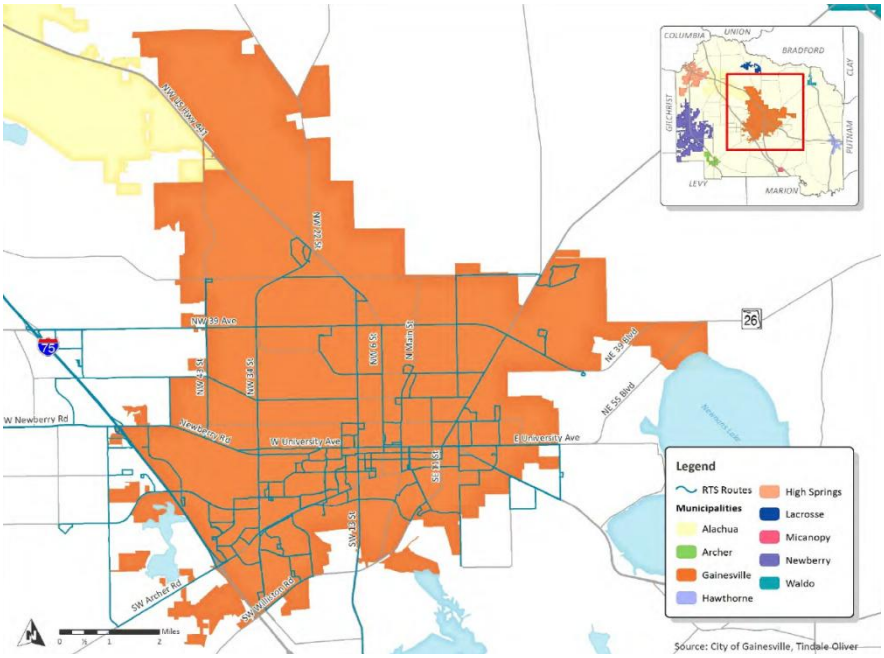


Figure 1: Gainesville RTS Route Map

East Gainesville has less bus services compared to other areas of the city, resulting in disproportional access to transit, entertainment, and medical needs. Thus, mobility in the east-west direction needs improvement. The University serves as a daily destination within Gainesville, with over 35% of the population being college students (University of Florida, 2020). Additionally, the university facilities (e.g., UF Shands hospital, UF campus) serve as one of the city's largest employers, employing over 30,000 residents (Alachua County Library District, 2016). Movement into the city is dominated by personal vehicles, but RTS still serves as a major facilitator of mobility. Due to the university serving as a hub for education, health, and employment, a high percentage of the RTS routes run through or nearby the University, but do not adequately serve the areas East and West of the University. More so, ridership has continually decreased in RTS which could be a result of low accessibility in transit dependent areas as well as the reduction of services outside of normal school year operations. The lack of efficient routes for East and West Gainesville decreases attractiveness and trust in transit services. Micro-transit has recently been implemented within the East side of Gainesville, started January, 2019 (RTS Gainesville, 2019), and has reported a significant increase in ridership since being introduced.

2.3 TRAFFIC CONGESTION AND SAFETY

2.3.1 Traffic counts

The City of Gainesville collects traffic counts (e.g. Average Annual Daily Traffic (AADT)) on local roads including the perimeter roads around the UF campus as shown in Figure 2, below. Traffic counts on arterial roads are gathered by the Florida Department of Transportation (FDOT) since the perimeter roads around campus are state-maintained arterial roads which provide primary regional access to the University while also accommodating regional through traffic on the state highway system. Figure 3 below, presents trends in traffic counts for campus perimeter roads as collected by the FDOT. In general, the data in Figure 3 above confirms the continued trend, toward increasing traffic count around the main UF campus. This can be attributed to a decrease in the number of transit ridership and an increase in the number of private modes ridership.

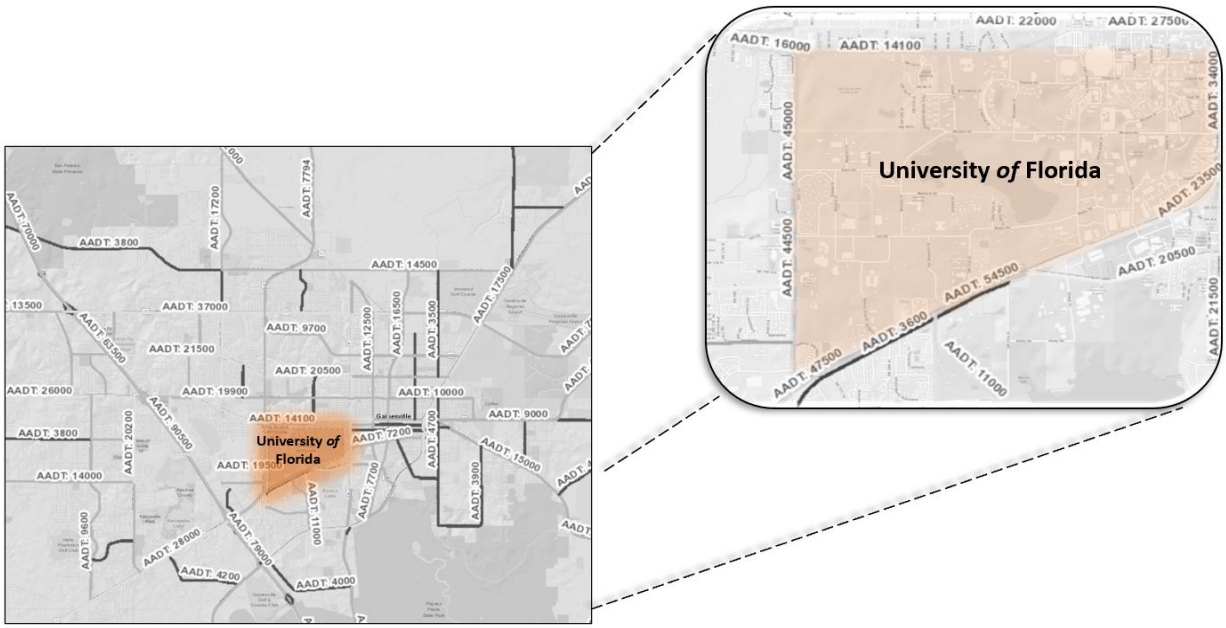
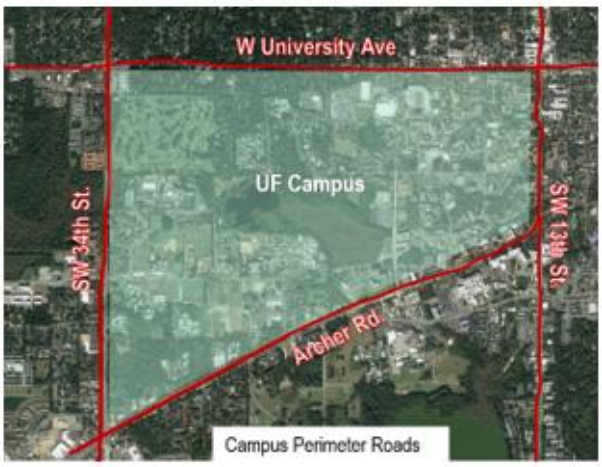


Figure 2: Average Annual Daily Traffic (AADT)[1], the city of Gainesville and University of Florida.



FROM	TO	Year	
		2013	2019
Archer Rd.	Campus	39,000	45,600
W. Univ. Ave.	Campus	27,500	31,500
SW 34 St.	Campus	54,500	58,000
SW 13 St.	Campus	20,200	20,600
Campus	Archer Rd.	34,000	37,600
Campus	W. Univ. Ave.	16,700	23,200
Campus.	SW 34 St.	45,600	50,600
Campus	SW 13 St.	12,600	16,500

Figure 3: Average Annual Daily Traffic (AADT), Campus Perimeter Roads, for years of 2013, 2019.

2.3.2 Traffic safety

The study area was mainly defined for UF and some parts of its immediate periphery. The University has approximately 52,000 students on-campus and 15,000 academic and administrative staff. And the recent traffic crash data obtained from the University Police Department (UFPD), shows that traffic crashes occur mostly due to the employees during leaving campus (i.e., in the afternoon peak) with an alarming trend of car mode crashes as shown in Figure 4 (a) and (b).

[1] Source: FDOT http://www2.dot.state.fl.us/FloridaTrafficOnline/viewer.html

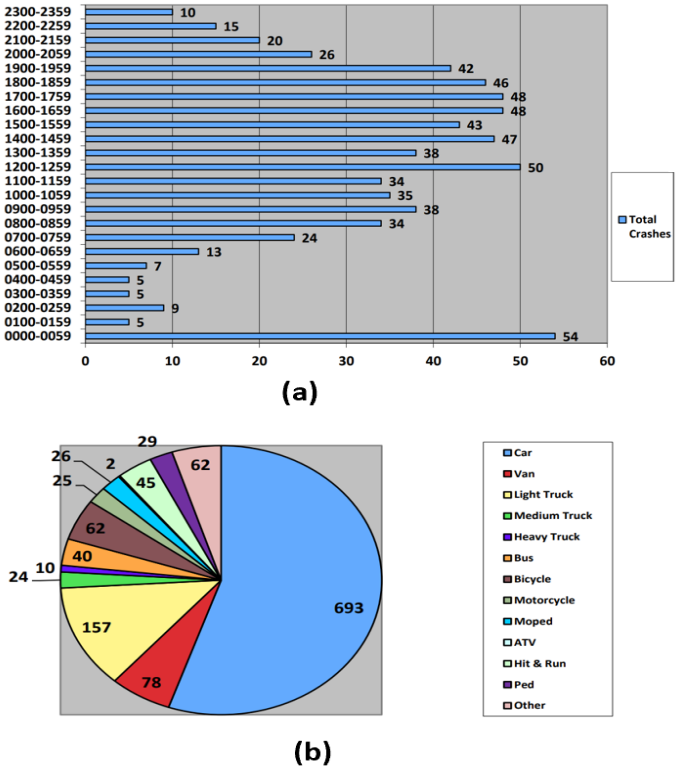


Figure 4: (a) Total Crashes by Time of Day, (b) Crashes by Mode[2]

According to Figure 5, most of the crashes occurred at roadway which is due to high traffic density in the perimeter roads around the UF campus. Moreover, crashes are related to junction constituting intersections and non-junction locations, and the significant contribution of crashes related to distracted drivers and congestion.

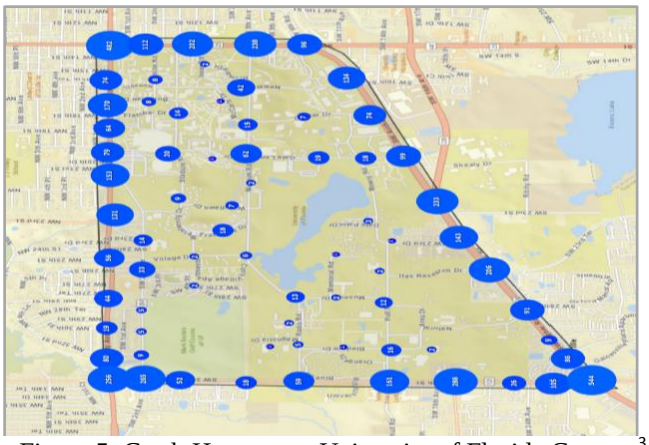


Figure 5: Crash Hotspots at University of Florida Campus[3]

III. Solution Action Plan

To provide seamless mobility to the riders, relieve congestion and increase safety levels for city roads and around the UF campus, this study proposes an inclusive mobility model based on following components (Refer figure 6). Solutions have been proposed with focus on the components depicted in the figure for City of Gainesville. Figure 6 provides a visual representation of the variables impacted by the proposed mobility model. The model encompasses the following variables to enhance transportation for Gainesville residents: 1) increase inclusivity, social connectedness, and access to basic needs in the community, work or school for city residents, especially those limited to accessible transportation, 2) use of transportation modes and strategies that reduce carbon emissions to become more environmentally friendly, 3) use of smart technology to offer city residents

[2] Source: University Police Department (UFPD), the years of 2016-2019
[3] Source: University Police Department (UFPD), the years of 2016-2019

and transportation users more options (location based, time based, and convenience) and 4) offering a number of modes of transportation, as each resident has different needs regarding transportation (e.g., assistance with a wheelchair, specific time to travel, distance). All variables listed above work together and impact one another to support the mobility model and improve transportation for city residents.

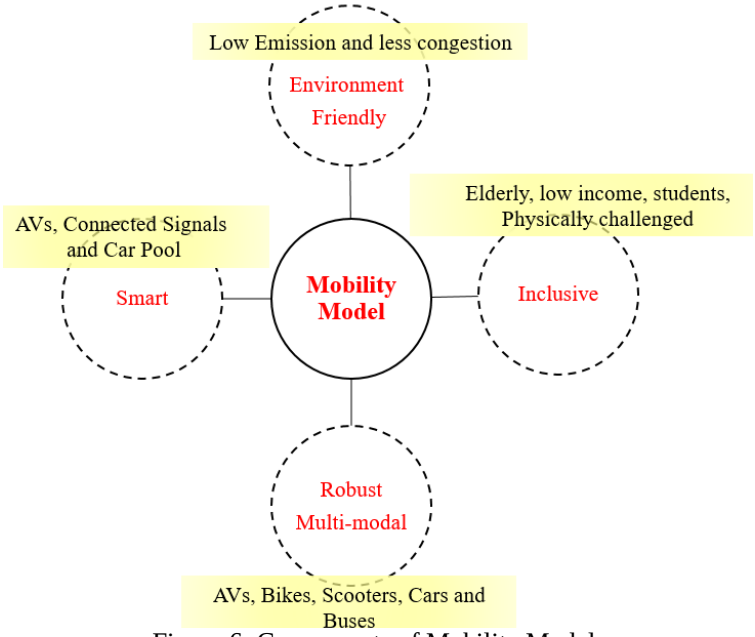


Figure 6: Components of Mobility Model

3.1 Mobility Hub

To integrate various modes of transportation and increase connectivity, mobility hubs can be implemented throughout the city. These hubs will include bus services and be extended to other transportation modes such as bike and scooter share, and on-demand autonomous shuttles services. To cater to vulnerable populations and increase ridership in RTS, mobility hubs can be placed in transit limited areas, such as East of downtown and near I-75 in Gainesville (see locations in Figure 7).

Figure 7: Location of Mobility Hubs in Gainesville City

These hubs will integrate RTS routes, Microtranist, micro-mobility, autonomous shuttles, and ridesharing options to create a seamless transportation network within Gainesville. Each hub will include various components (Figure 8) that will be placed around Gainesville. The University currently serves as a transportation hub serving a high frequency of bus stops, car sharing options, electric charging stations, and ride-hailing along the campus perimeters. There is also higher pedestrian, bicycle, and motor scooter traffic within and surrounding the campus. With plans to create a more walkable yet dense campus (Smithson, 2019) the campus can be retrofitted with micro-mobility, micro-transit stops, and further implementation of

autonomous shuttle technology currently being used in the Gainesville I-Street Project. The University will serve as the main hub since it already has many of the components needed for a mobility hub.

Another location for a mobility hub is in East Gainesville, which is considered a transit dependent area due to lower income and vehicle ownership. This area has been inundated with racial disparities which have kept developers away (University of Florida, 2018) and placed necessities further West. This heightens the need for better East-West mobility within the city and an increased amount of service to East Gainesville. The East Gainesville Hub will be equipped with components that can be beneficial to the community and improve accessibility. The mobility hub will increase pedestrian connections while simultaneously assisting in resolving ridership issues associated with first mile last mile.

To ensure that the RTS system is attractive and equitable to an area with higher levels of poverty and lower levels of car ownership, the bus service should be updated to provide alternative routes and information distribution to keep track of buses and available micro-mobility options (bikes and e-scooters). A text-in option shall be presented for users who may not have access to a smartphone or data and the older population who may struggle to use newer technology. Currently micro-transit has seen success in East Gainesville (RTS Gainesville, 2019) and could be repurposed to assist vulnerable groups such as the elderly. For the elderly population that may rely on public transportation, the micro-transit can be integrated in the mobility hubs to aid with essential trips such as doctor appointments, prescriptions pick up, or grocery pick up to ease use of the public transportation system. Given the weather conditions unique to Florida, covers should be installed at all stops to deal with gully washers and extreme sunlight. To further enhance bus infrastructure solar panels can be incorporated at stops to power screens for real time updates, lights at night, outlets, and possibly Wi-Fi. The real time updates should include how RTS routes connect with each other and the newly introduced multi-mobility modes. Assimilation of technology such as Wi-Fi on buses should be prioritized to buses in which passengers spend more time aboard, through analysis of route length and ridership. Further facility improvements near the hub would include expansion of bike lanes, multi-use trails, and sidewalk connectivity. East Gainesville currently has bike lanes that run through its main corridor and could be branched off through various streets to increase connectivity via bike. Allowing trails to be accessible by multimodal forms of mobility such as bike and e-scooter will facilitate more mobility. The introduction of micro-mobility systems will alleviate first-last mile issues faced in the area, but focus should be given to making modes within the system easily accessible by lower income areas. Not everyone has a credit card or smartphone, which are needed for most micro-mobility systems, so alternative forms of payment should be accepted through fare machines that distribute fare cards. It is imperative that the payment methods for RTS and micro-mobility system share a common form of transactions to facilitate multi-modal trips and increase attractiveness.

Due to its increasing popularity, the hub should be equipped with drop-off and pick-up zones for ridesharing. However, the cost of ridesharing can make it unattractive to lower income communities and these zones should be retrofitted for future autonomous shuttle operations. Ultimately creating drop-off and pick-up zones that could be used by more than one mode of transportation. To ensure longtime use of the mobility hub it is important to consider the implementation of autonomy in public transportation. The improvements in mobility in the East-West direction will not be immediate and the first stage should include providing high frequency bus routes in East Gainesville that connect to stops at the main hub (University of Florida) that can effectively facilitate movement to destinations in the West. New direct routes from east west can be explored once the increase in ridership is noted.

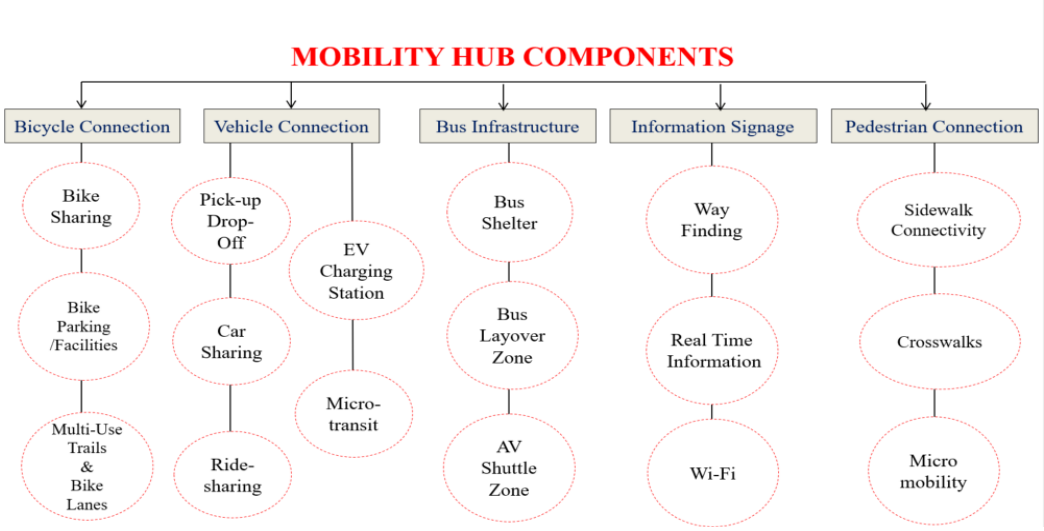


Figure 8: Components of Mobility Hub

3.2 Connected Signals

Connected signals can be used to facilitate movements throughout Gainesville, and more specifically between mobility hubs. This application is an example of traffic signal V2I technology that will collect real-time information such as (current signal light state and time, pedestrian and bicycle information) at selected signalized intersections and routes of University Avenue, US 441 (SW 13th Street), and Florida State Rds.121, 24 (SW 34th St, and Archer Rd) as in Figure 9, then sent it to Gainesville drivers via a mobile phone app for conventional vehicles and via onboard unit for connected/autonomous vehicles. This application will potentially lead to a number of benefits: First of all, it will help to ease congestion as drivers can avoid stopping altogether. Next, it can reduce red-light crashes and other pedestrian and bicycle crashes. Finally, it will reduce the number of stop and go activities and consequently save and reduce emissions. The location of existing connected signals is around UF, which will serve as the main hub. The high volumes of traffic could be better mediated with this V2I technology that can keep private vehicle operators and bus operators better connected for seamless movement. Although this will not be a complete fix, it could be beneficial to the safety of pedestrians and bicyclist near campus.

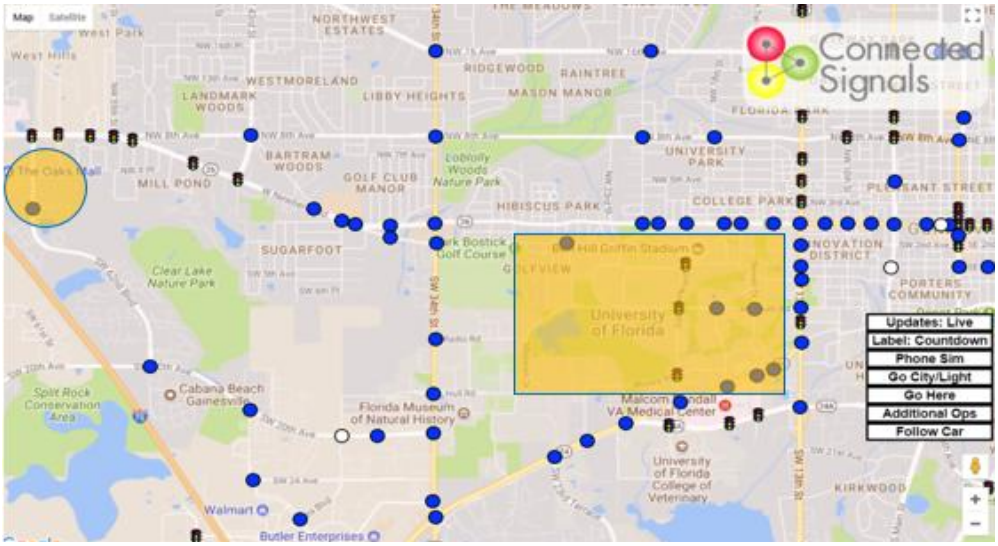


Figure 9: City of Gainesville – Connected Signals

3.3 Carpool Program

The Carpool Program encourages eligible UF and Shands faculty and staff members to share a ride to and from campus every weekday. The program matches prospective participants who have similar work schedules and live along a similar commuting path. After the matches are identified, then they will be assigned parking spaces on campus. The parking zone will not be limited to the carpool designated zones, other parking areas will remain open for carpool parking if space is available. The carpool matches must commit to riding together on a majority of days; but, if on an occasional basis one of the group members is unable to carpool or has an unexpected personal/family emergency, an emergency ride request can be issued to the Campus Cab. Having a secondary option (Campus Cab) the other group members may leave and/or arrive to campus with lower stress levels. The Carpool Program offers a commuter option that may work best for people who live where transit service may be limited or non-existent, and it may better fit your schedule. Furthermore, the program will lead to a better environment, fewer gas emissions, and reduce congestion by lower the number of private vehicles overall road network.

3.4 AV Shuttles

This project will deploy Autonomous Transit Shuttles (AVs) to connect the city downtown and the University campus with student housing by means of frequent transit service. AV routes given in Figure 10, are aligned over low traffic streets where AVs can operate at lower speed for safety precautions. Moreover, the routes changed from a 1-way to 2-way service depends on the requested demand at real-time basis. The AVs can help to bridge the gap in bus services by providing first-mile, last-mile solution for commuters to reach their destinations. Moreover, this project may provide new mobility options that are reliable and safe during emergency crisis such as (pandemics) for specially deliveries around the city.

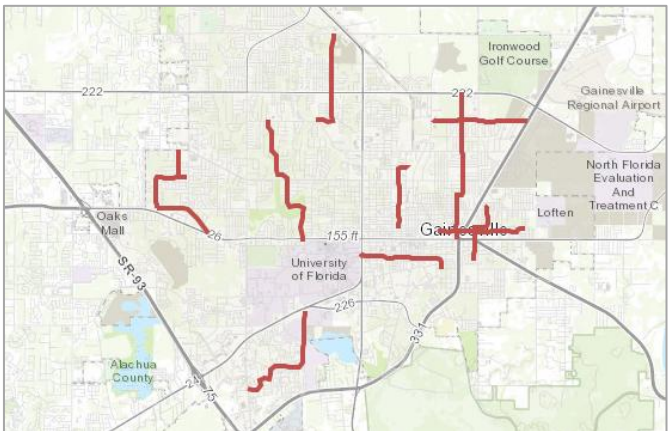


Figure 10: City of Gainesville – Proposed Autonomous Shuttle Routes

IV. Final Summary

Mobility is a contributing factor to wellbeing of life within Gainesville, especially given the westward growth patterns within the city. Goods and services should be easily accessible by all groups, no matter age, income level, or car owner ship. The introduction of mobility hubs can facilitate higher use of multi-model travel and pedestrian friendly areas, which can lessen the carbon footprint of personal vehicles. The City of Gainesville will be more accepting of various modes of transportation given the high population of college students. If more modes were offered at an affordable price, they can be easily integrated into everyday travel patterns of RTS users. By making modes like walking and biking more attractive, the mobility incentive becomes intertwined with health benefits as well. The addition of mobility hubs will help to extend transportation opportunities to the disadvantaged areas of Gainesville. In turn, these additions will help address the racial and income disparities (e.g., first-mile-last-mile) in Gainesville by providing better access to transportation for more individuals. Components of the existing University of Florida RTS system can be integrated with autonomous shuttle technology, micro transit, and micro-mobility systems to serve as the model for the effectiveness of multi-modal integration. All hubs will share similar components while attempting to adhere to the direct needs of the population that frequent them most. Options for the elderly population will be further advanced via micro-transit. The implementation of connected signals can have positive effects on driving through the city by easing the stress and anxiety of congesting. These advancements in connectivity can result in lower vehicle emissions by limiting stop-and-go activities and entice more individuals to use ride-share or car-pool. Priority could be giving to buses that are traveling with connecting routes to other hubs through connected signals, ultimately making bus trips more attractive and further reducing the number of vehicles on the road. With higher levels of connectivity, safety of riders and other road users can become enhanced. Additionally, this access to transportation will allow individuals opportunities for education, employment, and engagement in everyday activities. Our proposed mobility model is a robust multimode mobility model that offers multiple convenient transportation choices that best support the University's resident transportation needs.

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