

# Mobile Phone Access to a Sign Language Dictionary

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## ABSTRACT

We have built a functional prototype of a mobile phone app that allows children who are deaf to look up American Sign Language (ASL) definitions of printed English words using the camera on the mobile phone. In the United States, 90% of children who are deaf are born to parents who are not deaf and who do not know sign language [3]. In many cases, this means that the child will not be exposed to fluent sign language in the home and this can delay the child's acquisition of both their first signed language and a secondary written language [1]. Another consequence is that outside of school the child may not have easy access to people or services that can translate written English words into ASL signs. We have developed a prototype phone app that allows children who are deaf and their parents to look up ASL definitions of English words in printed books. The user aims the phone camera at the printed text, takes a picture and then clicks on a word to access the ASL definition. Our next steps are to explore the idea with children who are deaf and their parents, develop design guidelines for sign language dictionary apps, build the app using those guidelines and then to test the app with children who are deaf and their hearing parents.

## Categories and Subject Descriptors

K.4.2 [Computing Milieux] Social Issues: *Assistive technologies for persons with disabilities.*

## General Terms

Human Factors

## Keywords

Deaf education; mobile apps

## 1. INTRODUCTION

Reading English is a difficult task for many students who are deaf. In 30 years of standardized testing, half of deaf high school students have been found to read at the 4<sup>th</sup> grade level or below [4]. A major factor affecting their reading ability is vocabulary knowledge [2] and hence the accessibility of text.

Accessing sign language definitions for printed English words is difficult for children who are deaf and who communicate

primarily in sign language. This is particularly true at home in a family setting. In the United States, more than 90% of children who are deaf are born to parents who are not deaf [3] and do not know sign language. This means that a child learning to read at home most often can not ask a parent to define a new word encountered in a book.

This problem is important to deaf children who communicate primarily in sign language and their parents. It is important to children because it creates barriers to acquiring ASL vocabulary for English words. It is important to parents because a parent might use the dictionary to build their own sign language skills in addition to using it to teach their child in the home.

Current solutions to defining English words in ASL include web pages<sup>1</sup> and mobile phone apps<sup>2</sup>. In both cases using the dictionary involves selecting the word from a list of all words in the dictionary or typing a word into a textbox. We seek to eliminate both selecting the word from the dictionary list and typing in order to minimize interruptions to reading flow.

We have constructed a functional prototype of an Android phone app that allows children who are deaf to access ASL definitions of printed English words without selecting the word from a list or typing the word into the app. The app is a front end to our SmartSign Dictionary which is freely available on the Internet<sup>3</sup>. To use the prototype, a user points the cell phone camera at a page of text, takes a picture and then clicks on a word to access the definition. The definition is displayed as a video streamed from YouTube.

Our next steps are to engage with children who are deaf and their parents in order to establish design and usage guidelines for sign language dictionary cell phone apps. We will then use those guidelines to finalize the app design. These guidelines may also inform the design of other related apps.

## 2. GOALS

We have four goals for the design of the application.

**Eliminate typing.** We seek to avoid requiring users to spell unfamiliar words when looking for definitions of those words.

**Maintain reading flow.** The app should allow the user to look up a word with minimal effort and then to return to the reading at hand.

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ASSETS'15, October 26-28, 2015, Lisbon, Portugal.

ACM 978-1-4503-3400-6/15/10

<http://dx.doi.org/10.1145/2700648.2811364>

<sup>1</sup> Such as the dictionaries <http://www.lifeprint.com/dictionary.htm> or <http://www.handspeak.com/word/>

<sup>2</sup> Such as "ASL Dictionary" by Software Studios LLC or "ASL Dictionary from NTID" by Rochester Institute of Technology.

<sup>3</sup> At <http://smartsign.imtc.gatech.edu>

**No machine translation.** Using the dictionary should not require natural language translation technology that does not yet exist. More difficult problem of automatically translating English phrases or words to ASL is left to others.

**Increase dictionary use.** The app should measurably increase use of the dictionary.

### 3. SMARTSIGN DICTIONARY PROTOTYPE PHONE APP

The phone app prototype consists of two parts: the dictionary and the app itself. The dictionary is a collection of videos hosted on YouTube. At present there are 17,593 videos in the dictionary which represent a total of 65,670 words or phrases. We are actively expanding the dictionary to a target goal of 20,000 videos. The dictionary can be accessed by sending a keyword as a parameter in a URL. The server returns a JSON string which contains a list of ASL definitions for one or more meanings of that word. For each meaning of the word, the JSON contains a list of keywords, a thumbnail image and a YouTube video ID. The video can be accessed using with YouTube ID. The definitions were produced in collaboration with the Institute for Disabilities Research and Training.

The app prototype consists of three parts: taking a picture of text, picking a word and watching the definition. Taking a picture of the text is done using the cell phone camera. OCR on images with 1040x728 pixels is sufficient for this application for images taken 8-12 cm from printed text written in a 12 point font. We use the Abbyy FineReader mobile phone OCR package. When the camera plane is parallel OCR correctly identifies about 85% of the printed words (depending on lighting and other factors).

After taking a picture, the user clicks on a word in the picture to access a definition of that word. Pinch-to-zoom and swipe-to-pan allow the user to find the right word. Colored highlights overlaid on words in the image indicate words with definitions in the dictionary. For example, the image of the word “cat” in a picture is highlighted if the OCR engine recognized “cat” and the word “cat” is in the dictionary.

Clicking on a highlighted word in the image either brings up the ASL definition or brings up a disambiguation page. The disambiguation page lists ASL definitions for different meanings of the word. For example, clicking on the word “house” brings up two definitions: one for “house” as a noun and one for “house” as a verb. Each possibility includes a list of keywords in English as well as a thumbnail image. Clicking on one of the definitions on the disambiguation page brings up the ASL definition video. The user selects the word from a list but this list includes only meanings for that word and not all words in the dictionary.

The video is streamed from YouTube and displayed in a standard video player. After the video is complete, the app returns to the image of the English text where the user can select another word.

It is significant that the dictionary is not stored locally on the phone and that the video is streamed to the phone. This means that the dictionary can evolve over time and that the app does not need to store all of the 17,593 videos. But it does mean that the app only works when connected to the internet.

### 4. ESTABLISHING DESIGN GUIDELINES

Our next step is to measure preferences that will be used to establish design guidelines for this and other ASL dictionary apps on mobile phones. We have decomposed the design problem into three dimensions given below and plan to measure preferences for both children and parents along those dimensions.

**Input.** How should the user input the word to look up to the dictionary? We have assumed that eliminating typing is a good design goal. However children who are deaf may prefer to type the word in or select the word from a list of all words in the dictionary rather than use the camera.

**Selection.** Assuming the phone camera is used to generate input, how should the user select the word in the picture to define? Selection methods vary based on the number of clicks required to select a word. In the prototype we implemented a two-click process in which the user clicks to take a picture and clicks a word. We have identified other selection methods that require one or zero clicks. In the one-click method, the user aims the phone camera at a block of English then clicks on the word in the camera preview to access a definition. In the zero-click method, the user aims the camera at the block of text. Once the camera stabilizes the word at the center of the camera image is defined.

**Viewing.** How should the ASL video definition be viewed? Should other information be presented when viewing the video or should the video be presented in isolation? We can overlay video with the English word being defined or with the entire phrase containing the word being defined. Or we can show the word at the end of the video.

### 5. SUMMARY

A functional prototype of the app is complete but additional work is needed to establish design guidelines. These guidelines will inform the completion of this app and perhaps guide the development of other similar apps for children who are deaf and their parents. Future work will measure whether or not the app results in increased dictionary use by children who are deaf.

### 6. ACKNOWLEDGMENTS

This work was supported by the Sorenson Impact Foundation, a Google Faculty Research Award and NSF IIS-1124548.

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