



**University of Arkansas – CSCE Department Capstone  
II – Final Proposal– Fall 2022**

**TCA Carpool Overhaul**

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**Abstract**

Waiting in lines is annoying. Waiting in lines that must be waited in every single day is even worse. This is the problem for parents and educators at Trinity Christian Academy Addison in Addison, Texas. The current system for picking up an elementary aged child is to pull into the parking lot, wait in a line, then show a physical carpool number to a teacher that then uses a two way radio to broadcast the number inside the building where a second teacher writes the number on an overhead projector and the parent and child can finally be reunited. There is a ton of room for human error and inefficiency with this approach and that is what the project intends to solve.

The objective of the solution is to make carpool more efficient to save parents and educators time, and to save the school money. The approach for this will be to design a mobile application for parents to use to enter their students' pickup number, thus removing the human inefficiency and error potential with taking down the parents number and relaying that information inside the building. The significance of this solution is that if properly implemented the solution would make carpool more efficient, freeing up parents to have more time with their children, freeing up teachers to spend more of their time on campus actively being productive for their teaching, and saving the school thousands of dollars in police officers hired for traffic control.

**1.0 Problem**

The problem is that the current system for carpool is inefficient at best and dangerous at its worst. At its best, carpool takes 7 people simply to administrate the movement of vehicles through the carpool line. 1 uniformed police officer directing traffic in the public roadway, 4 members of the campus safety team directing traffic in the parking lot of the school, and 2 teachers to take the numbers, radio them into the building and write the numbers on an overhead. This is plainly a waste of human capital, but it is also a very expensive proposition for the school. The uniformed officer is paid \$60 an hour for a minimum of 4 hours per the local department policy despite the actual need of the officer only lasting roughly an hour. Multiply that out and then multiply the daily rate of \$240 per officer times 5 school days per week times roughly 38 school weeks and the cost just for the one police officer to direct traffic is \$45,600.

This is an important problem for the school for a number of reasons. The first reason is the human capital. The 6 school employees are having to actively take time out of their day when they could be doing other things. The 2 teachers could be grading papers, or meeting with parents, or having meetings with other teachers to lesson plan. The campus safety officers could be using their time to write and implement new safety policies that the director of campus security (and project sponsor) has been trying to complete since 2018 or performing other miscellaneous duties that pertain to their job such as changing batteries on panic fobs, and scheduling the door and vehicle gate unlocks for school events. The second reason is monetary capital. As previously stated the need for even a single police officer for directing traffic costs the school upwards of \$45,000 a year. A final reason is that carpool is time consuming for the parents who are ready to see and spend time with their kids, and the school's pickup system is currently a limiting factor in this.

## **2.0 Objective**

The primary objective of this project is to design a system that would replace the current system of two way radios and manual transmission of carpool numbers from the exterior of the building, freeing up two members in the human capital equation. In addition to this, the secondary objective of the project is to provide a more efficient system in replacement. If a more efficient system could be properly implemented, then a member of the campus safety team could be freed up from directing traffic on the interior of campus to direct traffic in the roadway, thus eliminating the need for the uniformed police officer, saving the school upwards of \$45,000 a year. Another secondary objective is provide parents more time with their kids and less time waiting in the carpool pick up line, which an efficient system would accomplish.

## **3.0 Background**

### **3.1 Key Concepts**

Carpool app will be a two part application, with a mobile application for parents and a web application for viewing inside the school. There will be a cloud database that allows the assignment of vehicle numbers to student families. There should only be one carpool number assigned per Lower School Family. This number will be the primary identifier for carpool purposes. The web application is built using NextJS and the mobile application is built using React Native. The key concept of the Carpool app is when a parent gets to school they log into the mobile app, and tap a button that says “I’m here”. This will then populate the pickup number on the mobile application for the student to see in the lower school gymnasium, where they wait to be picked up. The parent then proceeds to pick up their kid at the designated location and leave the school.

### **3.2 Related Work**

The primary solutions in this area are more related parents organizing carpool for their student to and from school (ie one parent in the neighborhood might offer to drive all the kids from their neighborhood to school or practices and events) as opposed to a system designed to be used by the school to facilitate the pickup of kids from the school to a specific vehicle [1] The other solutions in this space tend to be more robust than what our project sponsor is looking for [2]. The problem with all of these apps is that they either do not solve the problem we look to solve, as in case 1, or, they are too robust for the feature set that our project sponsor is looking for. Our development would be different because it would be tailored to the exact use case that our project owner is looking for, carpool pickup at his school. He doesn’t need an expansive administrator dashboard or a robust feature set, what he needs is a simple application that lets a parent register they are at the school and want to pick up their child, and for that child to be released to the proper pickup location so that he can eliminate the foot traffic in the carpool line which can be extremely dangerous for teachers.

## **4.0 Design**

### **4.1 Requirements and/or Use Cases and/or Design Goals**

The primary use case will be to facilitate the pickup of all kids in a single family to that parent’s/guardian’s vehicle. Secondary use cases would be to expand this functionality so that a single vehicle could pick up multiple families (this is currently done through parents giving their carpool number to another parent).

## 4.2 [High Level / Detailed] Architecture

The project will be composed of two main interfaces: a cross-platform mobile application written in React Native, and a web application, written in Next.js. These will be linked with a Firebase Firestore cloud database, and any server side logic will be handled by Firebase Cloud Functions. Authentication and other similar needs will also be handled by Firebase.

## 4.3 Risks

Risk	Risk Reduction
Parent reluctance	Keep Product Owner up to date about security measures
Connection issues	Limit communication as much as possible between components to avoid failure
UX design	Keep UX as simple as possible
Usage Timing	The product sponsor has a number of “A-frame” signs that can be placed at specific points in the carpool line to tell parents when to sign into the app
Student Safety	The app will be designed to only be used when a vehicle is at a complete stop

## 4.4 Tasks

1. Configure Firestore Database
  - a. Create specific tables needed for storing critical information
  - b. Implement server authentication
2. Begin development of mobile app using React Native

- a. Design a user friendly mobile app UI/UX
  - b. Configure mobile app logic
- 3. Design website Front End
  - a. Ensure website is easily read and understood from a projected screen
  - b. Have screen updated for both arrivals and pickups
- 4. Test Server Authentication
- 5. Final test demo

#### 4.5 Schedule

Tasks	Dates
<b>1. Configure Firestore Database</b>	<b>9/26-10/10</b>
a. Create tables and schema	9/26-9/29
b. Implement server authentication	10/03-10/10
<b>2. Mobile app development</b>	<b>10/10-10/28</b>
a. Design UI/UX	10/10-10/14
b. Configure logic	10/17-10/28

<b>3. Design website</b>	<b>10/31-9/14</b>
a. Ensure website is readable	10/31-11/11
<b>4. Test server authentication</b>	<b>10/31-11/11</b>
<b>5. Final test demo</b>	<b>12/01-12/01</b>

#### 4.6 Deliverables

A mobile app and web application linked to a cloud database will be delivered. This will allow interaction between parents and the school with the website displayed on the overhead projector.

#### 5.0 Key Personnel

**Andrew Smith** - Smith is a 5th year senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. He has completed a number of relevant courses such as Software Engineering and Database Management Systems. Smith is currently a software engineering intern for JB Hunt where he primarily works on backend technologies such as APIs and database queries. Smith is the team lead for the group and will be acting as the project manager, keeping contact with the product sponsor and creating work items for other team members

**Matthew Long** – Long is a 5th year senior Computer Engineering major in the Computer Science and Computer Engineering Department at the University of Arkansas. He has completed relevant courses like Software Engineering. Long has been working in an IT position for a printing company in Fayetteville for six years and has gained relevant SQL database experience. Long is responsible for the creation and maintenance of the project website, ensuring that all documents are up to date, as well as helping with the backend database.

**Kelby Morrison** - Morrison is a senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. He has completed relevant courses like Software Engineering and Database Management Systems. Morrison is responsible for the mobile registration and interface and ensuring it has all of its necessary features.

**Jibas Poudel** - Poudel is a senior Computer Engineering major in the Computer Science and Computer Engineering Department at the University of Arkansas. He has completed relevant courses like Software Engineering and Database Management Systems. Poudel is responsible for the Frontend Development of the Carpool-Web as well as Fetching data from the Firestore database in realtime.

**Lucas Faupel** - Faupel is a senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. He has completed relevant courses like Software Engineering and Database Management Systems. He is the architect for the project and oversees integration of the mobile, web, and cloud components.

**Robert Mason** - Mason is a senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. He has taken numerous relevant courses such as Software Engineering, Mobile Programming and Database Systems. Mason focused on the mobile application development side of the project with emphasis on Firebase authentication.

**Marcus Langston** -Langston is a senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. He has taken numerous relevant courses such as Data Mining, Big Data Analytics, and Database Systems. Langston focused on development of the Carpool-Web connection/ fetching of data from the Firestore database.

**David Smith** - David Smith is currently the Director of Campus Safety and Security at Trinity Christian Academy. He is responsible for the physical security of the campus, which is a Pre-K – 12<sup>th</sup> grade private school with approximately 1,500 students. The campus itself consists of 9 buildings on 40 acres. One of his daily tasks is coordinating and controlling the carpool drop off and pick up for all students on campus. Prior to working for TCA, he was a Lieutenant with the Dallas Police Department. During his 31 year career, he held numerous assignments including Watch Commander for South Central Patrol (where he oversaw all patrol officers in that division who worked between 6a and 4p), Love Field Police Unit, Information Technology, Dispatch, Tactical Planning and Traffic.

## **5.1 Facilities and Equipment**

If a fully featured test is conducted, the group will be using signage and parking lot facilities at Trinity Christian Academy in Addison, Texas under the supervision of the Director of Campus Safety David Smith.

## **7.0 References**

[1] <https://en.softonic.com/top/school-carpool-apps>

[2] <https://kidspickupapp.com/>