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The First/Last Mile:

Introduction

This report covers the First Mile Last Mile problem, often referred to as the First/Last Mile problem. This problem is defined as a large distance, usually half a mile or larger, between one's starting location and public transportation as well as one's destination. The First/Last Mile problem is a problem that affects people all over the world. However, this problem greatly affects those unable to afford means of private transportation. This hinders people's daily lives as they are unable to access necessary services. The First/Last Mile problem which hinders development and can continue the poverty cycle. While there have been many solution attempts in the past with varying degrees of success, they all have their own drawbacks and limitations. Due to the First/Last Mile problem, people who rely on public transportation have limited access to necessary services and are restricted in where they can live and work.

The problem and who it affects

The First/Last Mile problem greatly affects those who rely on public transportation to access necessary services. This includes traveling to their job, getting groceries, dropping off a child at daycare or school, or even for entertainment purposes, as they have no other means of transportation. Based on the feedback we received from Gypsy Gavia, at the North Central Texas Council of Governments (NCTCOG), demographics is an important measure when evaluating the problem with accessibility. So according to this demographic source, 20.1% of public transit riders surveyed made less than $15,000 annually within their household. Furthermore, 65.6% made less than $50,000 annually within their household. Most lower-income houses are concentrated in the same neighborhoods leading to people of similar incomes living near each other. These low-income neighborhoods, such as in Dallas, have limited methods of public transportation leading to difficulty for lower-income families to access reliable means of transportation. According to the United States Census Bureau, 20% of families in Dallas live in poverty, and they typically live in the same neighborhoods. According to the map below (figure 1), high concentrations of poverty in Dallas County are located in Dallas' Southern Sector Neighborhoods, which we previously mistook as South Dallas. We want to focus on impoverished neighborhoods with limited access to public transportation because many low

income and impoverished families typically can not afford modes of private transportation. The inability to access public transportation can lead to the continuation of the poverty cycle. With limited access to public transport, holding a job is difficult. The ability to get to and from a job can vary depending on availability and without consistent access to transportation methods the poverty cycle continues. According to the report by Thomas W. Sanchez (link to his report), which was considered an excellent resource by Timothy Oleary at the North Central Texas Council of Governments, there is a direct link to access to transportation and employability. This study used a geographic information system (GIS) to analyze the location and employment characteristics of workers with varying levels of accessibility to transit. Based on the founding of this report policies advocating increased transit accessibility in addressing urban underemployment are partially supported. This leads us to believe that if we improve the accessibility of lower-income households to reliably reach necessary services then their quality of living will increase.
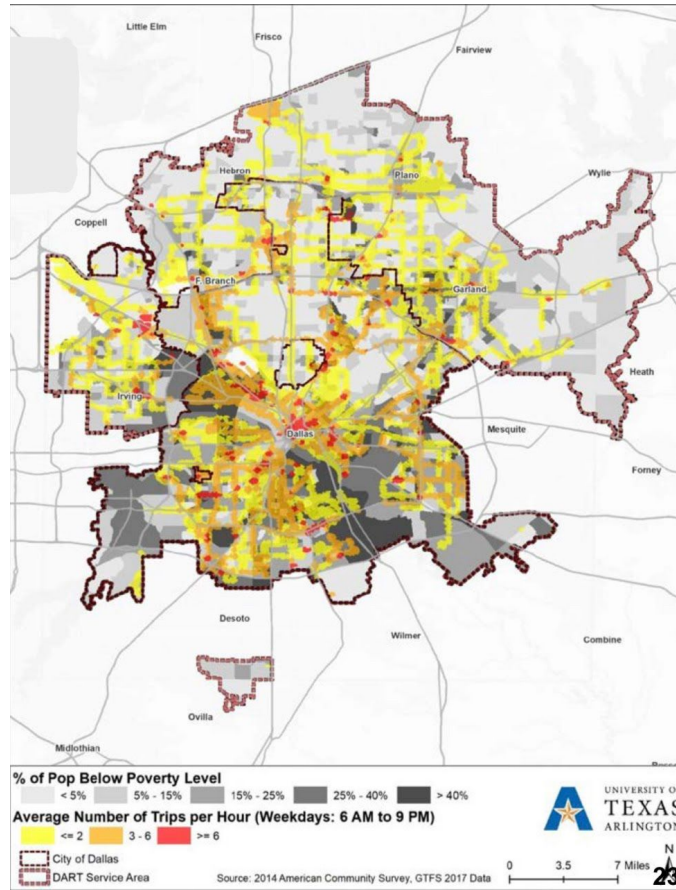
Figure 1: shows a high concentration of poverty in Dallas

Racially/Ethnically Concentrated Areas of Poverty within the city of Dallas. (Courtesy: University of Texas at Arlington)
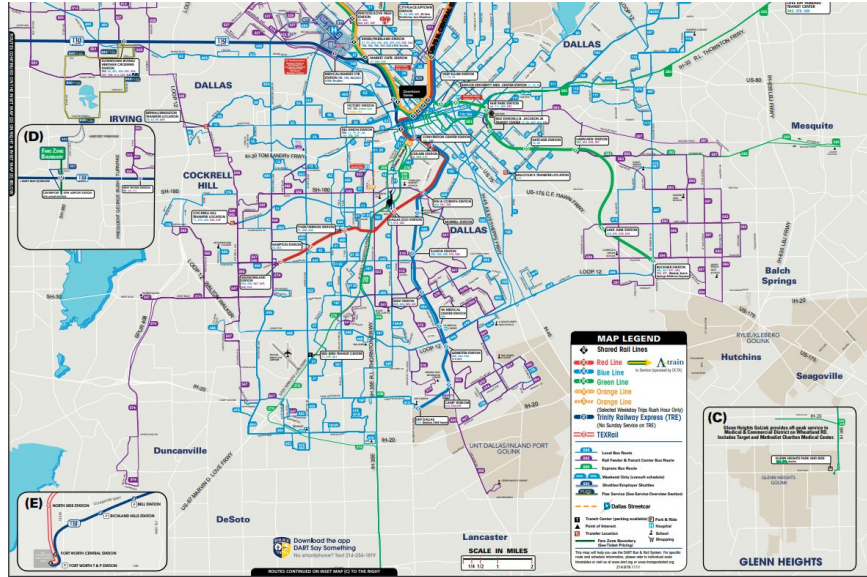
Figure 2: Map Dallas Area Rapid Transit (DART) Transportation (Link to Map)

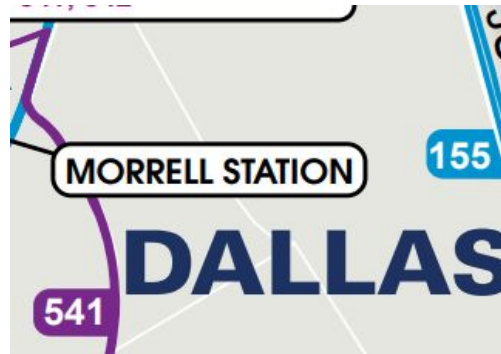Figure 3: Public Transportation Routes in
Joppa, Dallas, Texas

Figure 4: Public Transportation Routes in
Cadillac Heights, Dallas, Texas
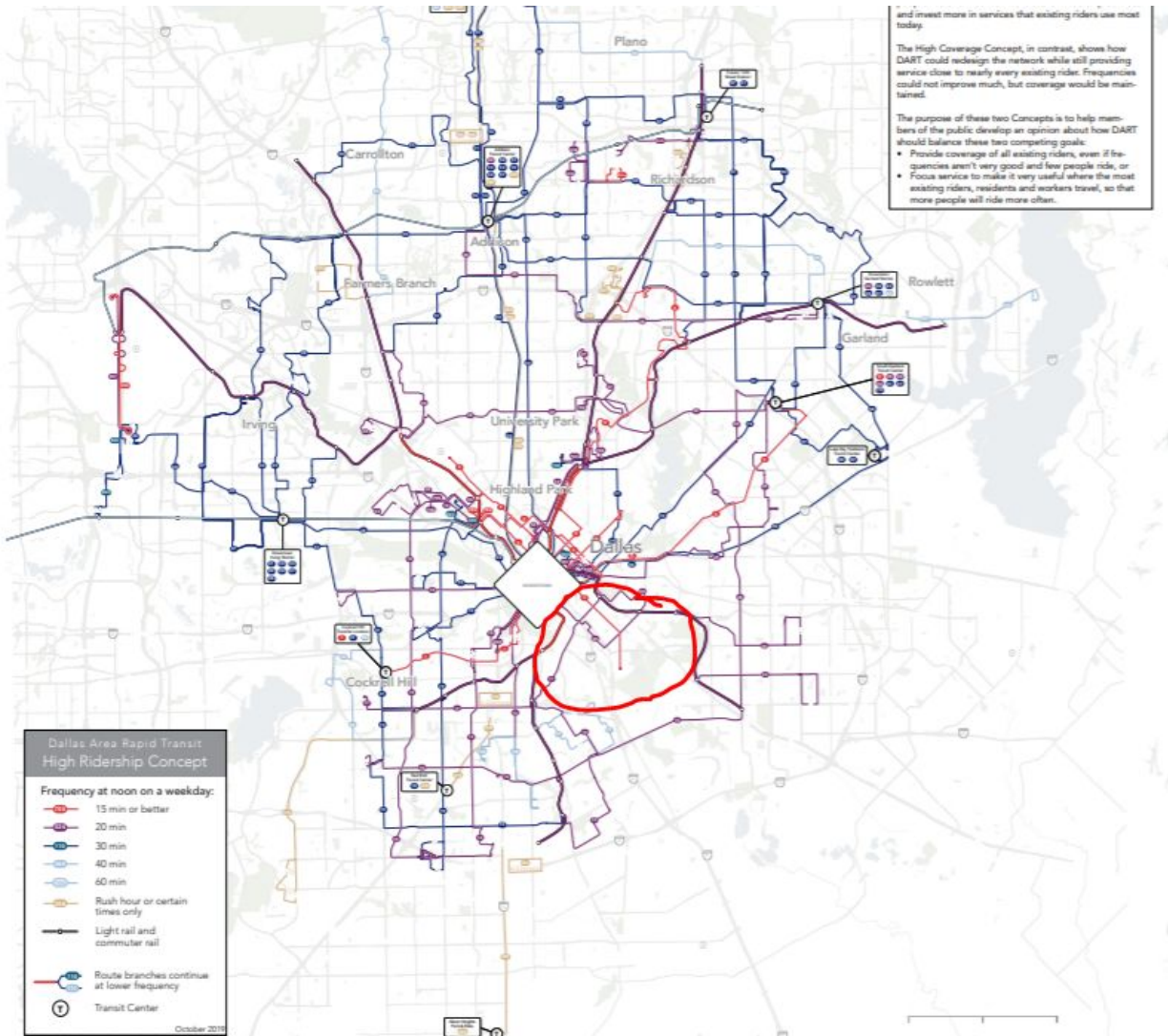
Figure 5: Frequency of bus routes in Dallas through DART

Where the problem exists

We have focused our research in the Dallas Metropolitan area with an emphasis on Dallas' Southern Sector neighborhoods such as Cadillac Heights, Joppa, and Wolf Creek. The map above (Figure 2) includes all of the public transportation systems provided by Dallas Area Rapid Transit (DART). From that map, we have zoomed in and looked at DART public transportation provided in the neighborhoods of Dallas' Southern Sector neighborhoods (Figure 3 and Figure 4). We noticed a trend of less public transport in those areas from examining

systems maps provided by DART. Also based on feedback from Jing Xu at DART, we added a map of usage frequency of DART bus routes, it can be shown in figure 5 that there are limited bus routes in Dallas' Southern Sector neighborhoods. This can be seen as within the red circle (which includes the. This leads to difficulties in accessing modes of transportation reliably as after leaving the service, they must walk or somehow get to the public transportation stops that are upwards of 1 mile away from them and still meet the transportation schedule. Which leads to the difficulties in performing many common daily tasks such as going to work, picking up a child from daycare, or even obtaining groceries for the week. Also according to Jing Xu at DART, combination trips are one thing that exacerbated the First/Last Mile problem. For example, when having a strict work schedule that requires one to enter and leave a job at a certain time there is no guarantee that the public transportation schedule will match their schedule. Therefore there is no guarantee they will be able to pick up their child on time at the daycare or be able to get to the grocery store before it closes as the public transportation route might not match up or allow for time to walk between stops.

Time frame of the problem

This problem has been prevalent since services and distances between places began to increase with Urban sprawl. As distances between necessary services, such as shelter from one's home and food from the grocery store, increases with the development of cities people will need a method of transportation to reach each service. The First/Last Mile problem will continue to affect people until everyone is provided with reliable transportation. This problem is something that people typically see as something they must adapt to or learn to live with. However, providing a solution to this problem will improve other's lives drastically as the radius of services they can access reliably will increase. Even if it is a .5 mile increase, the amount of services these lower-income families can now access has increased by almost double since the area they can access has increased. The longer this problem goes unsolved the longer people have to endure this burden and lose more time in commutes as well as money spent on public transport. Although many people have grown used to it and adapted just as many if not more have failed to do so.

Justification of the problem

The First/Last Mile problem affects the people who rely heavily on public transportation. The problem causes those unable to afford private means of transportation to typically live anywhere they afford that remains within the boundaries set by the problem in order to effectively get around cities without much hassle (as mentioned in the where paragraph). If there is ever an issue relating to the public transportation system, whether it be environmental, technology, etc, the people relying on public transportation will either need to find another way to commute or inform anyone waiting they will not arrive. These transportation boundaries create restrictions not only on where those affected can go but also on the time it takes to arrive at the desired destination. When time is of the utmost importance (for example: getting to work on time, medical emergencies, scheduled appointments) those who are unable to afford private means of transportation must wait for the public transportation to arrive before they are able to begin heading towards the final destination. In dire situations, the time it takes for transportation to arrive could end up being too late.

	System	Largest city served	Annual Ridership (2016)	System length	Avg. daily boardings per mile (Q4 2016)	Year opened	Stations
1	MBTA light rail:	Boston	69,236,700	26	8,711	1897	74
2	Muni Metro	San Francisco	52,597,300	35.7	4,602	1912	152
3	METRO LRT	Minneapolis-St. Paul	22,963,500	21.8	3,344	2004	37
4	Central Link	Seattle	19,121,621	20.4	3,245	2009	16
5	Hudson–Bergen LRT	Jersey City	15,450,736	17	3,051	2000	24
6	Metro Rail light rail	Los Angeles	65,829,000	88.1	2,403	1990	80
7	METRORail	Houston	18,335,800	23.8	2,378	2004	44
8	San Diego Trolley	San Diego	38,068,600	53.5	2,140	1981	53
9	MAX Light Rail	Portland	40,240,300	60	2,070	1986	97
10	Valley Metro Rail	Phoenix	16,322,800	26.3	1,947	2008	35
11	TRAX (UTA)	Salt Lake City	19,220,300	46.8	1,374	1999	56
12	Denver RTD:	Denver	24,585,000	58.5	1,297	1994	62
13	SEPTA light rail	Philadelphia	25,127,600	68.4	1,199	1906	>100
14	RTA Streetcars	New Orleans	8,084,400	22.3	1,117	1835	
15	DART	Dallas	29,619,500 Rank = 6/20	94 Rank =1/20	1,091 Rank = 15/20	1996	64
16	MetroLink	St. Louis	15,343,900	46	996	1993	37
17	Sacramento RT LRT	Sacramento	12,286,600	42.9	963	1987	53
18	The T: Pittsburgh LRT	Pittsburgh	7,783,100	26.2	814	1984	53
19	Santa Clara VTA LRT	San Jose	9,931,100	42.2	709	1987	62
20	Baltimore Light Rail	Baltimore	6,888,500	33	691	1992	33

This table shows DART's data from 2016. The data includes annual ridership, system length, average daily boardings, and the number of stations present. A popular form of transportation in the Dallas area is the Dart train. According to a DART industry professional, in recent years the ridership on DART trains has begun declining, even before the pandemic. Problems relating to the First Mile Last Mile prevents potential riders from reaching boarding stations.

Who are the Stakeholders and how does the First/Last mile affect them

The people and businesses most affected by the issue are people unable to acquire their own private means of transportation, and local businesses located outside the public transportation set boundaries. People who are unable to afford private means of transportation commonly remain within certain boundaries that keep public transportation easily accessible to them. Currently, about a third of residents and transit-dependent citizens in Dallas do not have walking access (a quarter of a mile for bus and half a mile for rail) to a transit station. Due to these boundaries, these people are unable to visit areas residing outside the transportation boundaries unless they are able to acquire another form of transportation.

The First/Last Mile problem decreases a company's potential profits because those unable to afford private transportation are restricted by certain boundaries, and they would be unable to arrive at the company's shops and businesses resulting in the loss of potential profit. Following the creation of the Dallas DART, the city of Dallas saw a 33% increase in retail sales for stores near the newly created DART stations. Stores and shops located further from the stations saw only a 3% profit increase. The stores and shops located closer to the DART stations largely increased their profits because the DART made their shops more accessible to the public. The shops located further away did have an increase in profit, however, because the stores were located outside the transportation boundary they are not as accessible to the public as the stores in close proximity to the DART stations; this caused their profits to be significantly less than stores within the transportation boundaries.

General parameters and constraints to consider

As we move forward with the project, we will need to consider certain parameters and constraints in order to create the most effective solution. Certain forms of public transportation run on specific routes, stop at specific locations, and function on specific schedules. Public forms of transportation like trains and subways function on prebuilt structures and are unable to be moved or create new stops without spending millions of dollars on building new structures. Most people cannot go too far outside of the boundaries set by the public transportation systems as the farther they go the more limited public forms of transportation become. The cost of the solution

should result in end users saving money not spending more. If the solution ends up costing more than current methods of transportation the solution will be listed a failure.

Past and Current Solutions

There have been attempted solutions to the first/last mile problem, however, they all are missing a few factors that are essential to our end user. According to Gypsy Gavia at the North Central Texas Council of Governments, some of the things that limit private sector options that address the First/Last Mile failed to consider the bankless population and those who did not have a usable credit card. This limits their access to the private sector ride share companies, such as Uber and Lyft, which completely eliminate the first/last mile problem, but are also too expensive to use on a daily basis for the low income population of Dallas' Southern Sector neighborhoods. Uber costs a minimum of $7.20 per ride (meaning a minimum of $14.40 for a two-way trip) and Lyft has a similar price range. Scaling down, other companies like Lime and VBikes have made dockless scooters and bikes (respectively) that people can rent for around a dollar per ride. Additionally, those who participate in government benefit programs like social security can use their services starting at 70% off the original price, if not a greater discount. Furthermore, their users can track the vehicles so they do not have to go out searching for their ride. Lime and VBikes were successful in providing mobility to the poorest communities, however, their vehicles are incredibly unsafe and have discouraged many of its users from using their services. Some users have left the vehicles in the middle of roads and there have been many incidents of operators injuring bystanders. Even when Lime riders are driving safely, cases of severe injury or death still occur. However both the ride share and bike share companies only use credit/debit cards for payments. Users who do not have a bank account or can only pay in cash have to find an alternative method of transportation.

Jing Xu at DART informed us that in the public sector, DART has created a rideshare system called GoLink that will make its transit services more accessible than before. The service allows its users to schedule busses and other forms of public transportation to come to specific locations like one's home. DART's GoLink also keeps its prices staggeringly low as all of the fares can be paid through their DART pass. If the user does not have a pass, the cost per ride is still very cheap at a dollar per ride if riding to a specific bus or train stop and three dollars for

traveling to a specific location. The downside of this solution is it can not be used outside of their operating area located around DART's train stations.
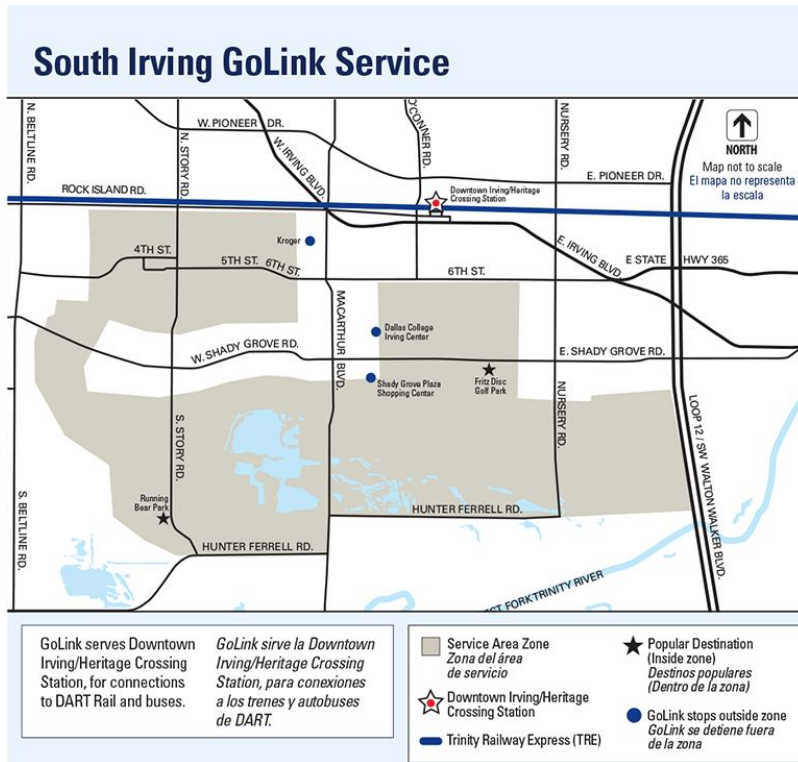
Map of the South Irving GoLink Service Area

All the solutions discussed above have reduced or even eliminated the first/last mile in some way. However, they all had some downfalls which are important to take into consideration when our team begins brainstorming. First, our solution needs to be safe. Lime and VBikes have proven that when a service is not safe, customers will withdraw from the service. Meaning if our solution is not safe, our end user will likely not use it. Second, our solution needs to be accessible in terms of price and location. Price is important as our end-user (low-income Dallas residents) have a very small spending budget so keeping in mind their limitations is crucial in defining the parameters of our solution. Finally, our solution needs to reduce or eliminate the physical exertion required to travel the first or last mile of any given transit method. Not only is this reduction the direct solution to the First/Last Mile problem, it will also expand our solution to the disabled and the elderly.

Goals of our eventual solution

The following goals have been reviewed by industry professionals that we have contacted from DART and NCTCOG. To facilitate the creation of a successful design, the following goals, parameters, and constraints have been identified. Our goals are what we hope to achieve, however, they are not the end all be all of what we need to achieve. If we run out of time and all our goals are not met, then there is not an issue. Our parameters, however, are far more strict and must be met for the project to be considered complete. Our constraints are things that we have decided aren't within our power to change, for example, we cannot change who the mayor of Dallas is.

These are the goals we hope to achieve with our solution; we have attempted to keep them attainable. Our team's overall goal for this project is to improve someone's living conditions in the Dallas County area by solving problems related to transportation. Specifically, access to necessary services related to the first/last mile problem for low income individuals.Our first goal for our solution is to increase access to necessary services for our end-user. Our next goal for our solution is to alleviate part of the poverty cycle for our end-user and that our solution will help them on their way to becoming financially stable. We also hope that our solution will be implemented in other areas, and help as many people as possible. For our final goal, we hope that our solution will increase the number of people who use public transportation.

Parameters of our eventual solution

The following parameters have been reviewed by industry professionals that we have contacted from DART and NCTCOG. Our parameters are more strict, and thus we needed more concrete numbers to base our solution off of. For our end user, the cost of the solution should not be more than already existing solutions. For example, we want to be under the cost of a used car which takes an average of ~$700 per month. This is about 55.4% of their income if they work a minimum wage job 40 hours a week. Furthermore, we want the solution to cost less than rideshare solutions, the estimated cost of rideshare apps like Uber and Lyft is ~$30 per day, which is if they make two round trips a day. This would take up about 72.6% of their income if they work a minimum wage job 40 hours a week. While we may not be under the cost of DART, we hope that our solution might help alongside DART. Thus our solution should be less than or

equal to the cost of a reduced price DART pass which is $48 a month, this is 3.8% of their income. This means that if our solution helps increase access to necessary services by working with DART, then our solution should not add any extra cost for the end-user or cost very little. Another parameter, other than the cost of transportation to services, is the time needed to reach them. Our solution needs to either keep the time needed to commute the same or decrease the amount of time it takes with current solutions. For example, using the DART system the closest hospital to Cadillac Heights takes ~35 minutes to reach, and you still have to walk ~.5 miles to reach the hospital. So our solution should decrease the amount of time it takes for this commute or at least keep it the same. Another example is the closest grocery store to Cadillac Heights. This trip takes around ~24 minutes using the DART system and you still have to walk ~.5 miles to reach the grocery store. This commute will also need to be decreased or be kept the same. Our last parameter is the physical exertion required in our end user's commute. Our solution needs to decrease the physical exertion required to get to necessary services. As stated earlier, in order to arrive at the closest hospital to Cadillac Heights you are required to walk around half a mile; it is the same for the closest Grocery store. Our solution should either reduce the half mile travel distance or make traveling the distance faster thus reducing the total amount of physical exertion. Furthermore, there are instances where you can't physically exert yourself in your commute, for example, going to a hospital, or a job interview.

Constraints of our eventual solution

The following constraints have been reviewed by industry professionals that we have contacted from DART and NCTCOG. As far as complexity goes, our constraints are quite simple. Our group can not increase the number of buses and trains that DART operates. Additionally, our group can not change the bus and train schedule for DART. Finally, we can not change where the bus stops and train stations are located. Secondly, we are unable to change the phone type or technology our end-user has access to. We also can not change where our end-user lives. Following the topic of location, we are unable to change where services are located, for example, we can not change where a hospital or grocery store is physically located. Lastly, The City of Dallas has banned dockless scooters and bikes, so our solution can not be a dockless vehicle.

Conclusion

  Due to the First/Last Mile problem, people who rely on public transportation have limited access to necessary services and are restricted in where they can live or work. It should be apparent by now that something has to be done. This problem affects so many people and we want to fix it. Our group will attempt to solve this problem. If you want to keep up with our process please check our website which contains most of our work. This report has been reviewed by industry professionals that we have contacted from DART and NCTCOG and revised based on their feedback.

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