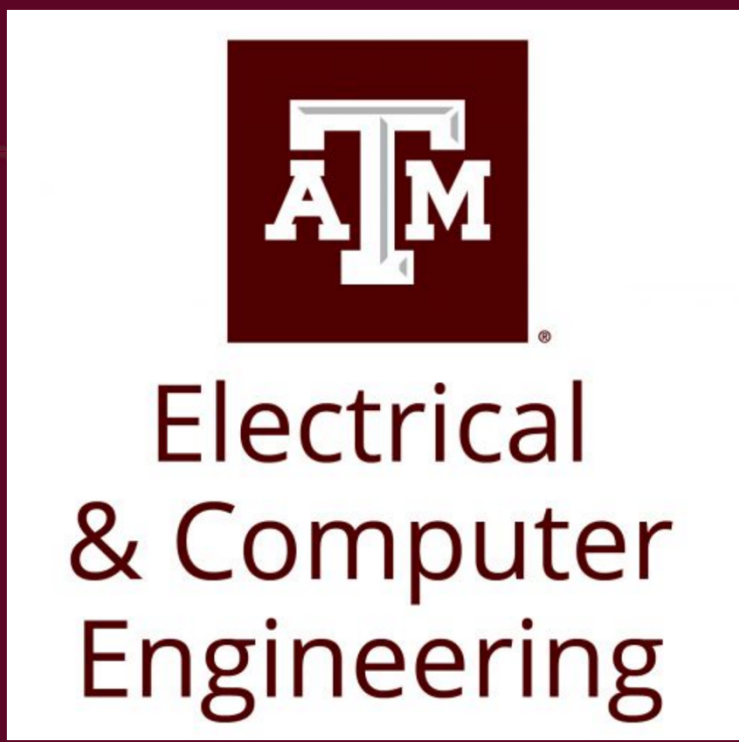


# ASL Interpreter Application

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## Problem Definition

Approximately 11.5 million Americans are deaf and no accurate count exists of the amount of people that use ASL on a daily basis. In order to try and facilitate conversations between signers (users of ASL) and non-signers, our team was tasked to build a mobile application that could take recordings of signers and return an English translation.

## Methodology

Our project consists of two subsystems:

The Android application and server backend, and the machine learning model.

### Android Application and Server Backend

- Developed an Android application to upload recorded videos to a remote server
- Created a lesson plan to help teach basic phrases and words in ASL to reduce dependency on the app
- Implemented multiple *php* endpoints to transfer data between the server and application

### Machine Learning Model (Translator)

- Trained a Long-Short-Term Memory (LSTM) Machine Learning model that can translate 39 words

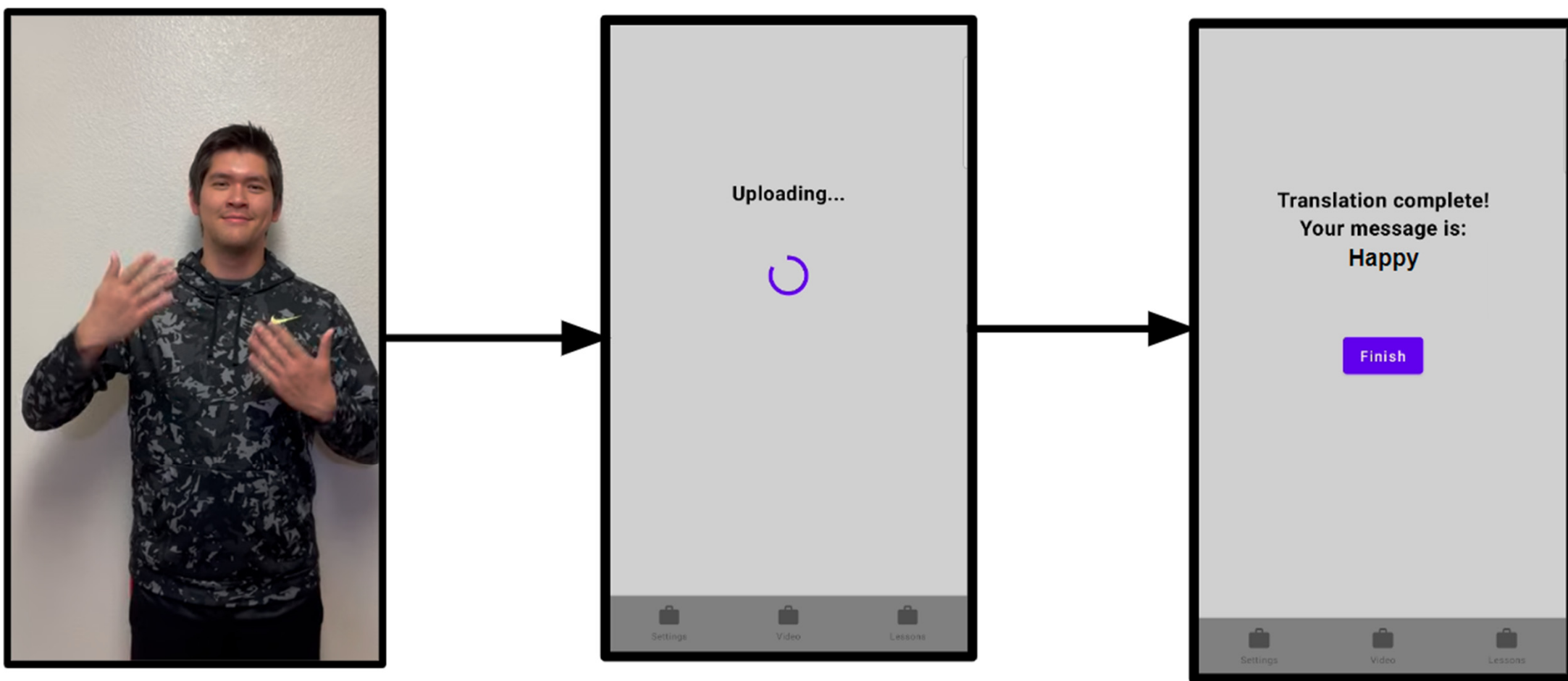


Figure 1. Example Translation Process

## Engineering Analysis

The goal of our project was to ensure that as many people as possible could use our application. To accomplish this, it was designed around the constraints of having a small install size, minimal computational power needed on the device, and a remote server to run the machine learning model.

- A. To minimize the installation size of the application, all assets are loaded from the server as needed.
- B. To ensure that most Android devices could run the application, all that is needed is a camera and an active internet connection.
- C. All processing is handled on the server to eliminate the need for a strong mobile device and prolong battery life.

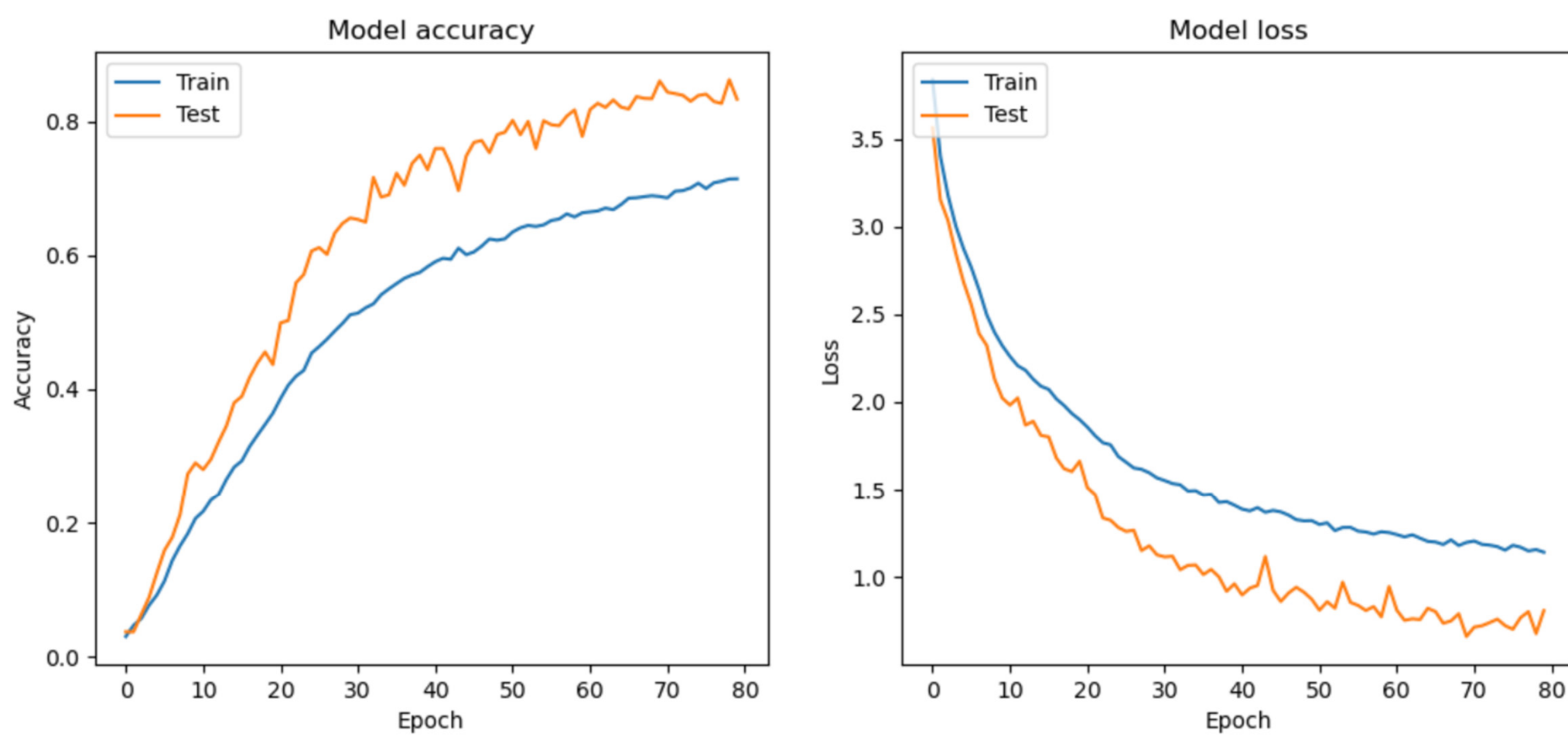


Figure 2. Model Training Results

Items	Specification	Actual
Accuracy	60%	85.30%
Word Count	30	39

Items	Value
Precision	85.28%
Recall	85.3%
F1 Score	84.6%

Table 1. Final Model Metrics

## Functional Block Diagram

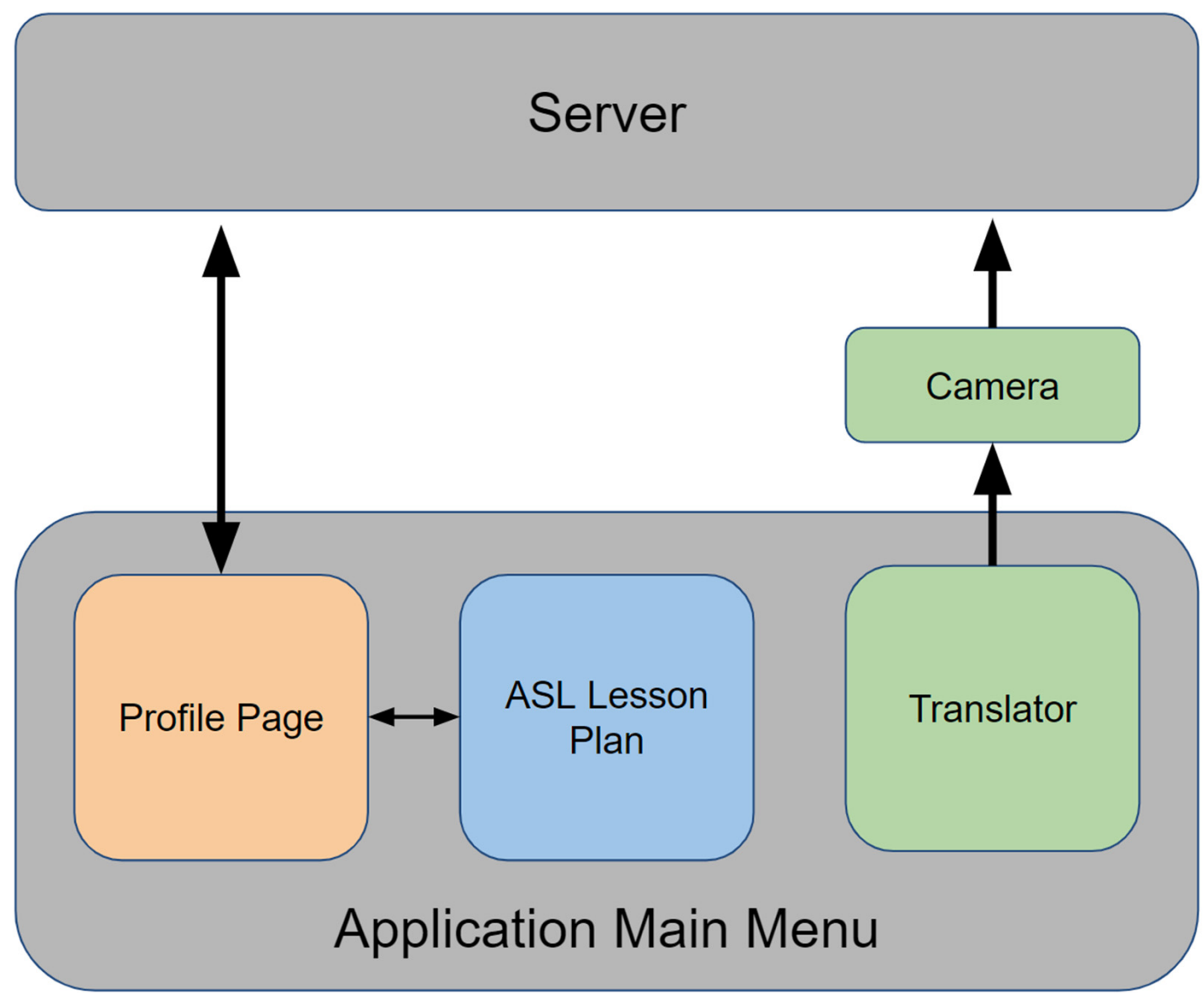


Figure 3. Outline of the Application's Workflow

## Outcomes

The project was able to achieve its primary goal of being able to produce ASL translations from recorded videos being uploaded to the server and then run through the model. However, due to the unforeseen complexity needed to consistently and accurately translate ASL gestures into words, our model can be inconsistent at times resulting in inaccurate translations. This can be improved with a larger dataset with more variety in the samples (lighting, positioning, background, etc.). The application and server provide a solid foundation to continue to build the service onto and allows the model to be updated without any updates to the main application.

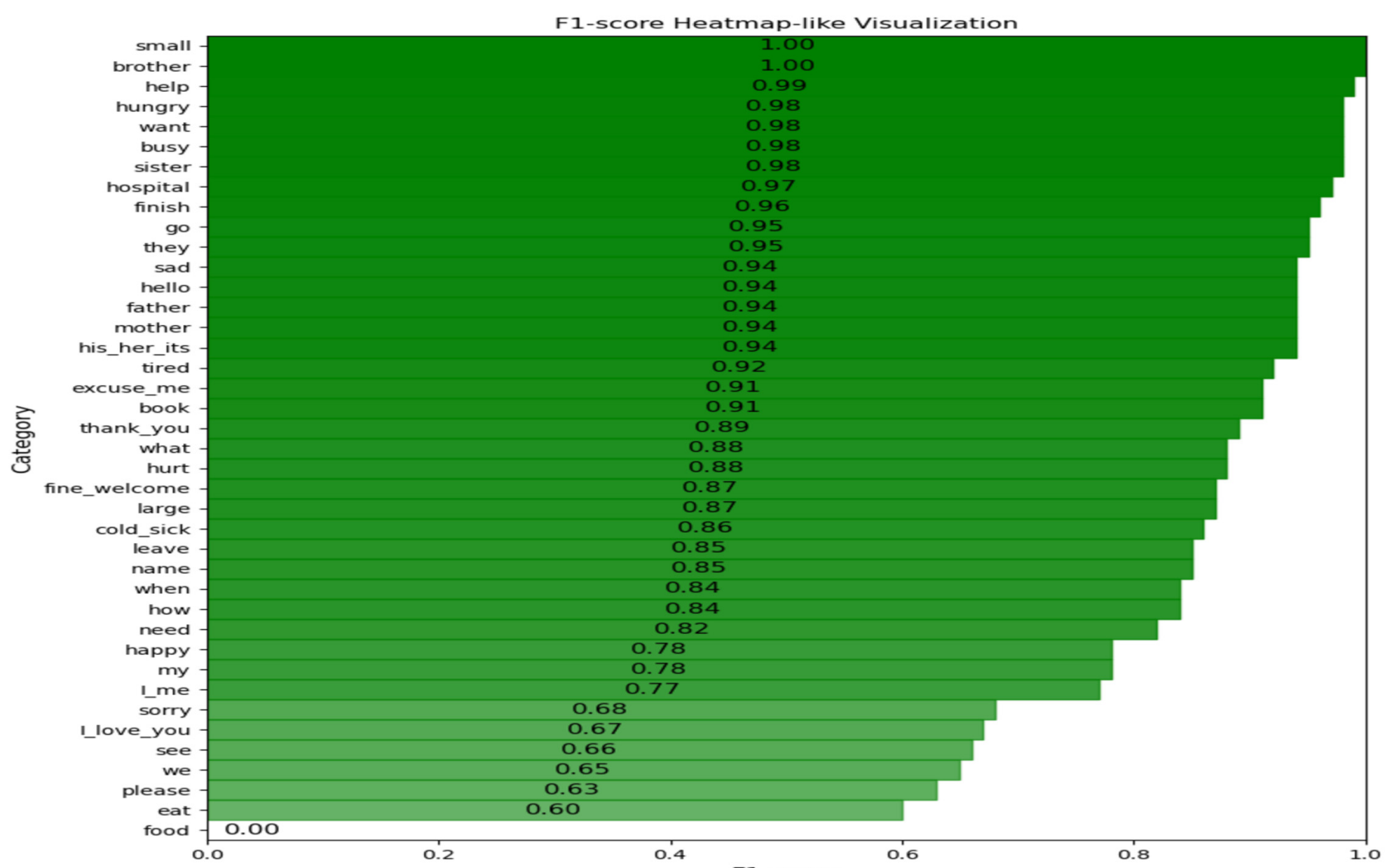


Figure 4. F1 Heatmap of Vocabulary

Table 2. Application Metrics

Items	Specification	Actual
Space Required on Disk	< 100MB	22.70MB
RAM Usage	< 200MB	157MB (Maximum)
Time For Translation	<= 15 Seconds	9.87 Seconds (Average)
ASL Lesson Plan	10 Lessons	Accomplished
User Data Storage	Server-based, cross-device	Accomplished

The table above shows the system requirements and general features of the application.

## Impact

This application will allow its users to communicate more effectively with ASL signers through both its translator feature as well as its lesson plan. In retrospect, a few areas of improvement to increase the effectiveness would be:

- Increasing the size of the dataset per word
- Expanding functionality from word-level translation to sentence-level translation
- Incorporating more user interaction in the lesson plan
- Allowing users to provide feedback on erroneous translations to allow users to contribute to the dataset

## References

1. American Community Survey (2021). "S1810 | Disability Characteristics"  
2. Mitchell, Ross; Young, Travas; Bachleda, Bellamie; Karchmer, Michael (2006). "How Many People Use ASL in the United States?: Why Estimates Need Updating" (PDF). Sign Language Studies. 6 (3). ISSN 0302-1475

## Acknowledgements

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