



**University of Arkansas – CSCE Department  
Capstone I – Final Proposal – Fall 2020**

**Cherokee Language Project**

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**Abstract**

Dialects of the Cherokee language can be found throughout the US. We have partnered with a local Cherokee language teacher to create an app that caters to middle and high school age students learning Cherokee in the Oklahoma-Arkansas region. The Cherokee language is a conversational language and we aim to teach it through story-based games. Users can practice language basics through flashcard repetition. The conversational nature and tonal nature of Cherokee are captured through story-based games. The user has the option to hear pre-recorded phrases and respond by picking from a set of word-phrases on their screen. The complexity of the recorded phrases and their corresponding sets of choices increase based on your learning level.

Cherokee has different regional dialects. This is a large reason why we have decided to introduce an app to cater specifically to the Eastern Oklahoma region. There have been efforts to counter the small number of fluent Cherokee speakers in communities throughout the US. Less than one percent of speakers are considered fluent today and re-education efforts from the 19th century have left a lasting impact on Cherokee traditions. Fortunately, there are already many great regional organizations and online materials available for learning Cherokee. This app would be a way to aggregate resources helpful to students learning Cherokee language in Eastern Oklahoma. This app hopes to be an aid to students on their journey and open learning Cherokee up to a wider population. We hope that this app is a useful tool in schools and communities alike.

**1.0 Problem**

Historically, up until the 1820s, the Cherokee was only a spoken language. Due to the arrival of the European languages, a “Syllabary” was created in hope of preserving the dying language [5]. After the forced relocation of the Cherokee to Indian Territory, the syllabary and languages witnessed a dramatic decline to the level right now. Cherokee is reaching a point of crisis as out of the 300,000 tribal members, there are only 12,000 native speakers, making it classed as “Definitely Endangered” [5]. Due to being a minority language, Cherokee parents are not passing on the language thinking that their children are better off learning the majority languages that will not hinder their chances with education and jobs.

Languages tie deeply with historical and cultural values. With Cherokee facing extinction after its historical background of three millennia, a tremendous part of Native American culture and history will be lost. By preserving the language, we can connect with people of that culture as well as obtaining knowledge that is impossible to get without the ability to understand the language [6].

Without a way to teach and preserve the language, Cherokee will surely die. When a language dies, its culture will soon be forgotten as well as it cannot be passed on. People of Cherokee descendants will lose their heritage and the important historical lessons and values will be gone.

## **2.0 Objective**

The objective of this project is to develop a mobile app to assist teachers in teaching Cherokee, in a fun and engaging way. This app would prove especially helpful as it lightens some of the teaching load. This gives teachers a chance to focus on other areas that they may normally be short on time to get to. Likewise, students can create an environment catered to them with the app. The flash card feature will give students opportunities to work on weak spots. The story-based feature offers a chance to practice conversations and further identify weak spots (i.e. unknown words and phrases). There are a few apps that currently dominate the market but to the best of our knowledge, none handle conversational language like what we have just described.

## **3.0 Background**

### **3.1 Key Concepts**

This project revolves largely around conversational practice with the Cherokee language. As users advance we want the app to grow to support them. When learning a language it is important to have support. This app hopes to be a support tool in and out of classrooms. We are planning to work closely with teachers and students to get a clear understanding of how this app can support them in learning Cherokee. The app gives us a huge opportunity to also share traditional Cherokee stories with users.

Writing Cherokee syllabary and phrases is important as well as understanding how words fit together to form phrases. While recognizing text might fall out of the scope of this project we still plan to give users access to materials like the syllabary, colors, objects, etc. so that they can practice writing outside of the app. There is a lot of new information to process when learning Cherokee and we hope that teachers see this app as an opportunity to incorporate the app into their curriculum. Teachers just starting off teaching the language might need time to understand what works and what doesn't with their students. As we speak with teachers, we hope to take their observations into account to allow for a better user experience.

We plan to use a cross-platform mobile development framework (e.g. Flutter) to build the app. The main benefit of a cross-platform framework is that we can release a finished product to Google Play for Android mobile users and have a clear path for iOS users defined should we want to release to the Apple Store in the future. This form of development gives us more options to grow the app when we reach the maintenance phase of the development process.

The key parts of this app revolve around image labeling and manipulating the information from this process (i.e. we use image labeling in the story-based section of the app). A lot of the app's

power will come from using Flutter, a cross-platform mobile development platform. It is within the Google development ecosystem and gives us access to some other powerful libraries/frameworks. Firebase ML and Cloud Firestore are two such technologies which will be used for image labeling and database storage respectively.

The app has two main functional features: flashcard study and conversational stories. Flashcard study gives users an option to practice timed recall and also study words picked up in other places in the app (e.g. words and phrases marked by the user in the conversation story section of the app might appear in their flashcards). We have a lot of room to expand on the basic flashcard structure. We can allow users to group decks (i.e. a user might group their decks by subject or difficulty). Users might also add small notes, pictures, or short recordings to their cards for further practice. The other feature, conversational stories, lets users practice building phrases. This portion of the app first requests that a user take a picture. The app uses the picture to choose objects and phrases within the users learning level. We then use the set of words found in the picture to choose a story. Object detection and image labeling is performed using Firebase ML [1]. The user is also given an option to choose a pseudo-random story. Each story consists of sets of phrases and corresponding choices that are stored in a database (e.g. text files can be stored in Google Firestore [3]). A user is presented with a phrase on the screen and has the option to also hear a recording of this phrase. The user then responds to the phrase using a set of word phrases on the screen. The choices are presented as tiles on the screen that they can mix and match to form answers. If a user is unsure about a word or phrase presented to them, they can opt to add it to their flashcard set(s). Each story contains elements found in the picture they took (i.e. colors, nouns). Firebase [1] gives us a way to label images and use this information in our app.

We can add more traditional game based based elements to the app by doing part of our development in Unity. With Flutter, we get the bonus of game-development embedded into the app. This might be done in the story based section to enhance user-experience.

### **3.2 Related Work**

There have been a few apps based around Cherokee, as shown in [7]. However, these apps are mostly restricted to the syllabary or a few common words. For example, the app [8] as well as the full version [9] have a quiz game style tool to learn animal names in Cherokee. The apps have audio that pronounces the animal names in Cherokee, and the user is supposed to select the correct image that corresponds with the audio, given multiple options. However, these apps lack a way to see how the words would be written and don't show the word used in conversation. Our project will allow users to practice conversational Cherokee with the use of story-based games.

## **4.0 Design**

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

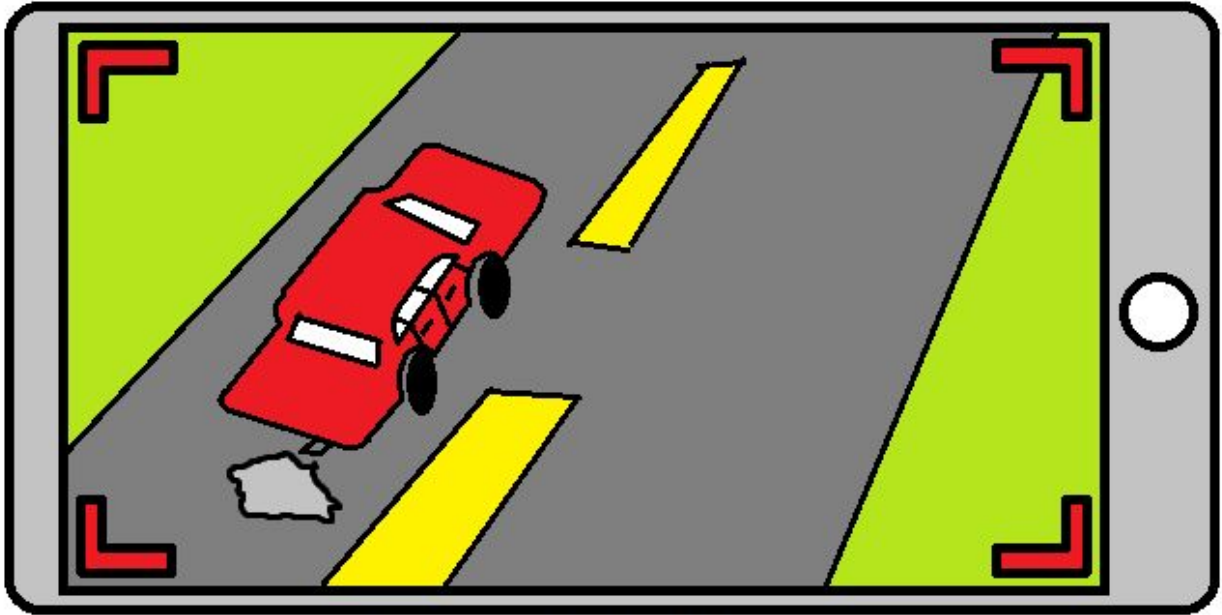
The two main requirements are that the user have a way to practice basic nouns/verbs and conversational Cherokee. Our design is similar to other story-based games in that the user will be able to hear and practice their own Cherokee through a set of stories.

We plan on creating a story-based game. To start, the app requests that the user take a picture and elements found in the picture (e.g. colors, objects) are used to choose from a story set. In each of the stories the user can practice and hear conversational Cherokee. The user is presented with a phrase (e.g. a question) from a character and they can respond from a ‘pool’ of phrases. Each story and phrase pool is tailored to a user’s learning level. If you are a beginner, the phrases may be shorter and have an English translation accompanying them. If you are an intermediate level learner they may be longer and have no English translation. The same levels might look and behave differently based on your current learning level.

If the user does not know a word or phrase they have the option to add it to their ‘notebook’ - a sort of flashcard dictionary where they can return to at any time and see words that are currently giving them problems. This notebook contains a preset dictionary of basic words and accompanying pictures for the user to return back to at any time.

## **4.2 High Level Architecture**

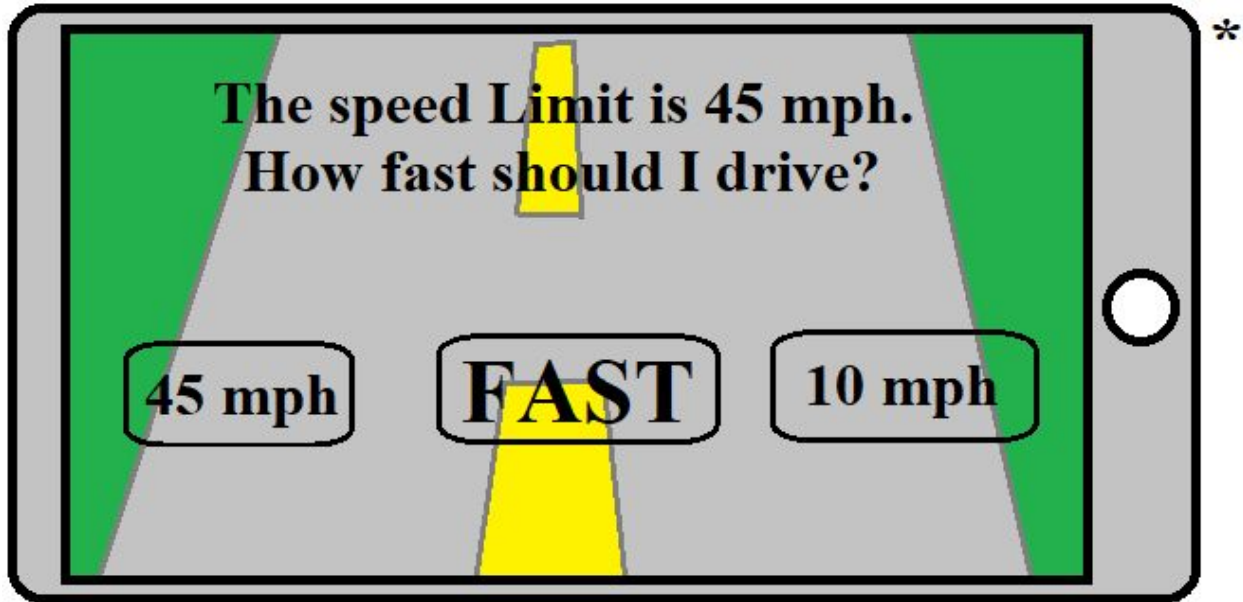
- Cross-platform mobile framework (e.g. Flutter)
- Unity (C#) for game development
  - Can be imported into a Flutter application
- In order to perform object and color detection, we will use Google’s ML Kit (specifically the image labeling model).
- Firebase will be used to store story tags as the key, and the story files as the value.
  - The story tags will be stored as a list and used as the key. The files needed for the story will be stored as the “document”. The document should contain sub-documents that have the required image(s) and text data to use for that story.
- User save files and data should be stored on the client side, not server side.
  - This means we won’t need to store account information in a database.
- The story game will be mostly text based. Therefore, parsing string information from text documents will be necessary.
- In order to do a level based progression system, we will need to save user progress locally. This progress file will get rewritten with each question that is answered.



### Detected Labels:

- Car
- Road
- Grass
- Red
- Gray
- Green

The first step is to detect objects/colors in an image using Google's ML Kit. Next, the user will be matched with a story that has similar labels from the Firebase.



*\*I used only english as an example. The app will utilize Cherokee as well.*

The story and game will be launched using Unity. The application will then use the story to ask the user questions. The user level and progress will be modified based on the user's answers throughout the story.

### 4.3 Risks

Risk	Risk Reduction
Time constraint	Keeping the project size doable, planning ahead.
Budget constraint	Define a clear set of requirements, stay close to the objectives and goals.
Poor quality code	Carry out frequent testing of various types (unit, integration, system, etc.), have checkpoints to test codes.
End-User conflict	Keep a clear and frequent communication with the clients, make sure the clients are on par with the development of the product at various stages.

### 4.4 Tasks

1. Gain background about story-telling techniques utilized in games and by Cherokee people
2. Develop the initial UI after first launching the app
3. Implement camera functionality to take pictures
4. Implement object/color detection on the photos taken
5. Testing 1: test proper functionality of camera usage and object/color detection

6. Create stories, questions, and answer options
7. Implement and integrate Firebase (will store the stories used by the app) into the app
8. Implement functionality to search Firebase for matching labels to retrieve story information
9. Testing 2: test proper functionality of Firebase as well as the retrieval implementation
10. Develop initial story game UI when the story is first started
11. Develop question and answer UI for when questions (part of the game) are asked to the user
12. Implement answer validation to check whether a user's answer is correct or incorrect
13. Testing 3: test proper functionality of the question and answering implementation
14. Implement user level/progress functionality, for example users gaining level after answering a certain amount of questions correctly
15. Testing 4: test proper functionality of user progress

#### 4.5 Schedule

Tasks	Dates
1. Research background/design prototypes	1/10/2021 - 1/17/2021
2. Develop initial UI	1/10/2021 - 1/17/2021
3. Implement camera functionality	1/17/2021 - 1/24/2021
4. Implement object/color detection	1/24/2021 - 1/31/2021
5. Testing 1 - prove flashcard feature works	1/24/2021 - 1/31/2021
6. Create stories, questions, and answer options	1/31/2021 - 2/7/2021
7. Firebase initialization	2/7/2021 - 2/10/2021
8. Implement Firebase retrieval	2/10/2021 - 2/17/2021
9. Testing 2- prove flashcards and story skeleton work together	2/10/2021 - 2/17/2021
10. Develop initial story game UI	2/17/2021 - 2/21/2021
11. Develop question and answer UI	2/21/2021 - 2/28/2021
12. Implement answer validation	2/28/2021 - 3/7/2021
13. Testing 3 - Initial User/Blackbox Testing	2/28/2021 - 3/7/2021
14. Implement user level/progress functionality	3/7/2021 - 3/21/2021

15. Testing 4 - Final user/blackbox testing	3/7/2021 - 3/28/2021
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#### 4.6 Deliverables

- Design Document: Contains a listing of each major hardware and software component and how they are implemented and used.
- Database scheme and initial data: The DB schema is for Firebase, Cloud Firestore.
- Flutter and Unity code for the project: the code for the application
- .apk and/or .ipa of the developed application: the app file itself
- Website code: any code that is involved in the creation of the website
- Final Report: report will consist of project implementation details as well as results

#### 5.0 Key Personnel

**Carter Buckner** – Buckner is a senior Computer Science major and Music minor at the University of Arkansas. He has completed courses in Database and Software Development. He also has experience in STEM education, health research, and aerospace. Buckner will be responsible for tasks 2, 3, and 6. He is also a member of the development team and serves as product owner.

**Watson Dunn** – Dunn is a senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. He has completed Software Engineering, Database Management, and Data Mining. He has interned with Murphy USA for two summers which gave him industry experience with database management and software development. Dunn will be responsible for tasks 4 and 5.

**Tyler Spreen** – Spreen is a senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. He has done group development in Software Engineering and has taken Artificial Intelligence, Database Management Systems, and Mobile Programming. He has also experience in making android apps, Microsoft Azure, and Google Firebase. Spreen will be responsible for tasks 7, 8, and 9

**Hong Phuc Vo** – Vo is a senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. She has done some group development in Software Engineering and Database Management. She has worked with the module PyGame, creating 2D games and some experience making websites. Vo will be responsible for tasks 10 and 11.

**Yatish Dubasi** – Dubasi is a senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. He has (or will have) completed the following relevant courses: Software Engineering, Artificial Intelligence, Database Management Systems, and Advanced Information Retrieval. He also has experience working with image recognition and color detection AI. Dubasi will be responsible for tasks 14 and 15.



**Tuan Nguyen** – Nguyen is a senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. He has completed Software Engineering and has experience working with machine learning and artificial intelligence. Nguyen will be responsible for tasks 12 and 13.

**Schon Duncan** – Duncan is a local Cherokee language teacher. He also teaches Cherokee culture and language to local community groups. His love for linguistics and teaching makes him the perfect partner for our project.

## 6.0 Facilities and Equipment

We do not need university facilities and equipment to complete this project. We will be using our personal computers and phones to complete this project.

## 7.0 References

- [1] Google ML Kit, <https://developers.google.com/ml-kit/vision/image-labeling>
- [2] Cherokee Basics, [http://www.native-languages.org/ Cherokee \\_ animals.htm](http://www.native-languages.org/ Cherokee _ animals.htm)
- [3] Cloud Firestore, <https://firebase.google.com/docs/firestore>
- [4] Flutter, <https://flutter.dev/>
- [5] Cherokee - Endangered Languages, [www.atlas-translations.co.uk/ Cherokee/](http://www.atlas-translations.co.uk/ Cherokee/)
- [6] The Cherokee Language is Facing Extinction, <https://forum.duolingo.com/comment/9541995/The-Cherokee-Language-is-Facing-Extinction>
- [7] Google Play, [https://play.google.com/store/search?q= Cherokee &c=apps&hl=en\\_US&gl=US](https://play.google.com/store/search?q= Cherokee &c=apps&hl=en_US&gl=US)
- [8] Cherokee Language Animals - Basic, <https://www.getjar.com/categories/education-apps/language/ Cherokee -Language-Animals-Basic-334554>
- [9] Cherokee Language Animals, <https://play.google.com/store/apps/details?id=com. Cherokee lessons.vocab.animals.one>