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Smart Eye Glasses for Visually Impaired Individuals

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ABSTRACT
A Smart Eye Glasses android mobile application is presented in this paper. Visually impaired people face lot of problem when exchanging currency, contacting their loved ones. This application provides a helping hand by providing a set of features such as currency detection, weather detection, calling/texting to contacts, object label detection to ease few tasks. All these features are available on the voice command of the user. The application uses mobile camera as a means to capture frames, process them, and provide output in the form of audio.
KEYWORDS—*mobile application, currency detection, message, weather detection, voice command, firebase ml-kit, android.*

I. INTRODUCTION

The number of visually impaired person is growing over the past decades. As reported by the world health organization (WHO), there are about 1 billion people suffering from moderate to severe distance vision impairment [1]. Many different devices are available for assisting visually impaired person to perform daily task, and among all assistive devices, wearable devices are found to be the most useful because they are hand free or require minimum use of hands.

Mobile phones being an indispensable part of every person's daily life, making an application which will help visually impaired people in their daily life can make their life little hassle free. Visually impaired person faces a lot of problem in their daily life, and they heavily depend on other sense such as touch, hearing, smell, and white cane stick [2]. To overcome such challenges, there are many devices, mobile applications available which can help blind people tackle certain tasks [3]. For instance, Colorine talking color identifier device, TapTapSee application can be used to detect color/light and define an image captured through mobile camera respectively [3]. Since, there are multiple devices for different tasks, this leads to increase in price [3]. Some features developed for normal people in smartphones such as speed dial or voice dialer can also help to make a call someone from the contact list [4]. A user still needs touch/swipe to make a call and hence it becomes difficult for a visually impaired individual to perform calling [4]. Therefore, we decided to make a mobile application which will consist of majority of features available for the user such as object label detection, currency detection, text detection, barcode reader, calling, messaging, date, time, weather. We have designed an application which can provide all these features with minimum usage of hands, all of these can be accessed using specific voice commands.

After successful implementation of the application, the user will be able to perform various tasks, such as exchanging the currency, get information about things in the surrounding. Along with such tasks, the application will be able to perform necessary tasks which include making a phone call to their loved ones or sending them a text message as well as get their current location, date and time.

II. DESIGN AND IMPLEMENTATION OF ASMART EYE GLASSES MOBILE APPLICATION

A. Overview of the Application

The main aim of the Smart Eye Glasses mobile application is to combine different features in a single mobile application which uses internet in-order to help visually impaired person to tackle certain tasks without much efforts. Firebase Ml-kit will be used to enhance the functionality and

accuracy of majority of the features. The input is taken in the form of voice commands. The requested feature is processed and the output is received in the form of text, which is further passed to text-to-speech model which turns the text into audio form. In-order to save battery life of the mobile, the majority of the processing happens on firebase ml-kit cloud vision and hence an internet connection is required to run the mobile application. The following are the main features available in the current mobile application:

1. Text Detection: we can recognize text in any Latin-based language and more, with Cloud based text recognition. We can use frames captured from the mobile camera to perform text detection. This feature is useful for reading an article, books, newspaper.

2. Label Detection: This feature is used to detect different entities present in the camera frame and name them. Entities such as chair, table, keyboard, etc. can be recognized using label detection.

3. Face Detection: This feature can be used to detect any human face present in the camera frame. The major goal of this feature is to capture/detect a face if present in the frame.

4. Currency Detection: We can use this feature in order to detect currency notes. This feature uses a custom model made using firebase ml-kit which is able to detect any new Indian Currency note (INR). The model is made using images from Kaggle dataset as well as adding images from around the internet. This can help in smoother transaction of currency for visually impaired person.

5. Call/Message: This is a handy feature which can be used to make a call, send a message to anyone present in their contact directory using voice command.

6. Temperature, Weather: This feature can be used to know the information about current weather prior to moving out. The application gathers location of the user using the GPS. It then sends the latitude and longitude to openweather api which returns the weather information in the form of text. This text is then passed to text-to-speech model which provides output in the form of audio.

7. Date, time: User can use this feature to know about the current date and time. The output is provided in the form of audio.

B. Flowchart for all activities

This section presents flowchart for all the features implemented in the mobile application. Fig. 1 shows the flowchart of text detection feature. It allows a visually impaired person to know the text present in front of the camera by providing an audio output of all the text present. The frame is passed to firebase ml's text recognition api which returns text present in the frame.

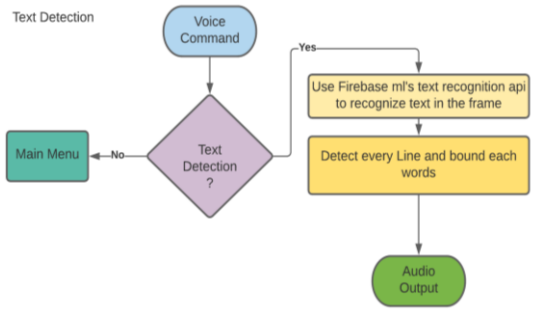

Figure 1. Text Detection Flowchart

Fig. 2 shows the flowchart for label detection feature. It let knows user about all the entities present in the surrounding around the user which are visible in the frame of the camera. The frame is passed to cloud vision image labeling API, which uses neural network to recognize object in the scene and returns a list of entities such as table, chair, people, etc. present in the frame.

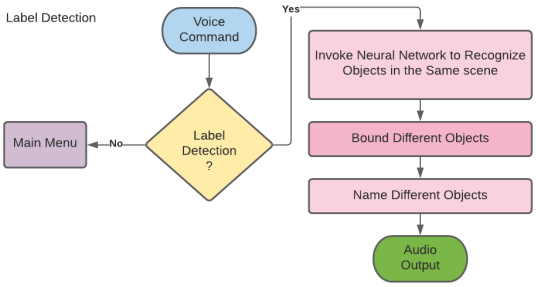

Figure 2. Label Detection Flowchart

Fig. 3 shows the flowchart for face detection. It allows user to know if there's a person present in front of them. It performs face detection in real time and detects faces in image, key facial features and identifies the contours of the detected faces.

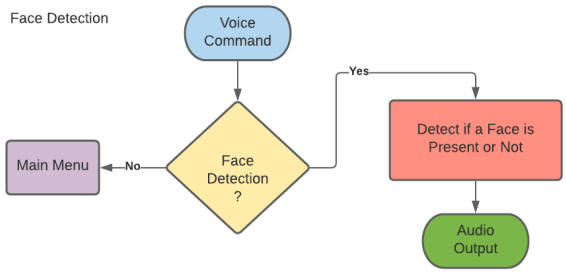

Figure 3. Face Detection Flowchart

Fig. 4 shows the flowchart for currency detection. This will allow user to detect currency

which will help them from any kind of frauds they may face during currency exchange.

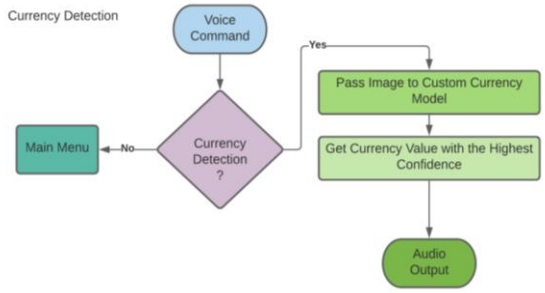

Figure 4. Currency Detection Flowchart

Fig. 5.1 represents flowchart for call feature and Fig. 5.2 represents flowchart for message feature. This will allow user to be in contact with their loved ones even when they are not present around them. The application takes voice command for either of the feature and proceeds towards taking appropriate action for assisting the user in making a call or sending a text message.

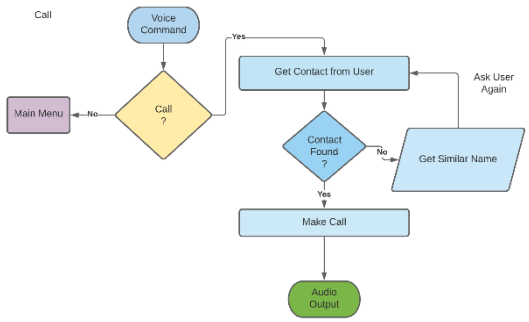

Figure 5.1. Call Feature Flowchart

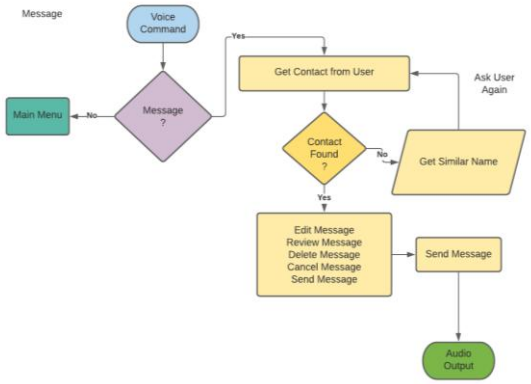

Figure 5.2. Message Feature Flowchart

C. Details of tools and APIs used

The following tools and APIs were used for successful implementation of the smart eye glasses mobile application.

- Android Studio IDE: To write application code.
- Firebase Ml-Kit: The base of the mobile application is made using firebase ml-kit.
- APIs: Text, Face, Label detection ml-kit api is used for text, face and label detection respectively, which is used to process the frame in-order to produce the output. Further, openweather api is used to gather weather information at the location of the user. The user needs to first allow the application to gather the current location of the user in order to provide accurate results.
- Postman: Postman is a collaborative platform for API development, testing. It was used to test openweather api before adding it into the mobile application.

III. RESULTS AND DISCUSSION

This section shows results of different features of the mobile application discussed in section II. Fig. 6.1, Fig. 6.2, and Fig. 6.3 belongs to One time registration, emergency details form, and home screen respectively of the mobile application. During the first launch of the application, the user or the guardian of the user has to register once using the mobile number. The verification takes place using an OTP. The registered number receives an OTP which the application reads automatically and validates the user. The verification is handled using the firebase authentication. After successful verification, user needs to add personal details along with two emergency contact details. The emergency contact details are stored in the firebase real time database, which can be used in case of any emergency. The features present in the mobile application can be accessed by taping on mic icon present on the home screen followed by any required voice command.

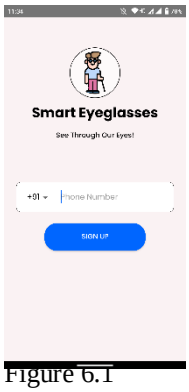

Figure 6.1

Figure 6.2

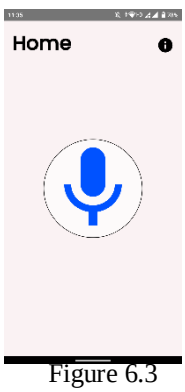

Figure 6.3

Fig. 7 displays text detection in action. The command for using text detection feature is "*text detect*". The application then detects text

present in the frame in real time with the help of firebase ml-kit and return result to the user in the form of audio.

Figure 7. Text Detection

Fig. 8 displays label detection. After using the command "*label detect*", the camera captures frame, and the frame is analyzed using firebase ml-kit in real time to provide entities present in the frame. The entity list is then passed to text-to-speech to convert the text output into audio output.

Figure 8. Label Detection

Fig. 9 shows currency detection in action. The command for using this feature is "*currency detect*". It displays numerical text over the detected Indian Currency along with the confidence level (0-lowest, 1- highest) of detection. The numerical value is then converted to audio form using text-to-speech model.

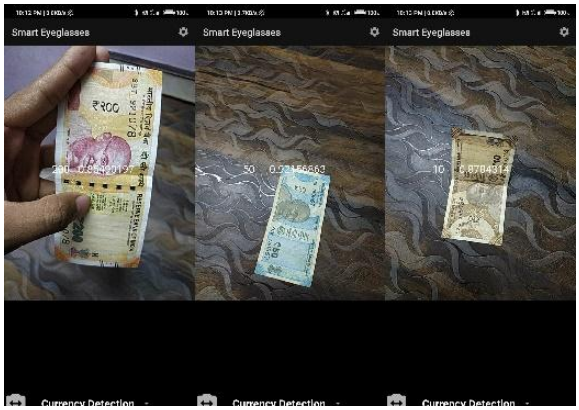

Figure 9. Currency Detection

Fig. 10. below shows face detection feature in action. The command for this feature is *"face detect"*. The mobile application is able to detect the face present in the frame in real time using firebase ml-kit.

Figure 10. Face Detection

Fig. 11.1 shows call feature in action and Fig. 11.2 shows message feature in action. The commands for both these features are generated dynamically. For instance, if the user wants to call a person named "Alex" from their contact list, the command will be "*call"* followed by the name *"alex*". Similarly, in case of sending a text message the command will be "*message"* followed by the name *"alex*". In case, when more than one person has same name, the application reads out name of the contact with similar names, and then the user needs to say the name for whom the call should be made. Fig. 5.1 and Fig. 5.2 describes how this problem is tackled swift fully. Message feature has additional commands such as "*edit message*" which can be used for editing a ready message, "*review message*" can be used to read out the message, "*send message*" is used to send the final message. "*cancel message*" can be used to cancel the message, and return back to the home screen.

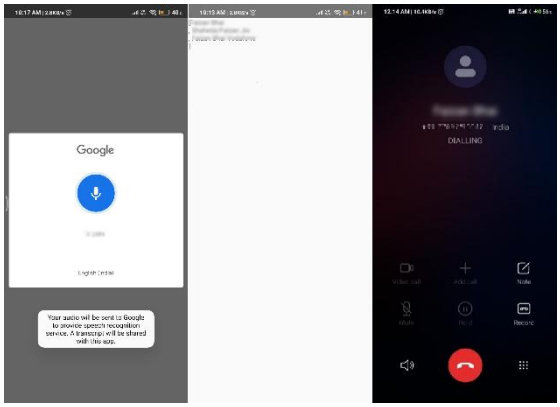

Figure 11.1 Call Feature

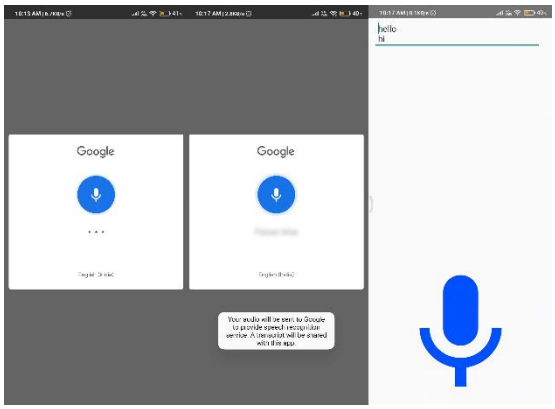

Figure 11.2 Message Feature

The command for using features such as date, time, temperature, and weather is "*date*", "*time*", "*temperature*", and "*weather*" respectively. The commands are designed while keeping in mind about the user in-order for user to get familiar with the commands quickly.

All the features displayed on the home screen (Fig. 6.3) can be accessed using appropriate voice command as shown in the form of text on home screen. Once a visually impaired person becomes friendly with these commands, they can take full advantage of the smart eye glasses mobile application.

IV. CONCLUSION

In this paper we discussed about smart eye glasses mobile application. This application assists visually impaired persons to overcome daily task with minimal efforts by providing them with features such as label detection, face detection, currency detection, weather, date, time, call, message. The interface is designed by keeping in mind about visually impaired people and hence the application can be used fully using voice commands, including output is produced in the form of audio.

V. FUTURE WORK

The application can be further used by mounting a Wi-Fi camera on sunglasses and passing the live camera feed to the application. Certain features such as cab booking using voice command, navigation using voice command can be added to enhance the application.

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