

ICSI499 Capstone Project Report

# The Cross-Platform Paratransit Assistant for People with Disabilities

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## **Abstract**

Nowadays, public transportation becomes one of the most important and necessary services in our daily life. However, people with disabilities (PWDs) usually feel uncomfortable and struggle to take public transportation services. In order to better assist PWDs, Capital District Transportation Authority (CDTA) has a paratransit application called STAR program, aims at helping PWDs to make trip reservations. PWDs could make trip reservations by calling STAR, using fax or email, or visiting the CDTA website, however, according to the complaints of the users, there are some issues addressed to the program for now such as the automated call process. Most users will try to make a reservation by calling STAR, and the issue occurs. It is a very complicated and difficult process to make a reservation through phone calls when you are trying to listen to a robotic voice and follow its order at the other side of the phone, while feeling less and less patient if you can't hear it clearly or forget the instructions mentioned before. Our job is to realize the simplification of the process of making reservations by providing PWDs with this mobile app also called STAR, which only requires them to interact with the mobile device and also has a guideline for PWDs to follow, at the same time maintains the paratransit services provided by CDTA. And CDTA's job is to accept or decline the reservations according to the information provided by PWDs.

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# 1. Introduction

## 1.1 Problem to be solved

Public transportation has always been one of the most important services in our daily life. In 2019, Americans took 9.9 billion trips on public transportation, which equals to 34 million times per weekday [1]. Out of 300 million people in the United States, this number means that more than 10 percent of the people going outside would choose to take public transportation. However, people with disabilities (PWDs) usually struggle to take public transportation services. According to the Bureau of Transportation Statistics, about 25 million people face difficulties of traveling due to disability, which says that 1 percent of all Americans — about 3.6 million people — rather stay at home because of a disability [2]. Seeking for some kind of solution would encourage PWDs to go outside, make them feel much easier and comfortable to travel outside.

## 1.2 Existing solution

In order to better assist PWDs, Capital District Transportation Authority (CDTA) has a para-transit application called STAR program, aims at helping PWDs to make trip reservations. PWDs could make trip reservations by calling STAR, using fax or email, or visiting the CDTA website. It operates within 3/4 of a mile of all CDTA fixed route services on the same days and times [3]. However, there are some policies to be followed. If the destination is beyond the fixed route, then you have to find another way to travel to your destination for the exceeding part at your own cost. All the trips need to be reserved in advance and the reservations can be taken up to 7 days in advance [3]. Without reservations, no service can be given to PWDs.

Furthermore, there is a 25-minute arrival window so paratransit bus arrivals may vary within this time window [3]. Everyone has a STAR ID number, which is very important, and if you forget, you need to call the STAR representative in order to recover your STAR ID number. One advantage of the STAR program is that it provides shared ride services and door-to-door services, wheelchairs and walkers are equipped in the vehicles in case PWDs forget to bring and they would also receive assistance from the front door of the pick-up place to the front door at the destination [3].

However, according to the complaints of the users, there are some issues addressed to the program for now such as the automated call process. Most users will try to make a reservation by calling STAR, and the issue occurs. It is a very complicated and difficult process to make a reservation through phone calls when you are trying to listen to a robotic voice and follow its order at the other side of the phone, while feeling frustrated and less patient if you can't hear it clearly or forget the formal instructions mentioned before.

### **1.3 Proposed Solution**

The proposed solution will be our mobile application which takes place of the complicated automated call process and gives PWDs a set of guidelines that they can follow to successfully make trip reservations. For example, the guidelines will tell the users the exact type of information to provide such as the pick-up address, the destination and the time to travel, rather than hear the options through the phone and press the number 3 for Wednesday. In addition, users can log in with their STAR ID and some information to have access to their frontpage and could create new trips or review trips easily. It will also include a repeat trip function which would automatically fills in the same pick-up address and the destination if PWDs would like to take the exact same trip in the future. The only thing they need to change is the date to travel, and in this way it saves the users a lot of time. Thus, the users would easily make trip reservations, view their trip information and modify their trips.

## 2. Background and Related Work

### 2.1 Category / Mobile Apps

There are many existing mobile applications that many people currently use to make trip reservations such as Uber. Uber is a mobile application that every user has an account to log in, and can make trip reservations [4]. Users enter the information such as the pick-up address and the destination, and the drivers pick the order. Carrying with the reservation system like the STAR program, Uber also provides instant trip appointment, for example, if the users want to travel to someplace immediately, they could use the application to make trip appointment at that time. And Uber operates, 24 hours a day, 7 days a week, while the STAR program operates at the same time with the CDTA buses.

However, Uber was not designed with PWDs as the primary customers in mind. Users of Uber pay their money according to how long they want to travel. The price increases when the distance increases. The price is higher than CDTA's STAR buses, especially when the destination is far away. Moreover, support devices such as wheelchairs and walkers are not equipped in most of the Uber vehicles, which sometimes may cause problems when PWDs need one for emergency. With our application, PWDs could make trip reservations easily and view the information of the reservation through phones, then wait for the appointment time, receive the support from STAR buses' staff and get to the destination comfortably.

## 2.2 Category / RideShare

Ridesharing refers to community members giving rides to others, usually for a profit. [5] "The drivers of rideshare vehicles act similar to taxi cabs, giving paid rides in their own personal vehicle to members of the community". Companies like Lift Hero aims at providing a ride service for senior citizens [6]. Lift Hero hires drivers who have knowledge of senior ailments and psychology. All drivers need to have at least one first-aid certification and pass through a training program that covers the usage of living equipment and emotional issues. However, Lift Hero only operates in San Francisco, California so availability is a huge problem as they do not operate in the region around Albany. In this case CDTA has already been performing greatly and efficiently in the Albany, Schenectady, Rensselaer and Saratoga areas. By using our app, PWDs in these areas could create account information and trip information, and those information would be sent to the database and be viewed by CDTA's staff. And then they would decide whether the reservation will be accepted or declined.



## 3. Proposed System/Application

### 3.1 Overview

Our key idea for this project is to create a simple and fast way to request rides for the PWDs, and let them arrive at destination on time. To do that we need to let the PWDs schedule and modify trips in the application, and let them modify personal information like address from the application. the user(PWDs) can Create a trip, Cancel a trip, and Repeat a trip. When the user creates or repeats a trip, the ride request is then sent through the database and viewed by CDTA. During this process, the trip is seen as pending by the user. CDTA then has the ability to confirm or deny the trip request. This response is then seen by the user as confirmed or denied on trip history, pending trip list and confirmed trip list are then contained within the SQL Database. Since CDTA provides the para-transit service, they have the authority to add or remove users(PWDs) while we the app admins have the authority to manage the database. The schedule of the user trip can then be seen by both CDTA and the user.

### 3.2 System Requirements

#### 3.2.1 Trip Status Update

The user starts the ride request process by 1st logging in with the correct STAR ID and Last-name information on the app. Next, the user chooses the "New Trip" option and proceeds to enter all the required travel info such as home and destination address. Then, select the

verify button, the Back-End Server will verify the trip information. throughout this verification period, the user will see the status of the trip as "Pending". and might be viewing within the pending area. Afterwards, the BackEnd Server will let the user recognize that the trip is with success scheduled by changing the trip Status from "Pending" to "Upcoming". If the user want to cancel the trip, they'll see the journeys within the "Pending" area, choose the "Cancel" button, the system will show a checker for if you wish to cancel, if the user confirmed, the trip are going to be canceled, and might be seen in the "Cancel" area. A outline of the scheduled trip can then be viewed by the user in the "Upcoming" area, the finished trips can be viewing in the "Completed "Information Storage.

### **3.2.2 Information Storage**

The Back-End server interacts with the SQL Server database to store trip information. once the Back-End server has received new trip information from the user, this information is then hold on within the SQL Server Database. This stored info will then be accessed for future trip schedules.

### **3.2.3 Pending/Upcoming Tage on App**

The Back-End Server sends the trip information from the user to CDTA. once the user requests a ride, the information received then sent into the database, and the representative of the CDTA will access the database. Upon trip info verification from CDTA, CDTA will let the Back-End Server know that the trip is accepted. Finally, the Back-End Server sends the trip outline to the user and changes the trip standing from "Pending" to "Confirmed". once this happens, the user are able to click the bottom "Upcoming" to se the trip which has been proved by CDTA, or click the "Denied" bottom to see the trips that are denied by CDTA.

### 3.3 Technical Design

Our design consists of 3 main components:

The Client-Side Mobile Device operating the Nova app, Microsoft Azure Cloud Services as the back-end server and Database, and the employees at CDTA handling the Database. . A diagram of the complete system design architecture is shown in the figure below.

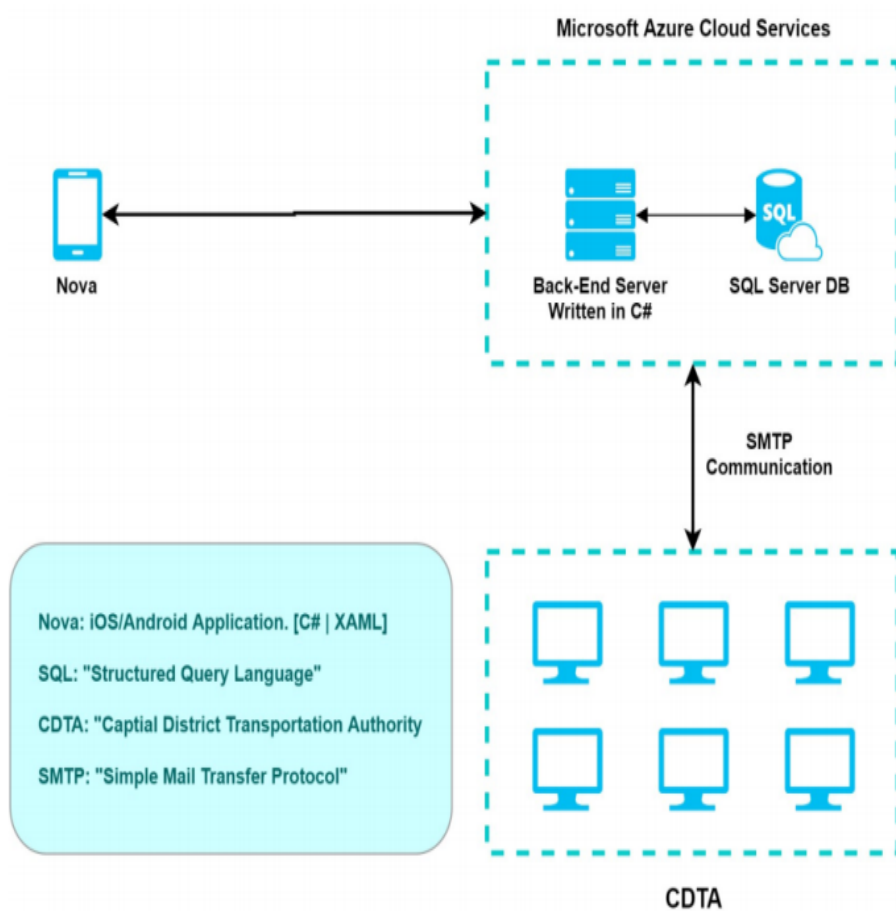


Figure 3.1: System Design Architecture

### 3.3.1 Mobile Application

The client-side system is a cross-platform mobile application(iOS and Android)that is meant to assist STAR clients communicate the request for a ride from CDTA. the application is written using C Sharp (for app functionality) and XAML, the protractile Application nomenclature that provides our program. The toolkit that may enable us to create the client-side part is called Xamarin Forms and is owned by Microsoft. we have a tendency to are managing all program versions by using Microsoft's Visual Studio 2019, an integrated development environment(IDE) that for our purpose, acts as a code editor and mobile phone simulator to check our mobile app. It utilizes the .NET framework to focus on multiple platforms for a unified mobile development environment resembling Android, iOS.

### 3.3.2 Cloud Service

Our second component features a back-end server(coded in C) hosted with Microsoft's Azure Cloud services. The server will be able to communicate with the Azure SQL(Structured Query Language) database that will be used to store client data and responses from CDTA. Storing the data in a database both reduces the load on the main memory of the server CPU and allows the data to be retrieved if the server crashes or loses power. If the app is deleted or the user accesses the app from a different mobile device, their account information is still available upon logging in with their credentials. Additionally, the cloud service also enables us to use a single back-end program server that interacts with and handles data sent to and from the client. More specifically, the back-end receives requests from the clients(ride requests) and contains the logic(C code) to generate and send the appropriate data back to the client(Ride is either CONFIRMED, DENIED, PENDING) after parsing the trip information email to CDTA. The database stores multiple types of trip data such as pending trips, confirmed requests, trip history and user specific information.

## 3.4 System Implementation

There are constraints or limitations that are obligatory on our system design. For example, there's a software package constraint once operating with iOS and humanoid devices. Since we, the developers are all android users, we are unable to check on the IOS system. However, the Xarmain is autogenerated app for android and IOS once the perform logic has been finished. Furthermore, the 1,000 dollar budget from NYSID may be a budget constraint. the standard of Azure Cloud services that we purchase from Microsoft should be at intervals the 1,000 dollar budget. the necessity for exaggerated Azure Cloud services might arise in the future because the user base for the mobile app grows. Lastly, our app can't be terribly subtle because it ought to be straightforward and accessible to our target demographic.

## 3.5 Use of Computer Science Theory and Software Development Fundamentals

The main instances of application of computer science theories that we use have three The main instances of application of computer science theories that we use have 3 main subjects, first databases data structure, the database structure is simply a list, we input the data within and call them once it's needed, the second data structure we use is a structure we create named as TripObject, this structure is to store the question information datatype that we see on the trips update, like "Pick up address" or "Trip ID", another data structure we use is a structure we create name "Triplist" this data structure is to store all the data type we use when we want to create a trip. These two data structures can facilitate us after we binding Xamarin and C sharp. the most algorithm we use is within the new trip page, this algorithm's operate is to gather data, and begin to examine the data, to envision if the data is correct or not, this algorithm has been employed in many functions like personal information update function. we additionally update this algorithm when we create the Repeat function, the new algorithm will preload the data from the SQL info base on tripID. The fundamentals of our software development are: first we use the same algorithm when we want to examine the data integrity, second Xamarin has multiple universal modules to develop different app interfaces. These kinds of methods and patterns help to improve our application's efficiency and accuracy.

## 4. Experimental Design and Testing

While running the application, the experiments are divided into two main parts. The first part is to design and test the functions existed already in order to see whether there is anything that needs to be added or changed, and the other part focuses on whether it is necessary to have new functions to be added in order to improve the performance and functionality of the application.

### 4.1 Experimental Setup

#### 4.1.1 The UI design

The first thing we are trying to check and modify is to see whether the used UI settings were clear enough for anyone to see. It is one of the most important things to have because we have to make every user feel comfortable and know what to do and where to go next while using our applications. In order to have a better visual clearance for any users, for the UI settings we used more colors to present the words and instructions in order to separate each function and instruction. Later, we asked 50 people's opinion about whether the former one is clearer to see or the changed one is better. Among those there are some people who have red-green colorblindness, so that we could receive more suggestions in order to make the application look clearer for anyone. The UI for login page looks like this below.

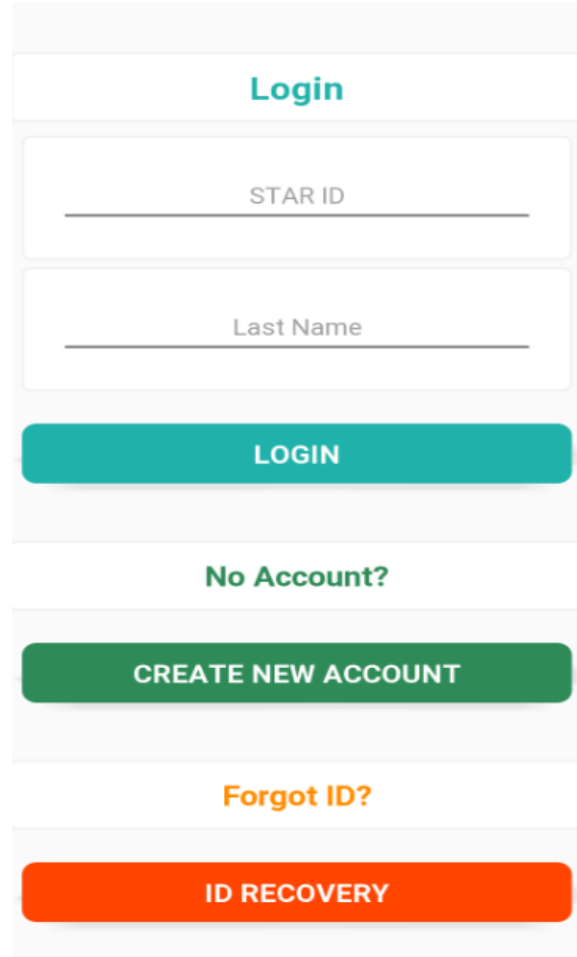
A vertical UI mockup for a login page. It features a light gray background with several white rectangular sections. The top section is a white box with a teal header 'Login'. Below it are two input fields: the first is labeled 'STAR ID' and the second 'Last Name', both with horizontal lines for text entry. These are followed by a teal button with the text 'LOGIN' in white. Below the button is a white box with a teal header 'No Account?'. This is followed by a dark green button with the text 'CREATE NEW ACCOUNT' in white. Below that is a white box with an orange header 'Forgot ID?'. The final element is an orange button with the text 'ID RECOVERY' in white. All buttons have rounded corners and a slight shadow effect.

Figure 4.1: Login Page

There are three things you could do which are clearly separated by different contrasted colors, users could login using their STAR ID and Last Name, or could create a new account, or could also recover ID if forgot. We also changed other UI settings for other pages in order to provide clearer instructions.

#### 4.1.2 The Registration Function

The given picture below shows how users are instructed to create an account.

The image shows a registration form titled "Register An Account". It contains the following fields and labels:

- Enter STAR ID:
- Enter First Name:
- Enter Last Name:
- Enter Email Address:
- Select Date of Birth: (with a date picker showing 2021年5月14日)
- Enter Phone Number:
- Enter Home Address:

At the bottom of the form is a green button labeled "REGISTER ACCOUNT".

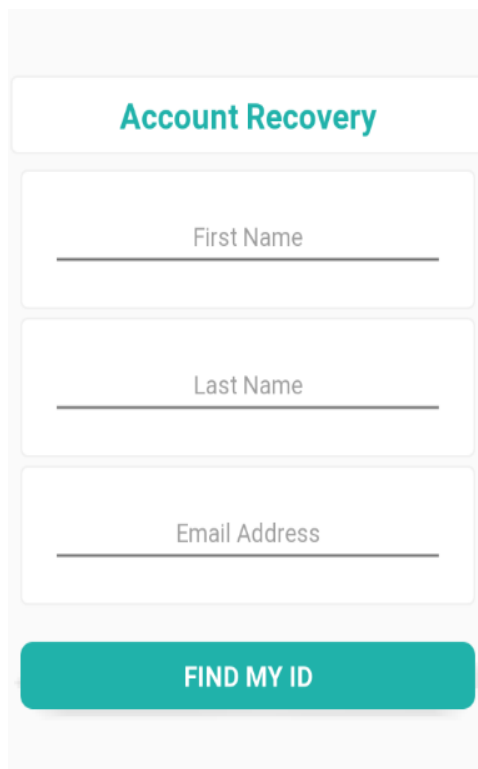
Figure 4.2: Login Page

The users need to enter the STAR ID provided by the CDTA, and their basic information such as their name, email address and phone number. Based on the former team's work, except from the improvement of UI designs, first we changed the way users try to enter their date. The users could easily pick their birth date from a calendar format. And the second one is to check whether the users have already entered all the needed information. If there is something forgotten to be entered, then there will be an error message popping up to tell the users where is forgotten to be entered. And after the users enter all the information and click to register account, a confirmation message will pop up to let the users to check whether the information they entered is correct or not.



### 4.1.3 ID recovery

If the users forgot their STAR ID, they don't need to call the STAR representatives to recover their ID, by clicking the ID Recovery button on the login page, users only need to enter their first name, last name and their email address to find their STAR ID. The process is to retrieve information from database and to match if there exists account with the same information provided by the users, and then return the matched STAR ID, present to the users, if there isn't, then it will pop up an error message showing which information is not correct.



The image shows a mobile application interface for account recovery. It features a light gray background with a central white card. At the top of the card is a teal header with the text "Account Recovery". Below this are three input fields, each with a light gray border and a horizontal line for text entry. The first field is labeled "First Name", the second "Last Name", and the third "Email Address". At the bottom of the card is a large, rounded teal button with the white text "FIND MY ID".

Figure 4.3: ID Recovery Page

#### 4.1.4 Creating Trips

For creating trips, the users just need to follow the instructions to enter all needed information such as the pick-up address, the date and the destination. And if the users would also like a return ride, selecting the button for Return would ask the users to enter information about the return trip. After finished, then hit VERIFY button.

#### 4.1.5 View trips

For trips that users have already submitted to the CDTA, they could view the trips which are still pending in the PENDING page, and they could also view their trips that are being denied in the DENIED page or approved in the UPCOMING page. Those three buttons are all on the login page.

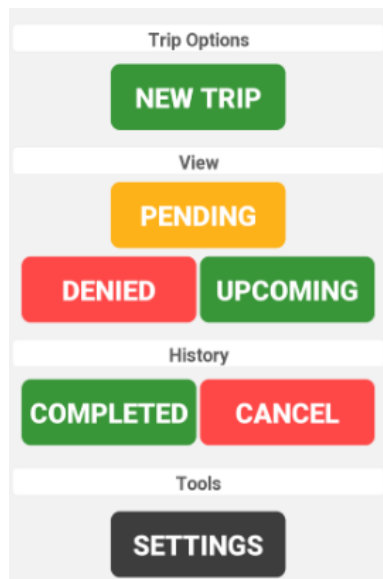


Figure 4.4: Front page

#### 4.1.6 Settings

In the settings, the user could either change their personal information here or log out. They could choose to renew email address or home address or contact number.

#### 4.2 Result and Analysis

We could see whether the information of the users or the trips reserved by them is correctly saved to the database, if they are all saved correctly into the database, then everything works fine. And here are two pictures of the users account and trip information in the database below.

	PUAddress	PUDate	PUTime	DOAddress	ReturnAddress	ReturnDate	ReturnTime	PCA	Ticket	Comments	STARID	Confirmation	TripID
1	Cancel Case	5/9/2021	00:00:00	Cancel	Null	Null	Null	False	False		Test	Canceled	22138
2	Upcoming Case	5/9/2021	12:00:00	Upcoming	Null	Null	Null	False	False		Test	Confirmed	31832
3	Denied Case	6/16/2021	15:45:00	Denied	Null	Null	Null	False	False		Test	Denied	23188
4	'12'12	5/12/2021	00:00:00	sdsafsaf	Null	Null	Null	False	False		99330	Canceled	61029

Figure 4.5: Trip Info

	STARID	FirstName	LastName	Email	DoB	HomeAddress	PhoneNumber
1	00	admin	dev	roger	01011990	suny at albany	NULL
2	0000	john	doe	jdoe@albany.edu	01011990	albany	NULL
3	0101	Saai	Mark	Djdkf@google.com	0948	Address	NULL
4	1111	test	Hun	hheo93@gmail.com	20050704	101 patroon dr	NULL
5	2222	Hun	Hei	Siskdjdj@gmail.com	0919	101 patroon dr	NULL
6	99330	Roger	Xiang	rogenxiang30@gmail.com	19990602	1700 wester avenue	123456789

Figure 4.6: User Info

All the trip reserved from the users are sent to the database, and the CDTA determines whether the trip is accepted or declined, user information is saved in the database, too, when the users register accounts, or when the users try to renew their information, it will also be modified in the database. All the built functions within the application also work fine and smooth.

## 5. Ethics and Legal Practices

Intellectual Property(IP) protects the CDTA company name. The name CDTA itself is registered and is a property of the owners behind the company. whereas it might be convenient for the CDTA brand to look on our app to instantly inform users that the mobile app they're victimization is legitimate, CDTA holds PP-2017 V2.1 9 the right to their name and that we do not want to step into any legal problems such as assumptive their name once we the developers of the app hold no rights to the name CDTA. Furthermore, our app doesn't communicate with the driving force of the bus in real-time. The app might not operate for some reason and the client is therefore unable to arrive at work or the medical appointment they scheduled. Additionally, because the mobile app can require personal data akin to a full name, home address, and STAR ID, we'll have to ensure clients that their hold-on information on the database will solely be used for the aim of their ride request. there'll be no malicious intent as outside third parties are restricted from accessing this info. we'll have a consent form within the app so users understand their privacy is safe with us. In addition, Microsoft outlines that Azure Cloud has intrinsic security services that guarantee information safety. Only those with the correct login credentials can access the data held on on the SQL database.

## 6. Effort Sharing

(Team Size)	(Joint efforts)	Roger Xiang	MingJie Xu	ZheKun Wu
(3)	J ( 40%)	I ( 20%)	I ( 20%)	I ( 20%)

## 7. Conclusion and Future Work

If the app been deployed, people with disabilities should have easier communication with CDTA, which brings more prefer to have a ride. Finally, to get a positive cycle to the STAR program and gain more advantages to people with disabilities.

### **Future work**

Since the final goal of the project is collecting data from app and send the confirm email to CDTA. Our group was focus on the app development and completed most of it. So, we hope the next group will be a backend development group which focusing the most on the back end, including the connection from the app to the database through a server, and send email base on the information from database by the server, etc. After that, just need more real case test of the whole project.

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