

The current advances in human-smartphone user interface design: An opportunity for people with vision loss

Dear Editor,

In today's modern society, smartphones play an important role and are becoming an integral part of our lives. There has been substantial growth in mobile technology in recent times from a simple basic phone to one with smart touchscreen technology along with various applications and features. With the advancement in research on "human-computer interaction," smartphones are incorporated with a new innovative user interface design, making it possible for a truly eyes-free interaction.^[1] Various innovations in the use of alternative body senses, such as gestures, haptic, and audio substitute the need for a good vision function to interact with mobile devices.^[2] Such a new interface design significantly improves the accessibility of the smartphones for individuals living with visual impairment. Such advances in mobile technology provide digital inclusion for people with visual impairment and can play an important role in changing their lives.^[3] Martiniello *et al.*'s^[4] study has shown that smartphones with their accessible user interface design have replaced many traditional assistive device solutions to a great extent in doing routine activities in persons with visual impairment.

Over the past few years, computer engineers and information technology professionals have developed many accessible built-in features for people with visual impairment. The most widely used built-in accessible features are "TalkBack" for the Android platform and "VoiceOver" for the Apple iOS.^[5] These accessible screen readers help the user identify the content on the smartphone screen with a verbal feedback voice on touching.^[6] By simply placing a finger on the icon, the smartphone will read out aloud what icon is underneath the finger. Other accessible built-in features are screen magnifiers, zoom magnifiers, voice assistant, Siri, so on.

Besides this, a large number of third-party accessible mobile applications (apps) are being developed that provide an eyes-free user interface. These accessible apps have been shown to be of great value and support in performing a wide range of activities of daily living for people with visual impairment. The operating system can download these accessible apps, and the users can install it for a specific purpose. These accessible apps are based on audio-, tactile-, or haptic-based interactions that enable smartphones to serve as an assistive technology for people with visual impairment. Therefore, such apps not only help in maintaining independence at home and in the workplace but also in accessing information like their sighted peers. Few examples are the "Kibo" app to read all types of electronic text; "Be My Eyes" for sighted help – an app that invites a sighted person through a live virtual video call; "Seeing AI" to read any printed document by placing the phone camera over the document; and so on. Such innovative, accessible, user-centered, and friendly smartphones have provided a new platform and opportunities for people living with visual impairment to overcome their daily challenges.

There are limited studies available in the low- and middle-income countries on the awareness and usage of smartphones and the accessible apps for people with visual impairment. In a study conducted in Ghana, the majority of people with visual impairment use a simple basic phone or do not have a phone. The study showed that 90% of participants who owned a smartphone did not know the accessible features.^[7] On the other hand, studies conducted in high-income countries reported good awareness and use of smartphones among people with visual impairment. An online survey among 132 people with visual impairment in the United Kingdom reported that more than 80% of respondents used a smartphone. The most frequently used features were Text to Speech, camera, and screen magnifiers.^[8] A similar exploratory study in high-resource countries highlighted that around 90% of respondents with visual impairment used their smartphones for a variety of daily routine activities, including for social inclusion and outdoor navigation.^[4] Furthermore, 95% of visually disabled people reported that these apps were useful for performing their daily activities as shown in a global survey.^[9] A telerehabilitation study in students with visual impairment showed the effective use of smartphones during the coronavirus disease 2019 (COVID-19) pandemic.^[10]

The study published by Christy and Pillai^[11] in the *Indian Journal Ophthalmology* in 2021 provides a wide collection of accessible apps for people with visual impairment. Such a study may help not only caregivers, family members, and special educators but also general or eye care practitioners to get information on 57 different apps. Of these, 12 were exclusively designed for people with visual impairment and low vision.

This study also shares the empirical feedback from the users about satisfaction on the apps being used. Such feedback from the users will enable the developers to design user-centered and user-friendly accessible apps. There might be a potential problem faced by the users that cannot be identified by the developers. Hence, the usability testing in people with visual impairment for a developed app is of paramount importance. Many usability problems could be due to inappropriate user interface design for the mobile. Therefore, the involvement of people with visual impairment while developing accessible apps is crucial to acquire high acceptability and adaptation for the apps.

Furthermore, such mainstream assistive technologies are less likely to have a stigma on the users compared with traditional assistive devices, such as magnifiers, Braille, and so on. Also, the use of smartphones has certain advantages, such as easy portability with a lanyard or holster, less discomfort on the users, and relatively low cost compared with some of the traditional devices. In addition, smartphones are universally designed and are becoming more user-friendly irrespective of the health conditions of the users.

Smartphone technology has revolutionized how people with vision loss can live and accomplish their tasks independently. Creating awareness and providing information on digital literacy about the various uses of accessible features and apps should be targeted to health practitioners, including eye care specialists, caregivers, and family members. At the same time, the accessible smartphone technology is continuously growing at an unprecedented rate. Mastering the use of a smartphone by a person with visual impairment is not an easy task. Therefore,

there is a potential need for the development of a user-friendly guideline on the use of accessible features and apps, especially for people with visual impairment.

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