Location and Context Aware Place Suggestion System Designed for Android Wearable Devices Optimized for Physically Challenged users

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***Abstract*— In today's world smartphones have become ubiquitous and they are being used in every aspect of life. Even with the rapid advancement of technology these new devices and services remain inaccessible to the physically challenged users. There is a wide gap in the uptake of technology and the related aspects by the physically challenged. Discover the app, is aimed at improving the adaptation of mobile devices. This is achieved by the app which runs both on the smartphone as well as the wearable device. The app helps in the discovery of new places and aids in the navigation for blind users by providing audio feedback and through haptic feedback.**

Index Terms - Android, Wearable, Navigation, Blind.

I. INTRODUCTION

The technology used in homes and consumer durables is becoming increasingly complex these days. Though newer technologies have come up and we are building increasingly complex computing machines, the adoption of these technologies to significantly improve the accessibility for visually impaired is relatively less.[5] The untapped potential to adapt the existing mobile technology to blind users was the key factor in bringing out this paper.

A. Smart Devices

A smart device is an electronic device, generally connected to other devices or networks via different wireless protocols such as Bluetooth, NFC, Wi-Fi, 3G, etc., that can operate to some extent interactively and autonomously. It is widely believed that these types of devices will outnumber any other forms of smart computing and communication in a very short time, in part, acting as a useful enabler for the Internet of Things.

Smart devices can be designed to support a variety of form factors, a range of properties pertaining to ubiquitous computing and to be used in three main system environments: physical world, human-centered environments and distributed computing environments.

Smart Devices can be characterised as follows:

- A set of system hardware & software ICT resources. This set is usually static fixed at design time
- Dynamic component-oriented resource extensions & Plug-ins (Plug and play) of some hardware resources
- Remote external service access and execution
- Local, internal autonomous service execution
- Access to specific external environments: human interaction, physical world interaction and distributed ICT / virtual computing interaction.
- Ubiquitous computing properties.

B. Two of the most prominent class of devices are:

- Wearable Computers
- Smart Phone
- Smart watch

Wearable computers also known as body borne computers or wearables are miniature electronic devices that are worn by the bearer under, with or on top of clothing. This class of wearable technology has been developed for general or special purpose information technologies and media development. Wearable computers are especially useful for applications that require more complex computational support than just hardware coded logics.

Smart phone A smartphone (or smart phone) is a mobile phone with an advanced mobile operating system. They typically combine the features of a cell phone with those of other popular mobile devices, such as personal digital assistant (PDA), media player and GPS navigation unit. Most smartphones have a touchscreen user interface and can run third-party apps, and are camera phones.

Smart watch as the name suggests is a computerized wristwatch with functionality that is enhanced beyond timekeeping. While early models can perform basic tasks, such as calculations, translations, and game-playing, modern smartwatches are effectively wearable computers. Many smartwatches run mobile apps, while a smaller number

of models run a mobile operating system and function as portable media players, offering playback of FM radio, audio, and video files to the user via a Bluetooth headset. Some smartwatches models, also called 'watch phones', feature full mobile phone capability, and can make or answer phone calls.

II. TECHNOLOGIES

A. *ANDROID WEAR*

Android Wear is a version of Google's Android operating system designed for smartwatches and other wearables. By pairing with mobile phones running Android version 4.3+, Android Wear integrates Google Now technology and mobile notifications into a smart watch form factor. It also adds the ability to download apps from the Google Play Store.

B. *BLUETOOTH*

Bluetooth wireless technology is a proposed publicly available specification for radiofrequency (RF), short-range, point-to- multipoint voice and data transfer which also supports point- to-point connections and facilitates ad-hoc connections for stationary and mobile communication environment.

III. METHODOLOGY

The application developed in this paper functions through voices. Smart Phone recognizes the voices, search for destination, routes, and provide the route to the user through voice. The functions of the application developed in this paper are as followed. The first function is to search destination through voice recognition and Google TTS service.[1] After pressing ‘search’ button, users say the wanted destination according to the instruction. In case of unclear voice, the message saying ‘speak once more’ will pop up and users say the destination once more clearly. If the application asks for confirmation of destination, the users say, ‘yes’, if the destination is correct. The second function is route research using Google Map. After users have confirmed the destination, the application materializes the map after searching for route from the current location of the user to the destination. The third function is to guide the users with voice. Using DB of Smart Phone, it sees the route to the destination and it begins to guide by saying travel range, and direction for each section of the route.[3] Using Bluetooth technology the routing instructions and guidelines are sent over to the smart watch. The underlying technologies which enable to do this are:

- Speech Recognition
- Android
- GPS
- LBS

A. *SPEECH RECOGNITION:*

Speech recognition for application is done on Google server, using the HMM algorithm.[2] HMM algorithm is briefly described in this part. Process involves the conversion of acoustic speech into a set of words and is performed by software component. Accuracy of speech recognition systems differ in vocabulary size and confusability, speaker dependence vs. independence, modality of speech (isolated, discontinuous, or continuous speech, read or spontaneous speech), task and language constraints. Speech recognition system can be divided into several blocks: feature extraction, acoustic models database which is built based on the training data, dictionary, language model and the speech recognition algorithm.

Analog speech signal must first be sampled on time and amplitude axes, or digitized. Samples of speech signal are analyzed in even intervals. This period is usually 20 ms because signal in this interval is considered stationary. Speech feature extraction involves the formation of equally spaced discrete vectors of speech characteristics. Feature vectors from training database are used to estimate the parameters of acoustic models. Acoustic model describes properties of the basic elements that can be recognized. The basic element can be a phoneme for continuous speech or word for isolated words recognition. Dictionary is used to connect acoustic models with vocabulary words. Language model reduces the number of acceptable word combinations based on the rules of language and statistical information from different texts. Speech recognition systems, based on hidden Markov models are today most widely applied in modern technologies. They use the word or phoneme as a unit for modeling. The model output is hidden probabilistic functions of state and can’t be deterministically specified. State sequence through model is not exactly known. Speech recognition systems generally assume that the speech signal is a realization of some message encoded as a sequence of one or more symbols.

B. *ANDROID:*

Android is a software stack and mobile operating system that includes the operating system for portable devices, middleware, user interface, and a standard application , multimedia message service (MMS). Android developers were able to write applications in the Java language, a runtime library that can run the compiled byte code. In addition, it provides the required application through the Android Software Development Kit (SDK) to develop a variety of tools and APIs. Android works on the Linux kernel and the Android system uses C / C + + libraries, etc. are included. Android, unlike existing Java virtual machines, uses a Java application made of Dalvik Virtual machine that runs on a separate process. In 2005, Google acquired Android Inc. and in

November, 2007, Google announced to freely open Android platform to the public. After the announcement, 48 different hardware, software, and communication companies collaborated to design Open Handset Alliance, OHA and it has been developing an open-to-public standard. Google distributed all source code of Android as Apache v2 license so that companies or users can independently develop Android program. A construction of Android is shown in figure 1 as followed. In these construction components, it is divided into a total of 5 class of application, application framework, library, Android runtime, and Linux kernel. Handset layout platform is adaptive to expand 3D graphic library based on OpenGL ES1.0, VGA, and 2D graphic library, and it uses SQLite database software for a purpose of data storage. Android supports connection technologies including GSM/EDGE, CDMA, EV-DO, UMTS, Bluetooth, and Wi-Fi. It also supports a web browser based on an open source, Web kit application framework and it allows the usage of touch screen that is supported by additional hardware, GPS, acceleration sensor, compass sensor, and 3D graphic acceleration.[2]

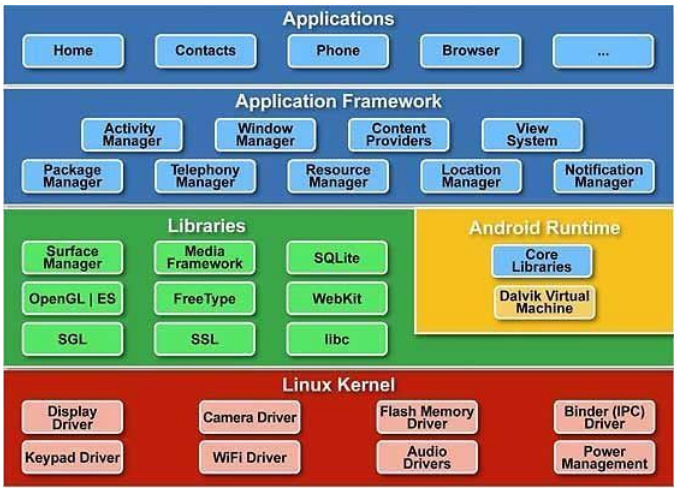

Figure. 1 Android Architecture

C. GPS (Global Positioning System):

GPS is a radio navigation system using satellites and it is developed by USA Department of Defense for military use navigation but it can be used by citizens with a limited range. It predicts radio coverage from satellites to a receiver, then it shows the exact 3D location, speed and time. This system can be universally used for 24 hours, and many people can use it. This GPS system can be dived into 3 different segments; SS (Space Segment), CS (Control Segment), and US (User Segment). SS (Space Segment) represents the location of 24 satellites that rotate around the Earth every 12 hours. As of April, 2007, there is a total of 36 GPS satellites with 30 of them are active and 6 of them are preparatory satellites in case of malfunction. CS (Control Segment) represents a general observation post that manages and tracks GPS satellites. US (User Segment) represents GPS users and GPS receiver .

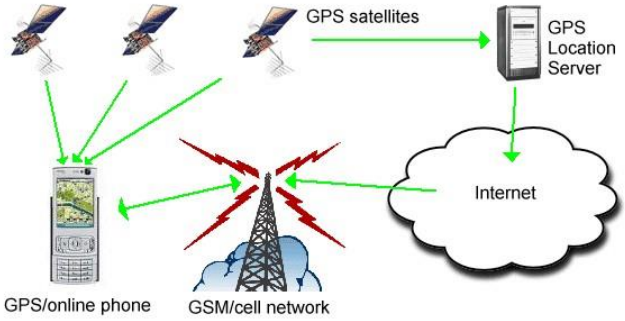

Figure. 2 Global Positioning system

D. *LBS (Location-Based System):*

LBS service indicates a wireless contents service that provides certain information based on the location change of the user. Developers of mobile handset have voluntarily tried to install LBS within their devices. However, LBS was originally developed by telecommunication companies and mobile contents providers. Main benefit of the system is the fact that the users don't have to directly insert location as they move. GPS positioning technology is one of important technologies that allows easier excess of wireless internet service.

However, in order to materialize LBS, there are more related technologies other than GPS and satellite based technologies. Within mobile communication network, there exists a management mechanism in order to manage a mobility of cell phone and there are many GPS LBS service based on the mechanism. Movements of LBS can be seen in *three different parts. They are*:

- Positioning technology
- Lay-administered platform
- Location application

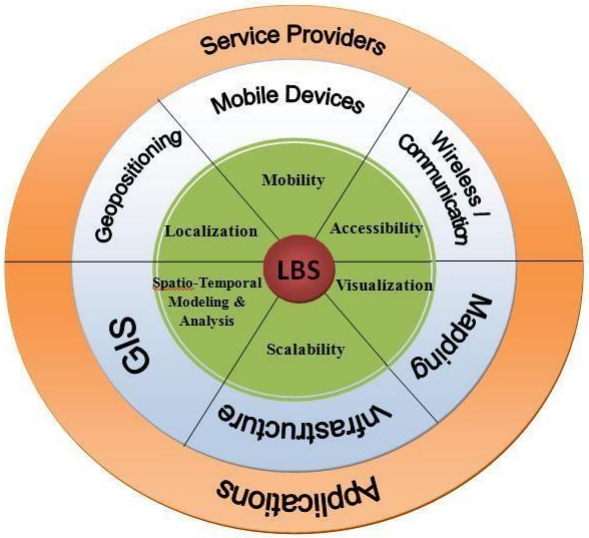

Figure. 3 Location Based Services

1) Positioning Technology:

Service provider can predict any location using GPS chip within wireless device. In this case, the positioning technology directly manages a calculation of location using received signal from satellite. Once the calculation is done, a variety of information can be received through mobile communication network. Depending on Mobile communication network or location information service, the system sometimes uses a single base station based information, rather than multiple base stations. Since mobile communication network, characteristically, constantly manages the mobility of cell phones, this positioning technology method can be a method of providing LBS without any additional position technology and any calculation from requests of location. The accuracy of location estimation is at the maximum when the location was estimated using GPS and the matching satellite based location prediction method. On the other hand, a base station method has the lowest accuracy of predicting location since it only allows predicting a certain part of region rather than a coordinate. LBL service can be materialized using other methods other than what are currently shown. Within current mobile communication network, there exists a variety of end terminals that have different method of predicting location. Therefore, normal mobile communication companies combines GPS, A-GPS and a base station based method to provide LBS.

2) Lay-administered Platform:

A lay-administered platform is a general word for LBs service components that achieves and process user location from position technology and provides information to application through an interface with network. Within network models based on GSM, CDMA, GMLC(Gateway Mobile Location Center) has been defined as a facility that request a base station based routing information by interlocking with management system in the inner part of mobile communication service and functions as a gateway of interlocking with LBS application within IP network. These GMLC can be sorted out to be one of LBS platforms within mobile communication network.

3) Location application:

This application represents a service that provides already processed contents based on locations of individual user or an object through communicating with lay administered platform or that can manage collected location information.

IV. IMPLEMENTATION

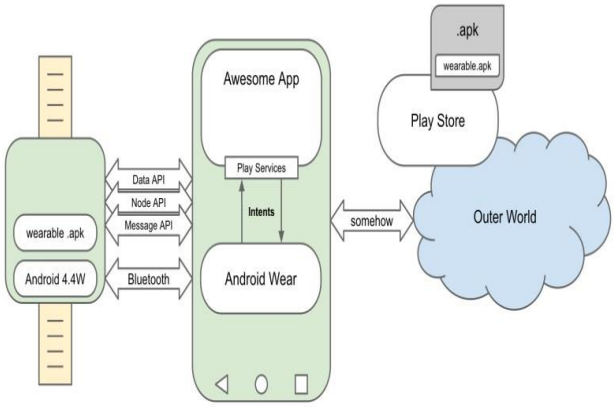

Figure. 4 System Architecture

The system architecture consists of components namely:

- Smart Phone
- Smart Watch

The smart phone connects to the smart watch and pushes notifications and data. The user starts the application on the phone by giving voice commands on the watch. This in turn will start the app on the phone. The application once started will respond to the user's commands and fetches the list of places. The results are then presented as a list which is displayed on the smart-watch. The user then can scroll the list on the watch using his fingers and with every scroll haptic feedback would be provided. The navigation then would be started and instructions would be provided via the earphones. Once the user has reached the destination, the application then notifies the user. Haptic feedback on the watch is used to provide alerts or warnings during the navigation process.

The implementation has been done by using the following:

- Voice information storage
- Voice recognition
- Voice features update
- Route navigation
- Track user

1) Voice Information Storage:

During the transactions, first transforms the user's voice information into digital signals and stores the digital signals in specialized voice database. Then the server will send new voice to a voice recognition system, where the voice will be de-noised and the voice features will be extracted. After the voice features extracted successfully, the features information will be automatically sent to the voice features database for subsequent voice recognition.[2]

2) Voice Recognition:

Voice recognition mainly consists of following steps:

- Receiving the user voice signal
- Using normalization to denoise
- Extracting feature and
- Comparing the voice features.

Specifically, the user's voice signal denoising and feature extraction of voice are completed by the android. The system finds the latest voice features in its database for the user and compares them with the voice features. If it's found that the voice features consistent with each other, it also indicates that the voice recognition is passed by the system and the user is legal.

Accuracy of the voice should be as follows:

- Error rates increase as the vocabulary size grows
- Speaker dependence vs. independence: A speaker-dependent system is intended for use by a single speaker. A speaker- independent system is intended for use by any speaker, more difficult.
- Isolated, Discontinuous or continuous speech with isolated speech single words are used, therefore it becomes easier to recognize the speech. With discontinuous speech full sentences separated by silence are used, therefore it becomes easier to recognize the speech as well as with isolated speech. With continuous speech naturally spoken sentences are used, therefore it becomes harder to recognize the speech, different from both isolated and discontinuous speech.[2]

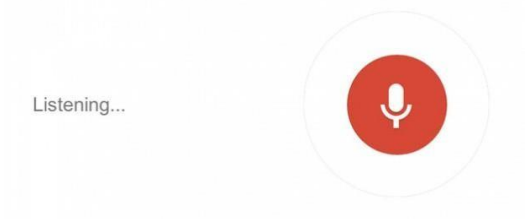

Figure. 5 Voice recognition service offered byGoogle

3) Voice Features Update:

The android should not only accept the input voice information, but also update the voice features timely. We collect enough historical information and summarize new law, and establish a system for regularly view of the user's voice features to update the voice features timely.

4) Route Navigation:

Route navigation services help people get from one place to another. Navigation tracking, often with a map "picture" in the background, but showing where you have been, and allowing "routes" to be preprogrammed, giving a line you can follow on the screen.

5) Track user:

A track is a trace of somewhere that you actually been. The GPS unit periodically sends details of the location which are recorded by the software, either by taking a reading based on a set time interval, based on a set distance, based on a change in the direction by more than a certain angle, or a combination of these. Each point is stored together with its date and time. The resulting track can be displayed as a series of the recorded points or a line connecting them retracing your steps is a simple matter of following the track back to the

IV. CONCLUSION

In this paper, it designed a navigation system for blind people in order to provide precise location information. Suggested system, as an independent program, is fairly cheap and it is possible to install onto Smart phone held by blind people. This allows blind people to easy access the program. The developed service utilized Smart Phone in order to search route between the current locations of user to the destination and provide a voice-navigation. The test of the application functions were done by using Android 4.3. As the result, voice support on route was successfully proven to work without any troubles. Further researches have to be continued in order to provide the users about the information on the obstacles using sensors connected to Android mobile. The navigation system uses TTS (Text-to-Speech) for blindness in order to provide a navigation service through voice. Also, it uses Google Map API to apply map information.

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