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Smartphone Accessibility Application for Visually Impaired

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Abstract-With the outburst of smart-phones today, the market is exploding with various mobile applications. These smart phones help the people by providing easy access to information and providing many basic functionalities to them .The sighted people can use such smart phones easily but due to the inability to read information on the screens, blind people face tremendous difficulties in using the smart phones.

Despite growing awareness of the accessibility issues for blind people, designers still face challenges when creating accessible interfaces. One major stumbling block is a lack of understanding about how they actually use touch screens. Many studies have been conducted to compare how blind people and sighted people use touch screen gestures. In this paper we propose "New Vision", an application to make calling and messaging simpler for the visually challenged. Using NEW VISION, calls and messages can be made to pre-saved contacts using pattern recognition and the position of user can be retrieved using Global Positioning System technology. Moreover, we present a text-to-speech interface and output through Vibrations to ease the usage of smart phones for the blind user. Using the various functionalities of any basic mobile phone like calling, messaging, knowing the time, battery level etc. are made easy for the visually challenged user.

Index Terms-Accessibility for Blind, Gesture Recognition, Android.

1. INTRODUCTION

Mobile phones have become an inevitable part of our daily lives. It is difficult to think of a day without having our mobile phone by our side. The evolution of mobile phones is witnessed by all of us, touch screens being the latest amongst all of them. While touch screens were once rare, touch screen-based interfaces are now present across a wide range of everyday technologies, including mobile devices, personal computers etc. As touch screens have become mainstream, it is crucial that touch screen-based interfaces be usable by people with all abilities, including blind and visually impaired people. Until recently, most touch screens provided few or no accessibility features, leaving them largely unusable by blind people. Unlike fully capacitated or sighted people, blind people cannot read messages displayed on the smart phones or cannot use the basic functions like calling, messaging etc. of the phone. Hence, Interaction via mobile devices is a challenge for blind users, who often encounter severe accessibility and usability problems. The main issues are due to the lack of hardware keys, making it difficult to quickly reach an area or activate functions, and to interact via touch screen. A touch screen has no specific reference points detectable by feel ,so a blind user cannot easily understand exactly where (s)he is positioned on the interface nor readily find a specific item/function. In this study we, therefore, investigate enriching the user interfaces of touch screen mobile devices to facilitate blind users' orientation called "NEW VISION", an Android Smart Phone application for the visually challenged. Through this application Calling, Messaging, Retrieving Position, Battery Level and Time is made possible without the need to see the phone. Accessible touch screens still present challenges to both users and designers. Users must be able to learn new touch screen applications quickly and effectively, while designers must be able to implement accessible touch screen interaction techniques for a diverse range of devices and applications. Because most user interface designers are sighted, they may have a limited understanding of how blind people experience technology. We therefore argue that accessible touch screen interfaces can be improved substantially if designers can better understand how blind people actually use touch screens .

2. LITERATURE SURVEY

Until recently, most touch screens provided few or no accessibility features, leaving them largely unusable by blind people. However, both the blind community and technology manufacturers have made progress on this issue in recent years. Google and Apple released basic screen-reading software for their touch screen-based mobile devices, and most Google Android and Apple iOS devices now ship with screen-reading software preinstalled. Buxton's introduction of an early touch tablet [6] was followed shortly by a panel discussing accessibility issues surrounding touch interfaces [5]. In the 1990s, the emergence of touch screen kiosks in public places such as airports and shopping malls prompted investigation of how touch screen hardware could be made more accessible .In recent years, researchers have explored accessible interaction techniques for mobile touch screens,and commercial manufacturers have begun to incorporate screen-reading software into their mobile devices (e.g.,VoiceOver, Eyes-Free Shell2, and Mobile Speak for Windows Mobile).

3. MOTIVATION & OBJECTIVE

There are many applications built in android for the visually challenged, but maximum do not address the basic problems faced by them.The applications, though really good in their approach do not cater for the basic needs of a blind person.After the analysis of the various applications available for the visually challenged, the following conclusions can be drawn:

1. Most Of the applications available are built for navigation purposes for example ”Walky-talky Explorer and Intersection. But these applications are not able to help the user with basic mobile phone features such as calling and messaging.

2. There are some other applications which have calling and messaging features example ”Mobile Accessibility” but these take voice as input and are not very efficient for Indian Englishaccent. The applications like “Vlingo Virtual assistant” and “speaktoit”are based on voice support which makes it difficult for the application to understand the accent of many users.

3.Application like “VOICe for Android”,which is also meant for visually challenged, is a universal translator for mapping images to sounds.

All the projects and applications mentioned above, do not address the connectivity problem faced by the visually challenged and thus the visually challenged are unable to do basic mobile operations such as calling and messaging. Thus this provokes the need for a new application that would enable people to use the basic operations of mobile and which would also keep in mind the needs of the vocally and the visually challenged. This research is motivated by prior attempts to create accessible touch screen user interfaces for blind people.The basic objective of this project is to overcome the limitations of the applications stated above and to help the visually challenged user to be connected with the world.To achieve this objective the following features have been implemented

_ Speed-Dial Calling, Messaging, Location Retrieving, Alert For Battery, Current Time and Date

4. PROPOSED SYSTEM

<u>Problem statement</u>:

In our project, an Android Smart Phone application for the visually challenged is proposed.

Through this application the visually challenged user can always be connected with the world around. Through this application Calling, Messaging, Retrieving Position, Battery Level and Time is made possible without the need to see the phone. The above features are implemented using a pre-defined gesture for each feature.

The initial Settings require a person with normal vision to configure the application after which the visually challenged user has to just make a predefined gesture on the Smart Phone screen to use all the features stated above.

<u>Proposed system:</u>

The purpose of this research project is to create an application that would enable the visually challenged to use some basic features of mobile phones thus making their life a bit simpler. The research is devoted to find an algorithm which would require less time for pattern recognition and that would be efficient. The two algorithms 13 point feature extraction and 23 point feature extraction are referred. Using multiple algorithms can help improve efficiency. The reason for using Android operating system based mobile phones is that Android is an upcoming open source technology. This project is dedicated to those millions of differentially-abled people who the world has wrongly labeled as disabled. This project would hopefully contribute something to the society and help make the lives of millions of visually challenged people easier.

Through this application dialing of any of the ten pre-saved phone numbers is implemented. The user can also send to these numbers any of the ten pre-saved message templates. To use the feature of calling and messaging the user has to enter the calling/messaging module by drawing the '>' gesture on the main screen, Subsequently he/she has to draw pattern(left, right arrow key-<, >) on his smart phone touch screen. The application then recognizes this number, asks the user if he wants to make a call or send a message. To make a Call the user has to draw ‘>’ on his phone screen. The application would ask the user for confirmation by asking him to shake the mobile (Call button) else he has to press right button (End button). To send a message the user has to draw ‘<’ on his Android phone. The **application w**ould then read the message templates and then the user has to write the number of the message template which he wants to send. The application would ask the user for confirmation by asking him to press left button else he has to press right button. To retrieve the current position the user makes a ‘<’ on the main screen and a voice informs the user about his/her current position. Then the user can choose to message this information to his/her contacts. Audio help is provided throughout the use of this application. To retrieve the current Date Time the user needs to draw 'V' gesture on his device. The device then responds via Audio with the current date time of the device. Similarly, the user can access the information about the phones battery levels by drawing the '^' gesture.

5. IMPLEMENTATION

5.1. Hardware Implementation and Requirements

The hardware requirements of this application are

Android Smart phone having a touch-screen and with a processor of minimum 600 MHz

Android Smart phone should have Volume Up and Volume Down button.

5.2. Software Implementation and Design

As the user draws a pattern on the screen, the system performs online processing on the pattern. The co-ordinate values of the screen are extracted and binary values are stored in an array. Further cropping is done and 13 point feature extraction is performed on the array. Then the array is compared with the database to find an appropriate match. Most frequently used numbers are cached in the memory thus implementing machine learning. The design of the modules in the system are discussed below:

BINARIZATION MODULE

The system uses online processing to process the pattern drawn by the user as the user draws the pattern the co-ordinate values are extracted and the respective position in the array is set to zero, The size of the array is decided dynamically by retrieving the screen resolution The number of rows are equal to the maximum X co-ordinate and the number of columns are equal to the Y Co-ordinate. Initially all the values of the array are set to one. As soon as the user leaves the screen after drawing the pattern the array is saved and further processing is carried out. Thus the output of the binarization module is a binary value array.

CROPPING MODULE

The array obtained after binarization is an input to the cropping module. This array needs to be cropped because there are very high chances that the user while drawing the pattern has not used the entire screen but the array contains information about the entire screen. The user being visually challenged is unaware of the screen size and may either tend to draw the pattern somewhere in a corner or may tend to draw the image either too small or too large. These conditions can be handled by cropping the array. Rows and columns where no value is set to zero are cropped from the existing array, thus a new array is obtained. The reason to crop rows and columns where no value is set to zero is that these rows and columns were not used when the pattern was drawn and hence contain no useful information.

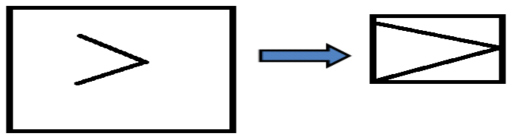
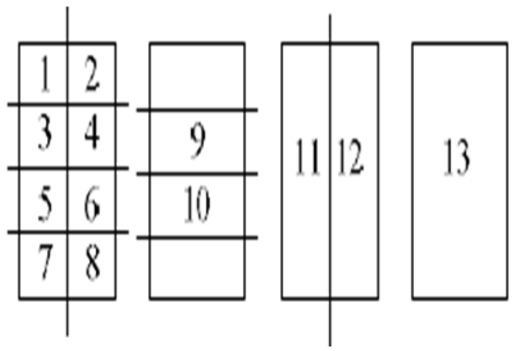


Fig 2. Cropping Module

13 POINT FEATURE EXTRACTION AND FEATURE MATCHING MODULE

In the feature extraction module the cropped array is divided into 13- point as shown in fig. 3. The number of rows is divided by four and the number of columns is divided by two thus we obtain the parts one to eight. Part nine is part three and four taken together and part ten is part five and six taken together. All the parts of the first column together form part eleven and the second column forms part twelve. The entire array taken together is part thirteen.

Fig. 3. 13 Point Feature Extraction



We count the bit set to zero in each part of the array and store these values in a separate 1*13 array. We use this array for comparison with the database.

In the database, there are pre saved 1*13 arrays for each number. The database has several entries for each number. Matrix is stored in the database. Hence the database has a variety of entries thus improving the efficiency of the system. The array which is currently obtained is compared with these existing arrays and the one which gives minimum deviation is chosen as the final result. To calculate the deviation we first find the difference of each of the thirteen points of the obtained array with the array in the database then we sum up the difference obtained from each point to get the total deviation.

If the obtained array is [0 7 6 5 10 11 6 5 9 20 21 28 49] and the array in database is [0 8 4 6 10 10 6 4 10 20 20 28 48] then deviation is |0-0| + |7-8| + |6-4| + |5-6| + |10-10| + |11-10| + |6-6| + |5-4| + |9-10| +|20-20| +|21-20| + |28-28| + |49-48| = 9.Thus the deviation in this case is nine.

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LEARNING MODULE

There is also a module which keeps an account of the commonly used numbers by the user and based on which it updates itself every time the user makes a pattern. This module makes use of the concept of caching that is the numbers which are most frequently used their arrays are stored in the cache. When an array needs to be compared it is first compared with the entries in the cache. If no match is found having the deviation within set limits then the array is compared with the entries in the database. This will not only ensure faster response but greater efficiency. In general cases the hit ratio is much higher than the miss ratio. Thus using the concept of caching the learning module is implemented.

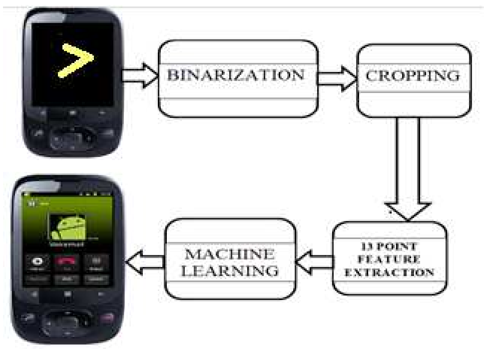

Fig.4. Overall Flow of Application

6. CONCLUSION

A Modified android accessibility application has been formulated for ease of use of smart phones for the visually impaired people in the context of smart phone usage. Methods using character recognition such as alphabets and numbers and only voice recognition were used initially. The aim in using processing multiple algorithms such as 13 point feature extraction and 23 point feature extraction is to help improve efficiency. For pattern processing two major approaches such as online and offline processing were considered out of which online processing was used as it is faster than offline processing and there is no need to save the pattern as image. This application through pattern matching, gesture recognition and voice messaging would make dialing and messaging from smart phones possible and simpler for visually impaired

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