ABSTRACT
This paper deals with design and implementation of user interface which makes accessible environment of the mobile operation system Android 4.0 and above for visually impaired users (especially for blind). Interface enables to perform basic operations with the system and common used touch gestures. Voice synthesizer, vibration and sound are implemented as a feedback. Interface was tested with 12 target users following man-machine design process including interviews with focus group and tests in a usability laboratory.

KEYWORDS
user interface, user centered design, Android, visually impaired user, user study, user testing

1. GOALS
Nowadays, majority of visually impaired users (especially blind) still use traditional mobiles with HW keyboard accompanied with special screen reader software (e.g. MobileSpeak). Despite of fast penetration of smart phones with touch screen there are only few apps targeted on visually impaired users, i.e. Talkback and none of them use exclusively multi-gesture control.

Our primary goal was to design an Android launcher app for addressing basic functions (calls, SMS, contacts, calendar, alarm, reminders etc.) solely via use of simple multi-gestures approach.

2. USER STUDY
User centered design was applied. First, semi-structure interviews were carried out with 4 blind users at their homes (qualitative phase) [1,2].

Each interview took 60-90 minutes. The questions used in the interviews were designed to identify how the participants used and experienced the BlindShell application in relation to mastering basic functionalities like making call, writing SMS or searching in contact list. Users were divided into 3 groups according their answers:
• Less experienced user – currently uses Nokia mobile phone and basic functions (calls, SMS, book reader, music player). Does not have experience with touch phones.
• Less experienced user with touch phone experience - currently uses Nokia mobile phone and basic functions (calling, SMS, book reader, music player). Has experience with touch phones.
Experienced user with touch phone experience – currently uses Nokia mobile phone or touch phone with Android or iPhone. Uses advanced functions like web browsing or emails.

Second, quantitative phase followed based on results of qualitative study. This part was accomplished by 30 partially blind and blind users via electronics form in email conferences and personally at rehabilitation centre for blind users [1,2].

*Figure 1* shows how are mobile phones distributed within visually impaired user group.

![Penetration of mobile phones.](image)

Based on the results of semi-structured interviews, the following design principles were postulated [3]:

- Alphanumeric keyboard for text input;
- Personalize and settings environment;
- Control using simple touch gestures;
- Notifications on missed events;
- Assurance of technical support.

3. APPLICATION

BlindShell is implemented as a launcher for Android 4.x devices. Launcher replaces default application for system control. Included applications allow visually impaired users perform basic operations with touch mobile phone as calls, SMS, contacts, alarm, book reader, notes, information about state and settings.

*Figure* demonstrates application simple design.

![Application screens.](image)
4. USABILITY TESTING

BlindShell was tested in Usability Lab with 12 participants on low cost device Huawei G300. Basic scenarios were defined by task covering operations like make call, write SMS, create new contact etc. Each test took 30-65 minutes [3,4].

Most of users where able to control application in few minutes. 7 of 12 users even didn’t have experience with touch devices. Users we asked to use embedded help in case of some problems.

Figure shows total time for accomplishing selected tasks.

![Figure 3: Usability testing - result of the SMS task writing.](image)

Despite of time limit of 30 minutes per task, 6 participants were able to accomplish the whole test. One of the most difficult task text input was accomplished by 10 of 12 users. Participants were enthusiastic by simplicity of touch gestures and keyboard control.

5. CONCLUSION

Development of the application evolved through several stages. First, User study was applied to comprehend needs of visually impaired users (especially blind). Study was followed by Usability testing, where several prototypes were tested with real users. From best prototypes were selected best concepts and implemented basic core that was enhanced with new features and applications. Finally pilot study consisting of 10 users will be launched in near future.

Regarding the next development we are going to implement new applications such as calendar, music player etc. Great opportunity for extension of BlindShell functionality is ambient intelligence such as barcode recognition for the shopping activities, colour and money recognition.

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REFERENCES


