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GuideCall: Affordable and Trustworthy Video Call-Based Remote Assistance

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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 a BVI individual to be independent by addressing some of these challenges, but there re-main many tasks that still require some sort of human assistance. Given that human assistance from someone nearby is not always possible or preferable, there is an increasing trend of using video-calls to receive assistance from a human remotely. To better understand how well current remote video-calling applications serve the needs of BVI individuals, this work conducts an online user study with 55 participants. The responses received suggest that the current approaches to receive remote assistance through video calls are either too expensive of do not use helpers whom BVI individuals fully trust. This work presents a smartphone 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 a unique combination of features not present in commodity video-calling applications and is specifically built to meet the needs of BVI individuals. Preliminary evaluations show GuideCall to be fairly effective in many daily tasks BVI individuals encounter, potentially proving to be an inexpensive option for receiving assistance while being more confident about the quality of assistance, privacy, and safety.

Keywords

Assistive technologies; video call-based assistance; mobile technologies; wayfinding

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 resulting in a 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 prior 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, (Ahmetovic et al.; Cheraghi et al.; Manduchi and Coughlan; “CamFind”; “TapTapSee”; “KNFB Reader”; “BeSpecular”; “SeeingAI”)). 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, there are many situations where a BVI person may be alone with no one present in spatial proximity to provide assistance upon request.

There has thus been a growing trend of BVI individuals resorting to remote assistance from others by transmitting real-time images or videos (Bigham et al.; “Aira”; “Be My Eyes”). 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 ("Aira")), or untrustworthy due to the use of unknown and typically untrained volunteers (Branham et al.) (in the case of BeMyEyes and VizWiz). 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 intended primarily to connect with a single person at a time, 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 assistant 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 a unique combination of features are designed to make GuideCall more effective in helping complete daily tasks when assistance is needed.

The major contributions of this paper can be enumerated as the following:

1. A user study of 55 BVI individuals posing questions about habits and preferences of using remote video-based assistance and ascertaining who they trust in various life

and work situations, helping establish appropriate motivations towards designing GuideCall.

2. A detailed description of the design and implementation of the proposed GuideCall app and its unique features such as customized group-calling, indoor wayfinding capabilities, and tools for helpers.

Discussion

Although FaceTime, Skype, Aira, BeMyEyes and other similar video-calling applications have been around for a while and known to be used by BVI individuals, little is known about how often such applications are used and in what situations they are used. In order to better understand the role these apps play, their benefits, and their limitations, an online survey was created to gather responses from BVI individuals.

Method

An online survey was created using Google Forms and distributed via email after gathering appropriate IRB approvals. Emails were sent to all known prior participants (about 25) we had engaged with over the past 2-3 years for other studies. In addition, the survey was distributed to a mailing list associated with the American Council of the Blind (ACB). No compensation was offered for participating in the study, and the survey took between 10-15 minutes to complete. Participants were required to be blind or low vision to be eligible and at least 18 years of age. All responses were collected anonymously without any identifying information.

The survey had two main parts. The first one was mainly collecting demographic information such as age, gender, vision category (blind, low vision, neither), and comfort with using smartphone apps. The second part asked questions about the situations in remote video-

based assistance was typically sought, how often, and who was considered the most trusted to offer such assistance in each situation. Participants were also asked what apps they commonly use for remote video-based assistance.

Results

A total of 55 responses were received. Participant age fell mainly (and almost evenly spread) in the 29-69 age group, with only 15% total for the ranges 18-29 and beyond 70. Almost all participants identified as being regular users of smartphones and various apps. Participant responses to the specific questions about using remote video-based calling are summarized in Figure 1-5. Figure 1 shows that remote video-based calling is used very frequently, with 60% using it at least once a week, supports the premise of the paper that this is an important area to add new options for users to consider, including low-cost ones.

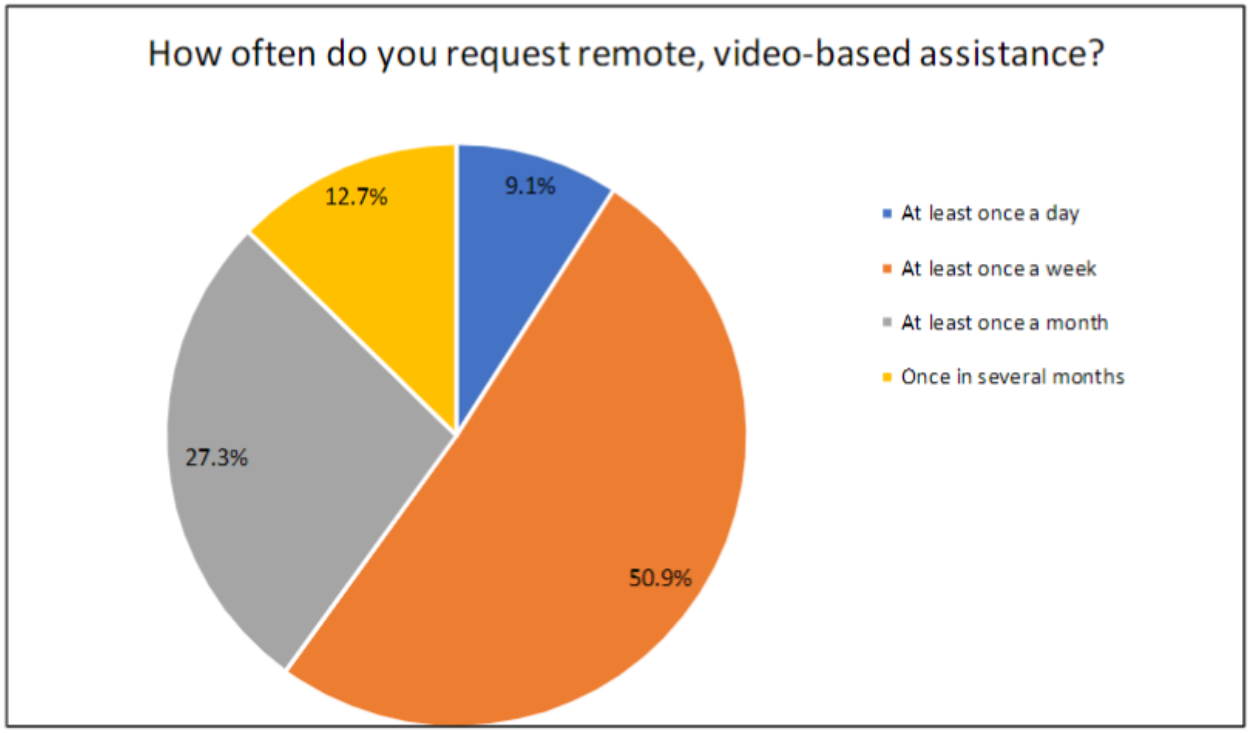

Fig. 1. How often do you request remote, video-based assistance?

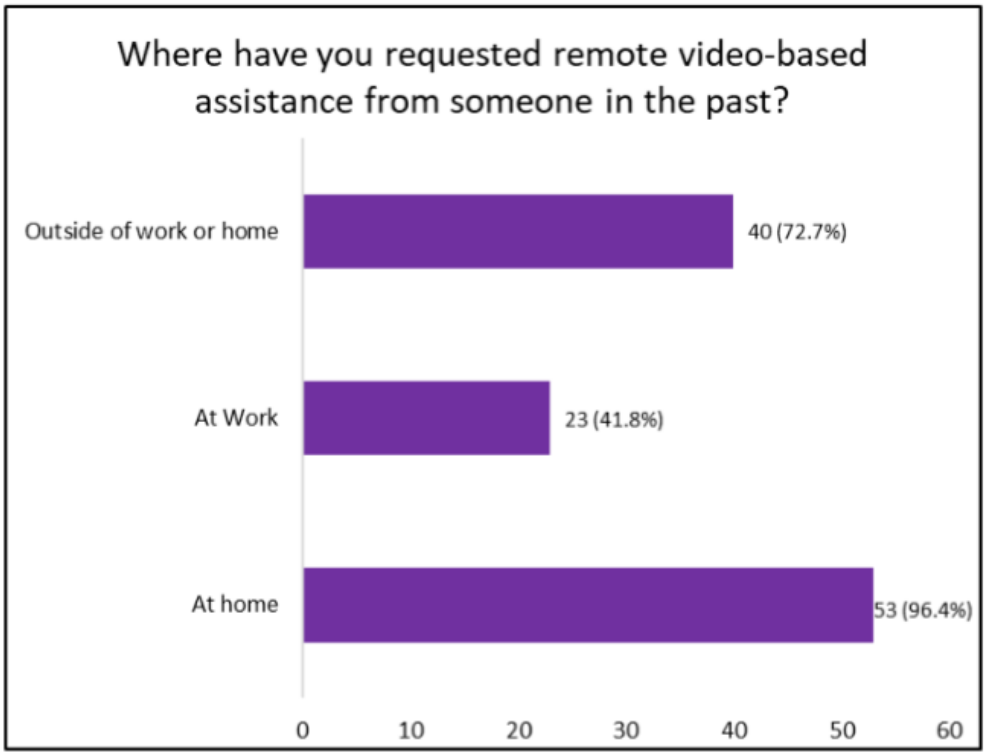

Fig. 2. Where have you requested remote video-based assistance from someone in the past?

For the question of what situations remote video-based assistance has been sought in the past, respondents identified (Figure 2) home as the scenario where they have used help the most (96%), followed by outside work or home (72%), with work being the situation where they sought least help (41%). Part of this result is explained by the fact that some of the respondents indicated through comments that they are retired or not employed at the moment.

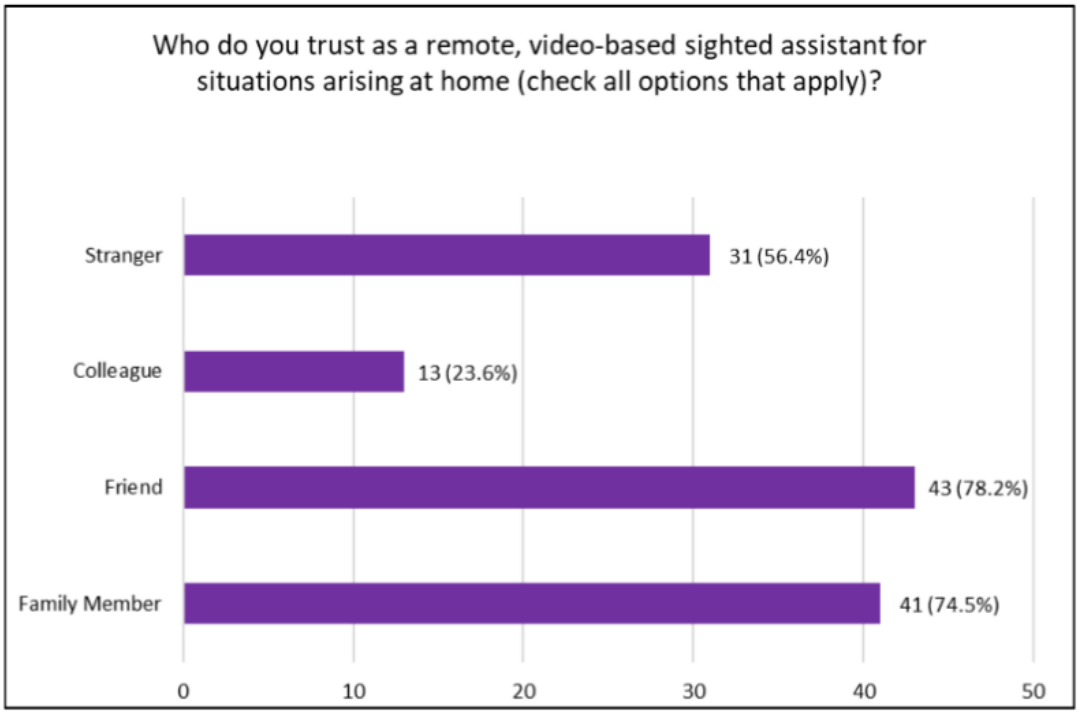

Fig. 3. Who do you trust as a remote, video-based sighted assistant for situations arising at home?

For the question of who BVI users trusted to provide remote video-based assistance at home, respondents identified (Figure 3) friends (78%) and then family members (74%) as the most trusted with strangers (56%) to a lesser extent followed by colleagues (24%) as the least trusted. User comments indicated that when sensitive information, documents, selection of something for the home, etc. are involved, they trusted a stranger less. On the other hand strangers were preferred when it was perceived that a friend or family member is not needed, putting less burden on the latter set. Colleagues naturally are not thought of for help at home, unless a close friendship exists with someone.

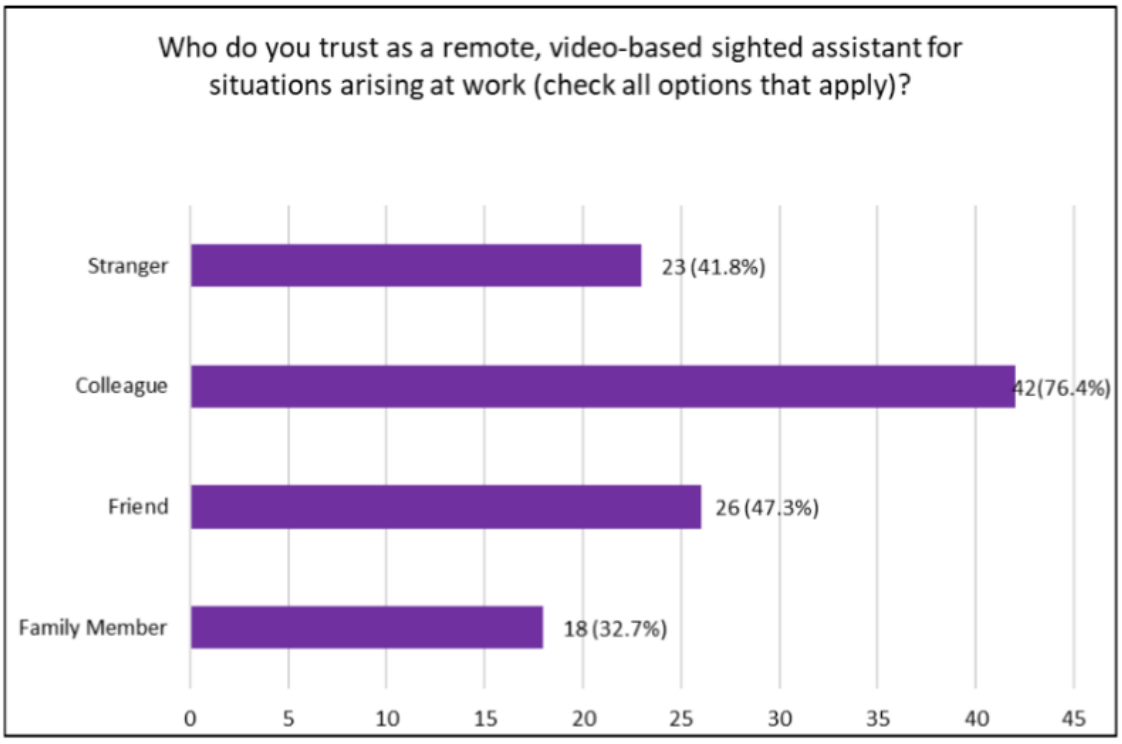

Fig. 4. Who do you trust as a remote, video-based sighted assistant for situations arising at work?

For the question of who BVI users trusted to provide remote video-based assistance at work, respondents identified (Figure 4) colleagues as the most trusted (76%) followed by friends (47%), with strangers (41%) and family members (32%) to a lesser extent. User comments indicated that wariness of revealing sensitive information to people outside made colleagues the most trusted choice. Friends were thought of as an in-between trusted partner if colleagues were not available. Complete strangers and family members were not thought of as good choices in work situations with documents or computer tasks.

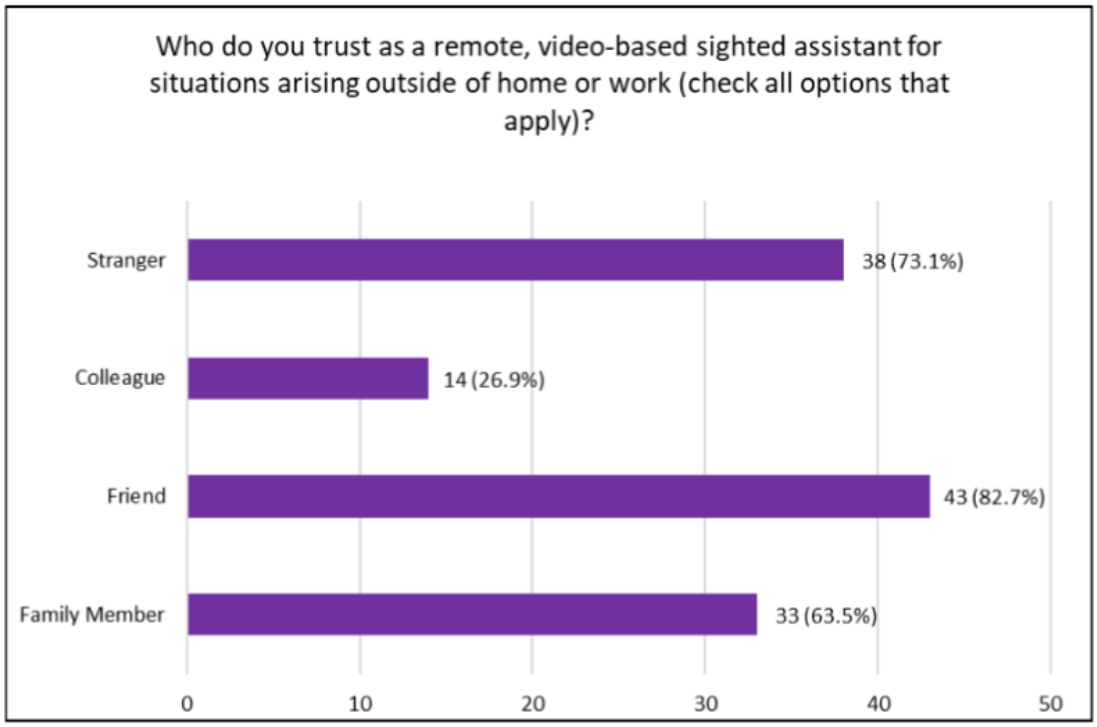

Fig. 5. Who do you trust as a remote, video-based sighted assistant for situations arising outside of home or work?

For the question of who BVI users trusted to provide remote video-based assistance outside of work and home, respondents identified (Figure 5) friends (82%) closely followed by strangers (73%) and then family members (63%) followed by colleagues (26%) as the least trusted. User comments indicated that when sensitive information is not involved, friends were most trusted, and usage of strangers were fine too if safety and/or privacy was not important. Colleagues were again not thought of as ideal helpers for this situation.

Analysis of the survey data collected from BVI respondents revealed some useful insights regarding their preferences for remote, video-based sighted assistance. Firstly, it is true that strangers can prove to be ideal helpers in some situations, and can even be more preferable in reducing burden on friends and family. However, this was not a very strong or overwhelming feeling within the community and when costs (for example that of Aira) are factored in, friends

and family can be equally if not more appealing as helpers. When asked what apps they mostly use, they mentioned Aira and BeMyEyes, with FaceTime, SeeingAI, BeSpecular, and Skype to a much lesser extent. The descriptive responses suggested that BeMyEyes has issues of trust, while Aira is more trustworthy, but not in all settings. Aira's costs were considered very high making users want an in-between option. In summary, the study identifies a need for an affordable and trustworthy remote video-calling application with features that are comparable or exceed that of existing options.

Table 1: GuideCall comparison with other existing options

Options	**Video Calling (e.g. FaceTime)**	**BeMyEyes**	**Aira**	**GuideCall**
Direct Calls	X	X	X	X
Group Calls	X	X	X	X
Outdoor location tracking		X	X	X
Indoor location tracking			X	X
Remote control of user smartphone		X	X	X
Fast assistance response		X	X	X
Trusted helpers	X		X	X
O & M trained helpers			X	
Inexpensive	X	X		X
Sensitive information preservation				X

Table 1 provides a comparison of the features of the current remote smartphone video-calling applications available to BVI individuals and how the proposed GuideCall system fits in. It can be seen that GuideCall provides all the features that Aira provides except that of assistance from orientation and mobility (O & M) trained professionals. Instead, it relies on groups

consisting of trusted friends, family, or colleagues only. This, however, allows GuideCall to be affordable and also meet corporate guidelines by utilizing colleague work groups in work situations. GuideCall stands out from other free applications such as BeMyEyes by having the capability to integrate real-time indoor positioning technologies in addition to getting assistance from trusted individuals.

GuideCall System

As seen in Table 1, the GuideCall system is designed to balance safety, privacy, convenience, functionality, and cost. Designed as a single smartphone application, GuideCall operates in two modes: BVI User and Helper. The overview of the system architecture is shown in Fig 6. The current prototype's application interface is shown in Fig. 7.

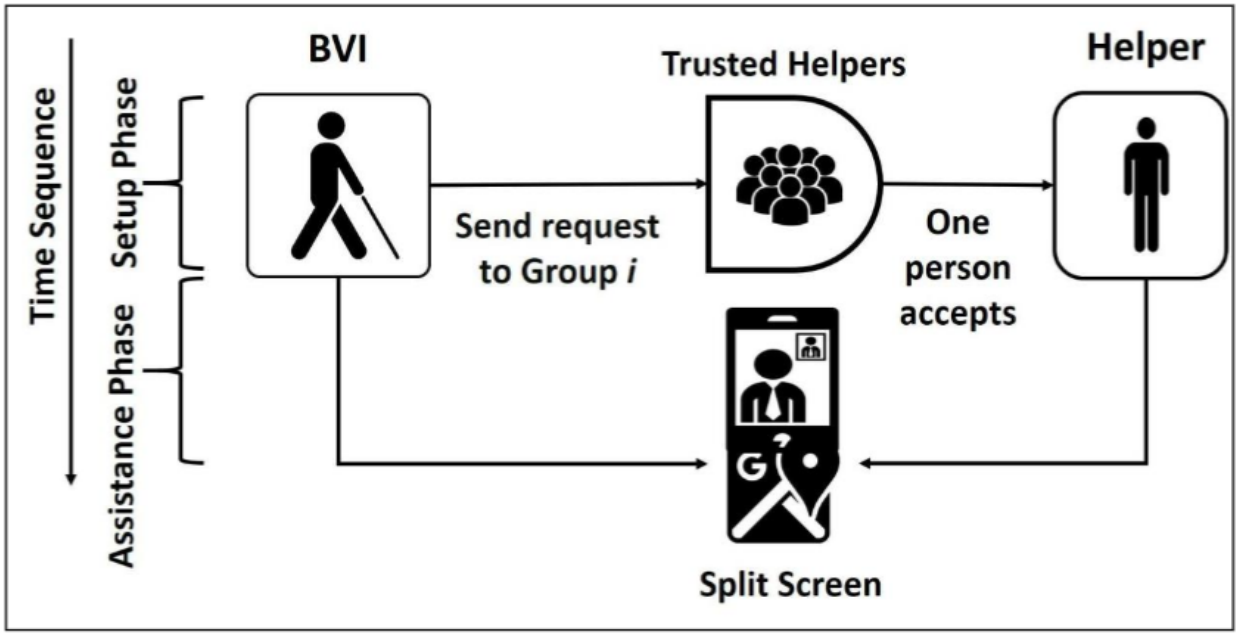

Fig. 6. GuideCall System Concept.

Fig. 7. GuideCall App Interface – Helper Side.

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 ($i = 1 \cdot \cdot \cdot n$) who are potential helpers as notifications 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), flashlight, 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 (Cheraghi et al.), 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 and incorporate that in their instructions.

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.

GuideCall Implementation Details

Different services were used to implement the application and provide back-end support. 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 (with adequate permissions set), 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, with the potential to add other indoor mapping and tracking applications as they become available.

Conclusions

This paper presented 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. Motivations for GuideCall were derived from a user study of BVI individuals posing questions about habits and preferences of using remote video-based assistance and ascertaining who they trust in various life and work situations. This paper provided details about the design and implementation of the proposed GuideCall app and its unique features such as customized group-calling, indoor wayfinding capabilities, and tools for helpers.

GuideCall is still very much a preliminary prototype. Future work with GuideCall will include extensive evaluations of GuideCall under various test scenarios, developing an iOS version and integrating additional indoor wayfinding mechanisms as they become available. Releasing the app to be used more widely by the BVI population will allow gathering longitudinal data over many months of use with various helpers for different tasks, some beyond what this paper tested for. It is expected that as helpers get used to providing assistance (many of whom already do with FaceTime, Skype etc. in one-on-one sessions), they will better understand how they can better assist with the needs of BVI individuals remotely.

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