Location Based Path Guiding System for the Visually Impaired People

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Abstract- Visually impaired or blind people faced tremendous challenges daily in accessing the information while on the move or during communicating with the world around them. They had to depend on their sighted colleagues, friends, relatives, or the people on the road to help them with locating places. Our Location Based Information System is such a location based application that works as an audio road guider for the visually impaired people using OpenStreetMap. OpenStreetMap (OSM) is a world-wide campaign for developing open source maps. Voice recognition represents a technology that is finally ready for prime time use. In our system we used voice recognition as visually impaired people unable to text searching.

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Location based Path Guiding System for the Visually Impaired People

M. Chowdhury [α], T. Alam [σ], P.P.Purohit [ρ] & S.A. Fahim[ω]

Abstract- Visually impaired or blind people faced tremendous challenges daily in accessing the information while on the move or during communicating with the world around them. They had to depend on their sighted colleagues, friends, relatives, or the people on the road to help them with locating places. Our Location Based Information System is such a location based application that works as an audio road guider for the visually impaired people using OpenStreetMap. OpenStreetMap (OSM) is a world-wide campaign for developing open source maps. Voice recognition represents a technology that is finally ready for prime time use. In our system we used voice recognition as visually impaired people unable to text searching. The CloudMade API was used to provide multi-mode routing services together with turn-by-turn descriptions for car users, bicycle riders, and pedestrians. This solution is relatively easy and fast to deploy. This paper provides a guiding solution with detailed navigational services for visually impaired people. The experimented result demonstrates the effectiveness of our system.

Keywords: *visually impaired, openstreetmap, audio direction, android.*

I. Introduction

A location-based service (LBS) is an information and entertainment service, accessible with mobile devices through the mobile network and utilizing the ability to make use of the geographical position of the mobile device. Location-based services are a general class of computer program-level services used to include specific controls for location and time data as control features in computer programs. As such (LBS) is an information and has a number of uses in Social Networking today as an entertainment service, which is accessible with mobile devices through the mobile network and which uses information on the geographical position of the mobile device.

For blind people the traditional devices to aid mobility have been the long cane and the guide dog. Although a large number of electronic mobility devices have been developed, their uptake has been very low. To help with orientation, blind people have had to rely on recognizing non-visual landmarks possibly in conjunction with an embossed map of the area.

The blind people faced tremendous challenges daily in accessing the information while on the move or during communicating with the world around them. They

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the people on the road to help them with locating places. Considering this, our proposed system is design for the blind people. Most of the existing applications are for normal people and very few of them address the special requirements for the disabled people. About 15 percent of the world's population some 785 million people has a significant physical or mental disability. According to a new report prepared jointly by the World He-alth Organization [1] and the World Bank [2], Geneva, June, 2012 - 285 million people are visually impaired worldwide: 39 million are blind and 246 have low vision. About 90% of the world's visually impaired live in developing countries. Due to growing populations and aging, these numbers are expected to double by the year 2020 making the colossal human tragedy even worse, stalling development and denying a basic human right [3].

To understand how developing mobile location services applications differs from traditional wire line applications, it is important to understand the basic principles of wireless network [4]. There are two basic of positioning a device on the market today, firstly by using satellite for example, GPS or its Russian cousin, GLONASS; secondly by using the mobile telephone network. There are also combinations of these, which increase the accuracy and decrease the cost for the user.

Global Positioning System (GPS) is based on twenty four satellites and five monitoring stations around the world. It is satellite-based navigation system, which is maintained and operated by the U.S. Department of Defense. Its primary purpose is to provide global positioning and navigation for land-based, sea-based, and air-based tactical forces, but it also been made available for commercial use [4].

GPS works by the user's receiver (which can now be made so small that they can be built into watches and cell phones) acquiring a sufficient number of satellites (a minimum of three) and triangulating them by using the travel time of the radio signal from the satellite (more properly, trilateration or resection because the system is not calculating angles). Because the position of the satellite in a space known (because the orbit and the time is known) and the distance is known (because the time it takes for the signal to get from the satellite is known, with a known velocity) the distance arc on the Earth's surface can be calculated from satellite although delays and errors that might

occur when signal passes thorough the atmosphere have to be corrected. Intersecting two spheres from satellite gives an ellipsoid; applying the third satellite gives two points where the ellipsoids intersect, the intersection with fourth sphere will narrow it down to one point although usually, one of the two points is not reasonable answer and can be discarded.

Android [5], [6] is an open-source software platform developed by Google, for mobile application development on devices powered by the Android OS. It is a complete software stack that provides all the middleware needed to run end-user applications on mobile devices such as: device drivers, OS, core libraries, an optimized virtual machine, Java Native Interface (JNI), and a complete Java development environment. The blind/visually impaired people usually face the problem in finding location in any area. Hence, we have proposed a location based service on mobile phones using Open Street Map (OSM) which is mainly utilized to provide audio and visual messages on the map [7]-[9]. Open Street Map is a rapidly growing open source map of the world because of the availability of map information across the world and invent of inexpensive portable GPS devices [10]. The demand of location based services is also increasing day by day with the emerging growth of smart phones. Our proposed system is developed for both the normal and blind people. Users of our application will get audio warning message in any direction. The rest of the paper is organized as follows. In Section II, we discuss about some related works and their shortcomings. Then we present the description of proposed location based system in Section III. In Section IV, system implementation details are described. In Section V, we have discussed the experimented result. Finally, we conclude this paper stating the future plan in Section VI.

II. Related Works

There exists some research works for helping blind people with map technology. Some modifications of these applications are required so that blind people can use these smoothly. An android platform based mobile application using OSM to help visual impaired and normal people was proposed in [11]. This application helps users to search a specific location with text. This system can't give audio direction to reach his/her destination and failed to give audio message if he/she on wrong path. One of the mentionable existing research works was Walky-Talky [12]. This application has been designed to help the blind with walking directions that combine Google Maps with GPS navigation technology. The main weakness of this pro-ject was it uses Google Map. Google Map has legal or technical restrictions on its use, holding back people from using it in creative, productive, or unexpected ways. System proposed in [4] and [13] can't consider audio

based path finding help. RFID-based system for navigation in a building for blind or visually impaired people was proposed in [14].This system can't work for outdoor users.

III. Methodology

a) Overview of the Overall System

The aim of our work is to help visually impaired people with audio to reach his/her destination. Fig. 1 demonstrates the workflow of our proposed location based system for the visually impaired people.
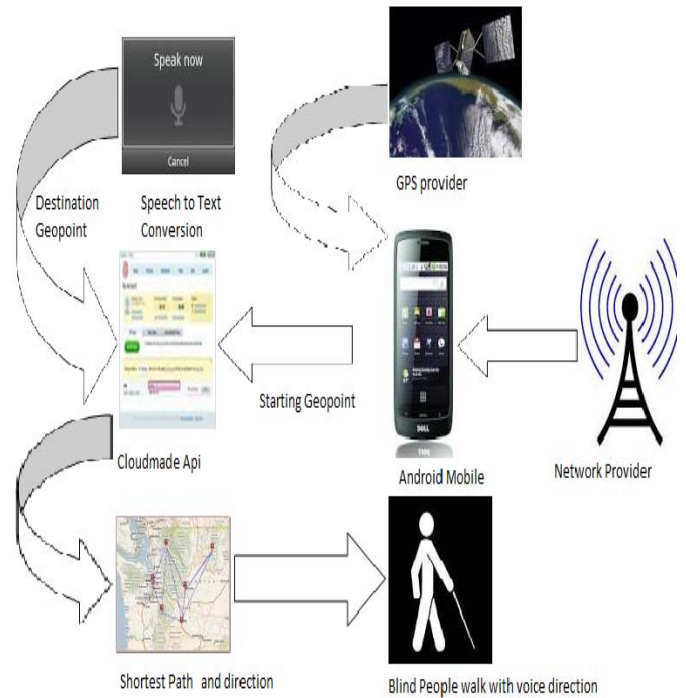

Figure 1 : Proposed location based system for blind people

b) Voice Recognition

First step is taking audio input about a particular location from user and convert the audio to text using "audio to text convert API" of android. The text will generate geopoint of the corresponding location.
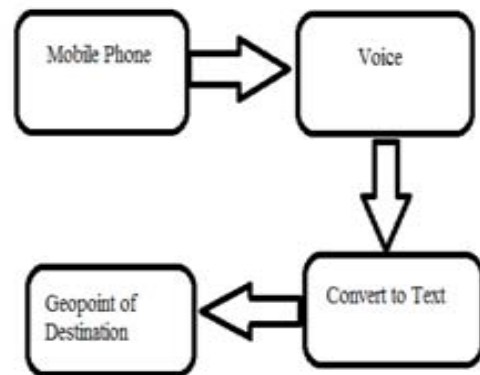

Figure 2 : Conversion from voice to text and assigning geopoint

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c) Cloudmade API

In this stage GPS provider or network provider will generate the current position of the location and we get destination geopoint from voice recognition. Then the starting and destination geopoints will be generated to Cloudmade API. Cloudmade API will generate geopoints of shortest path between starting and destination geopoints. It also generates direction to reach the destination.
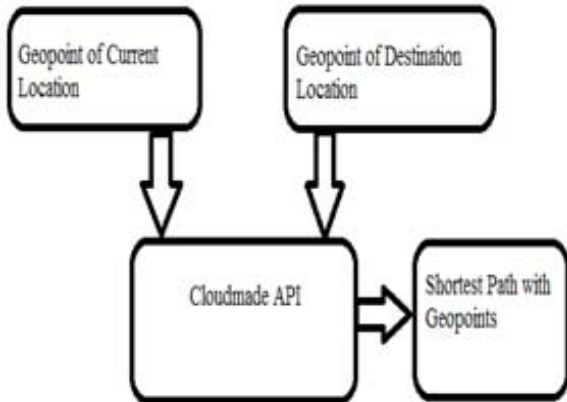

Figure 3 : Shortest path from cloudmade API

d) Audio Direction

At this stage user will get audio direction at every turn of road from source to destination. User will get direction on his/her way.
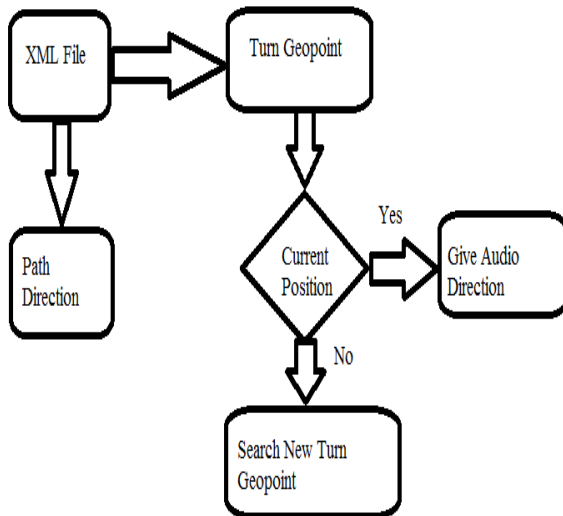

Figure 4 : Audio direction to a specified location

VI. Implementation

a) Turn on GPS

The application demands a GPS enabled android mobile. GPS must be enabled before start the application. Network provider is another system which can generate location information to the device from the network operator. In our application we need accurate data of a position. We used GPS provider and Network provider both.

Figure 5 : Turn on GPS to generate location information

b) Retrieving Voice Recognition Result

We used Google voice recognition API to convert voice to text. It is a real time service which generates instant text after giving audio to the device.
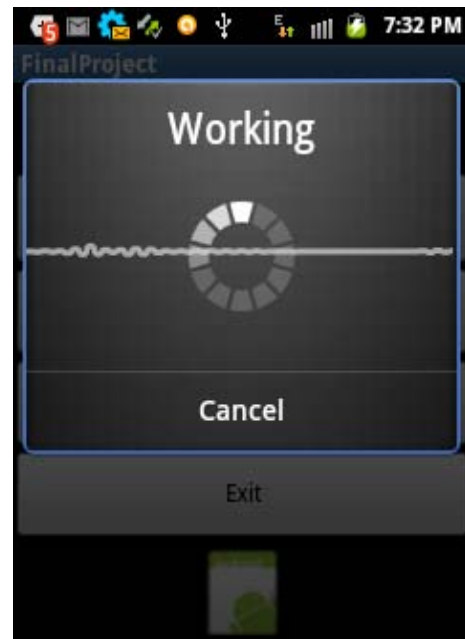

Figure 6 : Voice recognition demo

c) Retrieve Shortest Path from Cloudemade API

We have got starting geopoint from network provider and GPS provider and destination geopoint from the user. These geopoints will be generated to the Cloudemade API. There are some formats to generate data to the Cloudmade API. We have selected language English and distance in miles and API 0.3. After giving the geopoints it generates a shortest.xml file. The file contains shortest path from starting location to destination location.

```
<rtept lat="22.462374" lon="91.973289">
<desc>Head south, 98 ft</desc>
<extensions>
<distance>30</distance>
<time>7</time>
<offset>0</offset>
<distance-text>98 ft</distance-text>
<direction>S</direction>
<azimuth>180.0</azimuth>
</extensions>
</rtept>
<rtept lat="22.462105" lon="91.973297">
<desc>Turn right, 0.1 miles</desc>
<extensions>
<distance>216</distance>
<time>52</time>
<offset>2</offset>
```

Figure 7 : XML data from cloudemade API

d) XML Parsing

Parsing XML from the internet is a pretty common requirement on any platform. There are numerous ways to accomplish this task on every language out there, and the Android platform is no exception. On the Android, this is accomplished using SAXParser, a serial access parser API for XML. SAXParser functions as a stream parser, with an event-driven API, using callback methods that trigger every time events occur during the reading. The majority of the work is done by a SAX-Handler. The SAXParser will walk through the XML file from beginning to end (hence parsing is always unidirectional) and calls appropriate handler methods along the way. For this exercise, we will create a Handler that extends org.xml.sax.helpers. DefaultHandler and overrides the necessary methods.

On the start/end of each document, the following methods get called:

```
public void startDocument() throws SAXException {}
public void endDocument() throws SAXException {}
```

When the Parser reaches an opening tag, like <exampletag name=\labs">, the following method gets called:public void start Element (String namespace URI, String local Name, Stringq Name, Attribute satts) throws SAXException {}

In this case, localName will be \exampletag". The atts variable will hold any associated attribute information: atts.getValue(\name") will return \labs". When we reach a closing tag, like < =exampletag>, the equivalent closing method gets called: public void endElement(String namespaceURI, String localName, String qName) throws SAXException {}.

In between an opening and closing tag, there can be a string, like <exampletag>here is some content< =exampletag>. The SAXParser reads in the string, one character at a time, but buffers method calls to the handler: public void characters(char ch[], int start, int length) {}.

The ch[] array holds a buffer of characters that the SAXParser has read in, but the only relevant chunk is given by the start and length values. With large enough strings, the characters() method may be called multiple times within a single block of character data. This is a place where we personally stumbled with, as it seems many tutorials out there seem to ignore this fact, assuming the entire block is returned and end up only getting partial data.

e) Audio Direction

In the result our application will generate audio direction at every turn of a road. We got geopoints of every turn but we take a round area by taking the geopoint as a center. By Haversine formula [15] we find out the distance between two geopoints and we took 5 meters as its range. We used an algorithm to generate the audio message when user reaches to the area. We used a thread to perform task in background and on progress of the application.

Figure 8 : User current position to generate audio direction

V. EXPERIMENTAL RESULTS AND ANALYSIS

a) Experiment

We tested our program by six users. They used our program for 3 days and gave their feedback.

Table 1 : Experimented Results

User	Details	Comment
Volunteer-1	Blind Man	Satisfactory
Volunteer-2	Student	Satisfactory
Volunteer-3	Student	Satisfactory
Volunteer-4	Blind Man	Average
Volunteer-5	Blind Man	Average
Volunteer-6	Blind Man	No Comment

b) Evaluation

After three days of testing period, they acclaimed that the system is much more helpful to find their destination. They found the system much more helpful as they didn't have to search their destination with text typing. Although they were on wrong direction they got new direction from the application. When the volunteer reaches within an area they got audio message. They didn't have to be attentive on their way for searching turn of road.

Criticisms: But still they (users) have some complaints. Volunteer-2 said that it is very slow. We said him, due to slow internet connection it works slowly. They also got some problems in running the application. The application became stop when there is no route in Cloudmade API for given geopoints. We said them about our limitations, in our country OpenStreetMap is not well developed like Google map. Besides, all the routes are not developed to get shortest path and direction of road.

c) Our Feedback

We have considered all the problems and suggestions from our experiment and fixed the problems. The following solutions of problems are fixed in the new version of our software. Firstly, the speed of speech engine is now maintained so that users can comfortably recognize the audio. Secondly, the distance of two positions is maintained. We hope our new version will now satisfy all the users and perfectly applicable to the real environment.

VI. Conclusion

Our location based system mainly developed for the visually impaired people. Our application helps visually impaired people to reach his/her destination with a shortest path. It generates voice before reaching the turn of road so that user can be aware of the turn of road. There are some limitations for the application to run in developing country. Our total work depends on internet speed. In developing country it is very costly to generate high speed internet. Lack of details on OSM of Bangladesh is the main challenge of our work. The more volunteers working on OSM can make map of the country rich. In that case, our application will perform better in the context of Bangladesh. Moreover, we have future plan to implement another application that will generate suitable path for visually impaired/blind people to reach his/her destination by observing traffic jam and weather. Finally, our proposed system has opened further research so that anyone from any part of the world can work on the existing system and incorporate their ideas with it.

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