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INSIGHT: PERSONAL ASSISTANT MOBILE APPLICATION FOR THE VISUALLY IMPAIRED IN SRI LANKA

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Abstract

Smart phones play a major role in people's life nowadays. However, it has become a challenging task for visually impaired people to get involved with smart phones in their day to day activities because of the limited accessibility to the input mechanism. “Insight” is a personal assistant mobile application mainly focusing on visually impaired, which will give them a hand in their routine tasks. This application provides a tangible input mechanism based on braille which will simplify the task of using mobile phones. Two types of keypads are used in the application according to the input needed to provide. There are several main components included in this application. Learning module, speed dialer, messaging, calculator, gaming module, scheduler, public transportation assistance and navigation instructions provider are those components. The main objective of this project is to provide equal opportunity for the visually challenged people to get the experience of a sighted person would get, using a mobile phone without any restraint due to their impairment.

Keywords: Visually Impaired, Smart Phones, Input Mechanism, Braille, Equal Opportunity

1.Introduction

According to the World Health Organization (WHO), it is assessed that 314 million people worldwide live with serious vision impairment, 37 million people are blind and 124 million people have low vision. 90% of the world of blind people live in low-income countries (http://www.vision2020.lk/blindness&vision.html).The usage of smart mobile phones has emerged drastically in the last few decades all over the world. Sophisticated technologies used in smartphones become more beneficial for sighted users and visually challenged people had to struggle with the smooth surface of the mobile device while interacting independently.

“Software systems that do not satisfy the users are often accorded to poor and incomplete design. The poor and incomplete design can be due to systems designers and developers failure to involve users in the development (Majid, 2010)”.

Since mobile technologies provide the convenience of aiding those people, nowadays most of the organizations have identified visually challenged customers and have developed some applications for them by using assistive technologies. But due to high cost, differences in user requirements, usability and accessibility most of the products are ignoring by the visually challenged community.

This research project looks at how Insight highlights the drawbacks of existing mobile applications and design the best solution to enhance the usability and user friendliness. It will be a personal assistant for visually disabled people which provides lots of facilities which will be helpful in their daily tasks and to spend their leisure time in an enjoyable manner. This research is minimizing the limitations of input and output accessibility problems and provides user-friendly navigation environment within the application by improving simplicity and reliability. Navigation instructions will be handled by inbuilt screen reader facility and gestures which come with android platform freely. Application input mechanism

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is based on Braille. Braille is an internationally recognized mechanism used by the visually impaired to read and write in which the characters are denoted by raised dots (http://www.afb.org/info/living-with-vision-loss/braille/what-is-braille/123). This is not a language, but rather a technique used to represent many languages all over the world. This tactile writing system was named after Louise Braille, a Frenchman who introduced and developed this system (https://en.wikipedia.org/wiki/Braille). In Braille technique, all the letters, characters, symbols, number, punctuation mark or word are represented with dots in six cells arranged in two parallel rows.

The special feature of our application is that it provides numerous features like a calculator, messenger, speed dialer, scheduler, learning module for Braille & navigation based service included in a single application which users can access in a matter of few clicks.

2.Methodology

The research team gathered the information regarding the existing applications for visually challenged people and about the difficulties they face when using smart mobile devices by giving them questionnaire. The team was able to get an idea about the basic requirements need to cover in our research project from their feedback. According to the comments and opinions obtained from analysis, the team could further clarify the problem which needed to be addressed.

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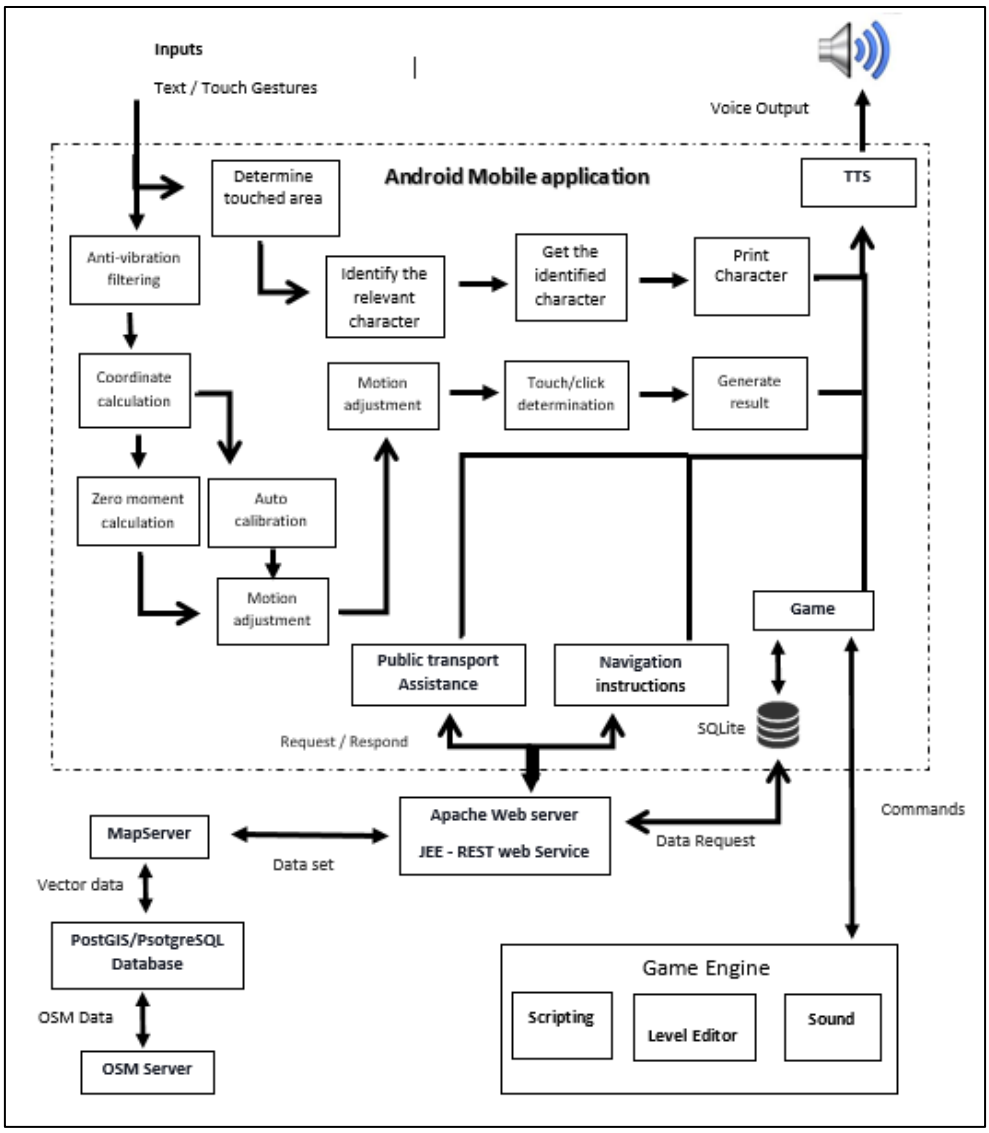

Figure 1: High level diagram

As the next stage of the development process development team analyzed the drawbacks of existing products and checked whether proposed application would be able to overcome those limitations with feasible and economical manner.

The proposed application consists of following components:

Virtual braille based keypad

Figure 2 virtual braille based keypad

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This component provides the facility to users to enter their inputs using a virtual braille based keypad. This keypad is designed similar to the existing QWERTY keypad for mobile phones. This special keypad is supported with a sticker which is to be placed on the screen of the mobile phone. The sticker has embossed braille characters representing each character in the virtual keypad. This helps the user to touch and identify the character they need to type. Users can take their finger along the sticker similarly, they read braille characters punched in papers to identify each character.

When the user touches the desired key, it will activate the key in the keypad underneath the sticker. After the selected character is typed in the textbox it will provide a sound, a vibration signal to notify the user that he has typed something. At the same time, it will speak out the character which the user has typed for verification

Basic keypad

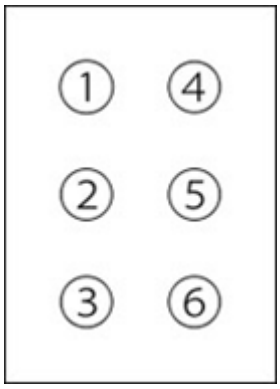

Figure 3: Braille cell

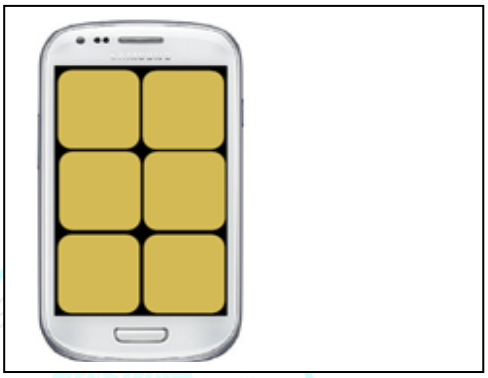

Figure 4: Braille keypad with six buttons

Braille characters are small rectangular blocks called *cells* that contain tiny tangible bumps called *raised dots* (Figure 1). A full Braille cell includes six raised dots arranged in two lateral rows each having three dots. The dot positions are identified by numbers from one through six. 64 solutions are possible from using one or more dots. A single cell can be used to represent an alphabet letter, number, punctuation mark, or even an entire word (http://www.afb.org/info/living-with-vision-loss/braille/what-is-braille/123).By considering the above braille cell concept, the basic keypad of six buttons was developed (Figure 2). Here, from this keypad, users were able to type any alphabet letter, number or punctuation mark.

3.Voice instructions and gestures

In the case of maintaining the output mechanism of the application, a voice is generated via Text To Speech API which is an inbuilt feature of android platform gestures API which it uses to navigate within the application with a user-friendly environment. Voice instructions will be given in each and every step while user interacting with the application.

4.Learning Module

Learning module is working as a self-learning module for visually challenged people who are not aware of braille technique or lack of knowledge of braille. Basic six divided keypad will be used as the main input mechanism for this component. It is providing the same experience on learning of braille in the usual manner by touching and giving input by clicking on the screen. This module consists with two main functionalities like helping module & tutor module. As the initial phase of this module, the user will be trained via helping module to identify the basic keypad (six divided) with step by step instructions. After successfully identifying the six areas of the keypad separately, users can continue with the tutor module.

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The tutor module consists with three main areas like English alphabet, numbers & punctuation marks.

5.Gaming Module

Gaming module is to apply previously learned knowledge of braille through learning module and can verify the faultless of the input by obtaining relevant feedback according to the user inputs for this module. The Gaming module consists of a number of mathematical equation based questions, as well as simple English learning questions. This is not just a game, but it facilitates of memorizing the braille technique and provides educational advantages as well.

6.Speed dialer

Both the speed dialer and calculator module use the basic keypad (keypad with six buttons) as the main input mechanism to generate results. When considering the speed dialer module, this functionality provides a unique way for blind users to get connected with their closely related people especially in a case of emergency. In this component, applications let users add, edit or delete specific numbers from the contact list and dial a specific number using the priority number instantly using touch gestures. Here, the inputs entered by the user, using basic keypad, are converted into braille signs. The contact details entered by the user are saved in shared preferences, its way of storing data in android applications which allows to save and retrieve data in form of key, value pair.

7.Calculator

When considering about the calculator, this option performs basic mathematical functions with the help of braille alphabet. Once the user enters an operator or operand using the basic keypad of six buttons application will give the meaning of that command by voice. Finally, the answer will be also given to the user by means of voice output.

8.Messenger

Users can compose, edit and send text messages to predefined contacts using this component. Meanwhile, they can view the received messages and delete them if they need.

9.Scheduler

This component provides users the ability to schedule their work for future. They are provided with the facility of adding, editing and deleting schedules.

10.Navigation Based Service Module

Finding current location and navigation is the most difficult activity for the visually impaired. Because a blind person cannot see where is he/she now? And how do I find a place? And which way do I need to take? In modern times, many types of research are introduced including different technologies like GPS, GSM, and Ultrasonic to navigate a blind person. All these applications have some limitations for the visually impaired.

Another concept of Insight mobile application is helping a visually impaired to outdoor navigation. During walking with the cane going from place to place, they sense and guess directions, locate places by hearing sounds surrounding, sniffing smells in the air, feeling touches on skin, counting footsteps they walk and memorizing events in time and spaces. However, it is difficult for them to guess where they are when the surrounding environment is new or when they forget the locations (Prudhvi Bollineni & Bagani, 2013).

Navigation Based Service Module is an interactive feature that will be able to interact through touch command and touch gestures with the user.

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- Assisting in public transportation

This provides a better solution to visually impaired and blind persons for travel using public transport services in Sri Lanka. The visually impaired can use this feature as the reminder based on the location. Therefore, they are able to find their destination without getting help from any other person.

- Provide walking instructions

To find user's current location, find nearest bus stops and get working direction to a selected bus stop or to a particular place using customized vector data.

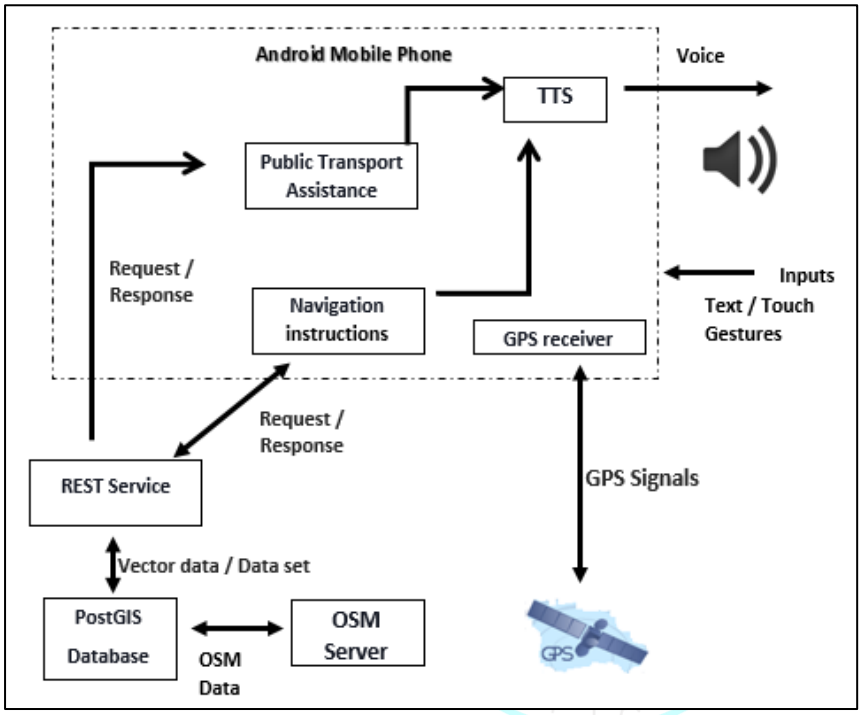

Figure 5: High-level Diagram for navigation based services

11.Results and discussion

The completed system was tested by eleven visually challenged users from university under graduates, employees and general public. The results obtained from the users proved the strengths of the application while highlighting the areas needed to changed or improved further.

The research team obtained the visually challenged users feedback in the following areas to determine the usability of the application developed.

Table 1: User feedback

	Positive	Negative
Understanding the application to use	80%	20%
Features included	85%	15%

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Usage of application	90%	10%
Willingness to use the application	95%	5%
Willingness to buy if sold	75%	25%
Overall impression	85%	15%

This research work has led the team to the creation of a multipurpose mobile application focusing on helping visually challenged people. Here, the main intention was to come up with more sophisticated input and output mechanism for visually challenged people while providing them with more beneficial features like outdoor navigation, public transport support, solving mathematical problems, messaging, scheduling, providing a gaming module to improve their mathematical skills and English knowledge, giving hand to the target users to get familiar with their braille language and getting calls through modern touchscreen smartphone. Since modern mobile technology is mainly based on touch screens and gestures, our intention was to familiarize this modern mobile technology to visually challenged users. So that target users will be able to perform their day to day tasks more easily and efficiently without hindering any other person

Conclusion and future works

According to the above-mentioned results obtained after testing, the application shows that this application has addressed the problem of accessibility in smartphones by visually challenged users. Furthermore, the results proved that the application is in higher usability and consists with important features.

Future work will be focused on developing the Insight application in the Sinhala language at same time since the product delivering to the global market consists only with limited features development team focus on providing outdoor navigation support and public transport support also to global market.

Insight application is an open portal to any developer who is willing to design an application for visually challenged users.

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