# Socialeyes

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## ABSTRACT
Growing up is a difficult process. For the blind, social development and interactions can be quite a trial. While there are many tools to help the visually disabled with daily activities such as traveling, reading, and using computers, there are very few tools to help in social situations. We propose a tool with the ability to detect and locate specific individuals in small group settings (3-10 people). Using facial recognition, the android development kit, and discrete feedback signals, this tool will help the blind locate individuals in crowded and noisy settings and provide instructions on how to navigate to them.

## Keywords
facial recognition, android, visually disabled, mobile database, audio interface, cell phone

## 1. INTRODUCTION
In the United States there are an estimated 1.3 million legally blind people. Of these, 93,600 of them are children [8]. In 2008 in Colorado a total of 83,072 people reported having serious difficulty seeing, even when wearing glasses, or blindness. Approximately 42,726 of them were between the ages of 18-64 [2].

In day to day activities, sighted people usually take for granted how often they use their vision to accomplish tasks. It helps us avoid tripping over cables, locate buildings through reading signs, and even sign receipts. People who are blind or visually disabled face challenges like these everyday.

With the help of specialized tools and the use of the other senses, the visually disabled has been able to overcome many of these obstacles and succeed in a sighted world. These tools include white canes, talking watches, braille compasses, screen readers, and GPS.

Unfortunately, fewer tools have been developed to assist the blind in social situations. Many people who are blind have exceptional memory and are able to remember people by the sound of their voice, but this becomes more difficult in large crowds or in noisy environments.

We propose to develop a computerized vision system as a tool to help the visually disabled find people in small group settings. The system will consist of "off the shelf" items such as an android cell phone and a laptop. Along with audio and tactile feedback, it will utilize the real-time face detection and recognition system called FaceL [4] which is designed to be easily trained and to recognize a small set of people in uncontrolled settings.

## 2. Related Work
In the last couple years there has been a rise in the study of using computers, and computer vision, to help the visually disabled. Harvard's Schepens Eye Research Institute is involved with several studies of computer vision enabled devices designed to assist the visually impaired. One investigator, Dr. Gang Luo, is currently working on several projects including a device consisting of see-through augmented reality glasses which superimposes a mini-version of the outlines of a scene onto the actual scene for people with tunnel vision[5]. For people with central vision loss, there are devices that include features such as magnification and wideband enhancements. There was also a report of a possible device to help people with night blindness [3].

For everyday object identification, LookTel, an object recognition software sponsored by The National Eye Institute and the National Institute of Aging, is an application designed to work with a Windows OS smartphone to recognize various objects and landmarks.[9] It's reported to be able to recognize packaged goods from a grocery store, organize money, identify medication bottles, and help the user find a specific CD in their music collection. It can be trained to recognize landmarks and other objects of the users choice. It is also capable of taking a photo of printed text and reading it back to the user [7].

In addition to LookTel, researchers are using cell phones to help the visually disabled find rooms in a building. By creating signs with linear barcodes and implementing novel decoding algorithms that are robust to noisy images, a user can use a cell phone to scan the barcode and read the location's name out loud [6].

Tools to help the visually disabled recognize and find people they know are still being developed. The system proposed by this paper will be affordable, useful, and accessible.

## 3. SYSTEM DESIGN
The user of the proposed system will be able to discretely carry and use it. It will be designed to work in the following scenarios.

1. User is using the system to gather video images of a target for training purposes.
2. User is looking for a particular person and signals the system to look for them.
3. User found someone familiar and signals the system to give them instructions on how to find the person.
4. User is looking for someone familiar and signals the system to scan for a set of individuals.

5. User is interacting with an unknown person and signals the system to provide the name of the person.

## 3.1 Android Phone Model

The decision to use an Android Phone was based on several things. It is known to be accessible. The newest version of the android os includes a text-to-speech library and multiple free, accessible applications have been developed to make android phones easier to use. Also, android applications can be developed in the portable programming language Java which is one of the target languages of the Colorado State University Computer Science Department. This will ease the creation of the interface and will allow the blind college computer science students to easily read and add to the source code.

In choosing a specific model of cell phone to use we considered the following factors.

1. The number of hard keys available
2. How easy the hard keys were to find
3. The size of the phone
4. Includes a camera

Since all modern Android phones have the ability to enable text to speech and to download applications to assist with accessibility, the features of the operating system did not need to be considered.

After looking at several different phone specs and the phones themselves, the deciding factor became the number of hard keys available. Having physical buttons for the Home Key, Send Key, Power Button, and Menu key are important for visually disabled users since they are easier to find and use then touch screen buttons.

## 3.2 User Interface

The user interface will be included in an application on the android cell phone. It will be specifically designed for people with visual disabilities using the Android Standard Development Kit which includes an accessibility API. This will include features such as giving our buttons and menu options text descriptions so that it can be communicated to the user through text to speech.

## 3.3 Feedback

The android phone will also include TalkBack, an open source screen reader hosted by Google, along with Kickback, for tactile responses, and Soundback, for non-spoken auditory feedback.[1] The form of feedback for related events will need to be standardize in order to create an easy to use interface. For example the feedback every time an event or task is completed should be similar. The phone will also include the eyes free shell which provides a Text To Speech library and home screen interface for easy access to applications and settings.

Ideally feedback will also be subtle. Verbal or audio cues will be played through an ear bud and haptic feedback should not be so loud or frequent as to draw attention to the system.

## 3.4 Prototype

Initially the system will consist of a laptop and android cell phone. The laptop will contain the facial recognition software as well as host the database of training videos of people the user knows. After training on the data, FaceL will produce several Support Vector Machines (SVMs) that are relatively small in size and can be downloaded to the cell phone. SVMs are supervised learning methods which develop models to predict the categories new information belongs into. In the context of this system, the SVMs will allow the system to analyze the input video and categorize the data based on who is in it.

The android cell phone will serve as the host for the user interface and will be able to capture new video and detect people the user knows. After capturing new videos, the user will be able to conveniently download the new training videos to the laptop at anytime.

## 3.5 Completed Model

As the system is further developed, it will grow to include a camera mounted on a pair of sunglasses and an ear bud. This will increase privacy for the user. We also plan on adding a feature upload collected videos automatically to a database. The result being the user will not need to return to the laptop to download the collected videos periodically.

## 3.6 Estimated Timeline

- 1 Month:
  - Collect 4 Training Videos of at least 10 distinct individuals
  - Set up cell phone with TalkBack, Kickback, and Soundback
- 3 Months:
  - Preliminary User Interface Designed and Implemented
  - Collect 3 more Training Videos on the original 10 individuals
  - Collect 3 Training Videos of 3 new individuals
- 6 Months – Testing of Prototype System
  - Initial testing will be done by blind college computer science students who were involved in the design and implementation of the system
- 1 Year – Prototype Completed
  - Incorporate changes in light and size of crowd
  - Begin testing using blindfolded users
- 18 Months – Incorporate sunglasses and external camera into system
- 2 Years – Implement automatic upload of training videos to database and download of SVMs
- 2.5 Years – Testing of Completed Model
  - Expand testing to Fort Collins Blind Community

## 4. Evaluation

The system will be evaluated on two properties; how accurately it performs and how usable it is. This will be done in three stages. Each stage will consist of a different group of subjects

and will involve not only using the system, but collecting training data for each test individual.

## 4.1 Stage One

As mentioned in the previous section, we will begin testing with help from two computer science students who are blind and are currently attending Colorado State University. They will have been a part of the design process and as computer scientists their input will undoubtedly improve our system. With an understanding of how technology works and feeling comfortable with electronics, they will be biased in their evaluation of how usable the system is; however their observations will help determine if the system is working correctly. Their feedback will also provide us with suggestions for improvement relating to the user interface and feedback provided from the system.

## 4.2 Stage Two

To further test the accuracy and usability of the system, small-scale tests will be run with blindfolded sighted subjects. In many ways blindfolded subjects are poor substitutes for blind subjects as they have not developed the competencies that blind subjects have had to. However, sighted people that are willing to be blindfolded are much easier to find in a college setting. They can be taught how to use the system and in addition, this will avoid artificially raising the hopes of blind people in case initial testing does not go as well as planned.

## 4.3 Stage Three

In the final stage of testing, provided that the previous stages pass its goals, a small number of blind volunteers will be recruited from the Fort Collins, CO community to help us test the usability of the system.

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