

GuideCall: Affordable and Trustworthy Video Call-Based Remote Assistance for People with Visual Impairments

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ABSTRACT

Blind or Visually Impaired (BVI) individuals often face many challenges while performing daily tasks or exploring new places. Assistive technologies can help independently address some of these challenges, but there remain many tasks that still require some sort of human assistance. Some current approaches to provide remote assistance through video calls are either too expensive or do not use helpers whom a BVI individual can fully trust. This work develops an Android application called GuideCall that enables BVI individuals to draw assistance through a video call with a single volunteer helper selected from one of many pre-constructed situation-appropriate groups of trusted individuals. GuideCall provides is specifically built to meet the needs of BVI individuals and has some features not present in commodity video-calling applications.

Keywords

Accessibility; visual impairments; alternative input.

1. INTRODUCTION

Visual perception plays a central role in completing many tasks of our daily routine, such as indoor and outdoor wayfinding, locating items of interest at a store or office, comprehending visual signs and printed text, and getting a general sense of the current state of the surroundings. These tasks can pose great challenges for blind or visually impaired (BVI) individuals leading to the need to spend significant amount of additional time and effort (compared to sighted users) to complete these tasks (if they can be completed at all), potentially taking on undue physical risks in some cases.

There has, thus, been a lot of research to overcome these challenges. For example, there has been a lot of work in

the area of indoor and outdoor wayfinding through the use of global-positioning systems (GPS), computer vision and artificial intelligence (AI), and wireless technologies to provide location and associated contextual information for BVI users (for example, [3, 5, 6]). Even with these emerging advancements, there will continue to be many instances when the limitations of these solutions (such as lack of infrastructure or conditions unsuitable for the technology to work) will result in a BVI user not fully being confident in relying on them. In such cases, it always helps to be able to rely on another human's assistance to bridge the gap and provide the necessary assistance. Unfortunately, increasing automation has led to a decrease in the number of human personnel used in various occupations; such personnel in the past may have been able to anticipate the special needs of BVI persons and provide assistance upon request.

Thus, there has been a growing trend of BVI individuals resorting to remote assistance from others by transmitting real-time images or videos [1, 2]. The remote sighted assistant or "helper" comprehends the received images visually and passes along any information gleaned to the BVI user thereby "filling in" any of the latter's information gaps towards completion of the task. These systems, unfortunately, are either expensive to use due to high labor costs of the helpers (in the case of Aira [1]), or untrustworthy due to the use of unknown and typically untrained volunteers (in the case of BeMyEyes [4]). Additionally, contacting outside help may be restricted in situations that involve the workplace. Personal video calls through applications like FaceTime are common, serving as an inexpensive, trustworthy option utilizing known helpers. Finding someone to help in a hurry may not be easy with such commodity applications, and they were never designed to serve BVI user needs.

This paper presents the GuideCall remote video-based assistance system that allows a BVI user to seek and get assistance from a trusted set of known individuals through a free smartphone-based application. GuideCall allows the user to populate and create trusted groups for specific life scenarios (such as work, personal) and reach out simultaneously to all members of a group when assistance is needed. The first person to accept the call takes on the assistant's role with all others notified that assistance is no longer needed. Beyond a simple video call interface that is designed to be BVI-friendly, GuideCall provides tools for a remote assis-

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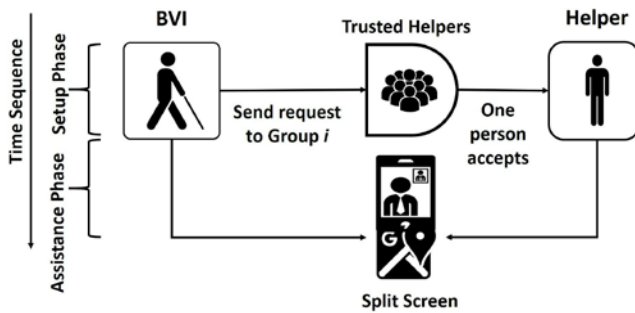


Figure 1: GuideCall System Concept

tant to (i) control the BVI user’s smartphone to better assist them, and (ii) see real-time location information in embedded maps as a user moves around utilizing GPS or other indoor positioning information available. Such unique features are designed to make GuideCall to be more effective in completing the daily tasks where they need assistance.

2. GUIDECALL SYSTEM

This section provides details about the system architecture of the GuideCall application and its various components. Designed as a single smartphone application, it operates in two modes: BVI user and Helper. The overview of system architecture is shown in Fig 1.

2.1 System Workflow

Whenever the BVI user needs assistance, the following steps will be followed through the application:

Step 1: The BVI user opens GuideCall app; if already signed in, the BVI mode screen activity will be displayed.

Step 2: Utilizing native accessibility features on the smartphone OS, (Google Talkback) the buttons and images inside the activity will be read to the user.

Step 3: To receive assistance, the BVI user selects a Help button. This triggers a message “Help Required” to be sent to a group chat application that contains all group users from the selected group i ($i = 1 \dots n$) who are potential helpers as notification to their smartphone.

Step 4: One of the trusted helpers (who elects to provide assistance) will select the received message and click a Call option that becomes available. This will result in video call to be connected between this user and the BVI user and a notification to be sent to all other users in the chat that a helper is connected successfully with the BVI user. This will assure other potential helpers that someone has accepted to be a helper for providing assistance.

Step 5: When the call is connected, a video stream of the BVI user will be shared with the helper so that they can be the “eyes” of the BVI user in assisting with visual perception. To assist effectively, a helper user can access features of the BVI user’s phone such as cameras (front and back), flash light, and microphone (to switch the speaker on if necessary). The video call can be viewed in full screen by double tapping on the frame and allows pinching by the helper to zoom in and out. Along with the video call, Google Maps is integrated into the application to assist BVI users in outdoor environments. This allows the helper to study both the default view and the satellite view and understand the

BVI user’s location and orientation and guide them towards the destination. Incorporation of indoor maps is a unique feature for GuideCall. In locations provisioned with an accessible indoor wayfinding system such as GuideBeacon [5], real-time location updates of the user walking can be shown on an image of the floorplan. This feature allows a helper to continuously learn about the context surrounding the BVI user.

Step 6: Once a BVI user has got the assistance they need from a helper, they can end the call by clicking a Done button. This button will send a message of “Thanks for helping me” to the group chat and enables others to understand that the BVI user was successfully assisted.

2.2 Implementation

The cloud communication service Quickblox that supports video calling, instant messaging, and push notifications was used to provide back-end support to GuideCall implemented as an Android app. While Quickblox was used to store user account information and group chats, Apache Maven, an automation tool that is used to build Java applications was used to create repositories. Vidyo, a software-based visual collaboration technology provider, was used to integrate video calling features in GuideCall. As the video call requires scarce mobile CPU, data, and memory, codecs designed deliberately for smart phone devices were used. Google Firebase was used to provide store all information about a BVI user’s location updates. Helpers can use this information to track the BVI user’s location on Google Maps, even if they are not actively assisting through a video call. This may provide an additional layer of safety on the background for a BVI user. Indoor maps and BLE beacon-based localization was used to track user locations indoors as they moved.

3. ACKNOWLEDGMENTS

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4. REFERENCES

- [1] Aira. <https://aira.io/>.
- [2] Be My Eyes. <http://bemyeyes.com/>.
- [3] D. Ahmetovic, C. Gleason, C. Ruan, K. Kitani, H. Takagi, and C. Asakawa. Navcog: A navigational cognitive assistant for the blind. In *International Conference on Human Computer Interaction with Mobile Devices and Services*. ACM, 2016.
- [4] S. M. Branham, A. Abdolrahmani, W. Easley, M. Scheuerman, E. Ronquillo, and A. Hurst. “is someone there? do they have a gun”: How visual information about others can improve personal safety management for blind individuals. In *Proceedings of the 19th International ACM SIGACCESS Conference on Computers and Accessibility*, ASSETS ’17, pages 260–269, 2017.
- [5] S. A. Cheraghi, V. Namboodiri, and L. Walker. GuideBeacon: beacon-based indoor wayfinding for the blind, visually impaired, and disoriented. In *IEEE International Conference on Pervasive Computing and Communications*, March 2017.
- [6] R. Manduchi and J. Coughlan. (Computer) vision without sight. *Communications of the ACM*, 55, 2012.