REVIEW OF ANDROID OPERATING SYSTEM INTEGRATED WITH TEXT-TO-SPEECH SYNTHESIS APPLICATIONS

Jagmeet Kaur[1], Parminder Singh[2]

[1]*Department of Computer Science and Engineering, SGI, Farrukh Nagar, Haryana, (India)*

[2]*Department of Computer Science and Engineering, G.N.D.E.C, Ludhiana, Punjab, (India)*

ABSTRACT

Android operating system have the biggest share among all the Smartphone operating systems like Symbian OS (mostly run in Nokia mobile phones) and Windows mobile. Android has very few restrictions for the developers for developing an Android application. Text to Speech Synthesis systems for various languages is already available on the platforms such as personal computer. But porting these systems on a resource limited devices like mobile phones is not an easy task because of their limited storage and processing power. In this paper we have reviewed android architecture, comparison of Android OS with other OS, and text to speech synthesis system in Android for various languages.

Keywords: Android, Speech Database, Speech Synthesis, Symbian.

I. INTRODUCTION

Mobile device play a vital role in our daily life. Incorporating the Text to Speech (TTS) application in the mobile platforms provides a user with a friendly vocal interface and allows people to read message or text on a screen for visually and physically impaired and illiterate masses. It also helps the users to read the text while driving [1], exercising, etc. Because of the limited storage and computing capacity of the mobile devices, it is a challenging task to generate an optimized speech synthesis system. Users don't want to devote a big part of their mobile's storage capacity just for a speech synthesis system. So design of the system should be in such a way that it should cater the maximum words while keeping the application size low. Text-to-Speech applications have been developed on many platforms like personal computers, electronic dictionary and mobile device, and most applications are for English language [2]. Building a speech corpus for other languages than that of English speech corpus is a different task [19]. The TTS application provides easy communication for the persons to read the messages, emails, e-books etc.

II. ANDROID ARCHITECTURE

Google entered into the mobile market by launching the mobile platform called Android for mobile devices like PDA, net books and smart phones on 5th November, 2007 [13]. It is an open development Linux based platform. A Text-to-Speech engine is also provided with the Android mobile phones. Android applications can be

developed using Windows, Mac OS and Linux systems, thus no special hardware is required. The most recommended IDE for developing Android apps is Eclipse. Dalvik is the virtual machine environment for mobile devices created by Google, and when projects are compiled, each application runs on its own VM, not on the Java VM [4]. Dalvik Virtual Machine (DVM) is the one important feature which is optimized for low memory requirement [13]. Main features of Android operating system are:

- Free use and adaptation of operating system to manufactures of mobile devices.
- Optimized use of memory with DVM.
- High quality of audio visual content.
- Quick and easy development of applications using development tools and rich database of software libraries.

The architecture of Android OS is divided into five layers, shown in Fig 1.

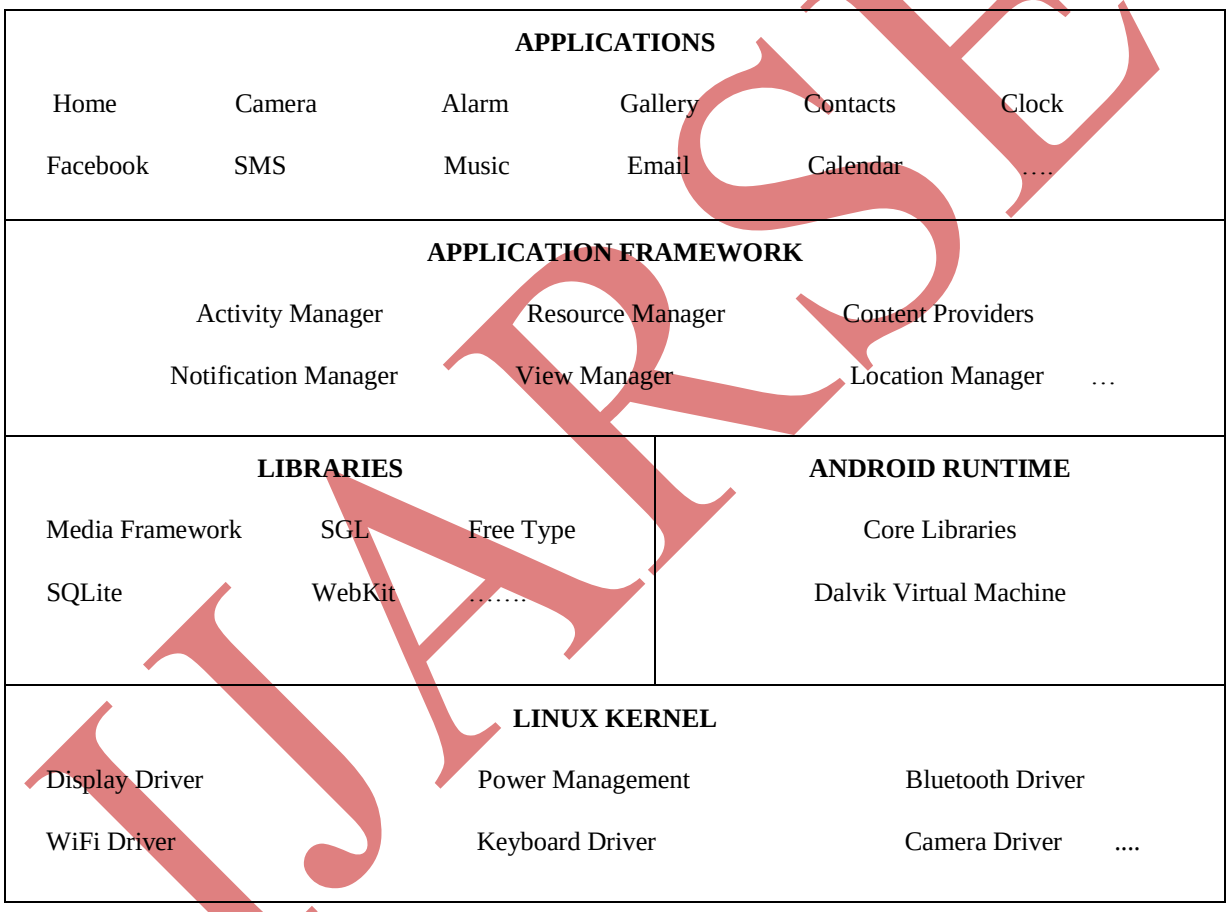

Fig. 1: Android Architecture

a) Application layer: This layer of Android OS is visible to end user, and consists of user applications like camera, alarms, contacts, gallery, email, SMS, calendars, maps, browser etc. The application layer includes basic applications which come with the operating system. All Android applications are written using Java programming language.

b) Framework: Framework is extensible set of software components used by all applications in the operating system.

c) Libraries: Android includes a set of C/C++ libraries used by various components of the Android system. These capabilities are exposed to developers through the Android application framework.

d) Android Runtime: All applications are written in the Java programming language. Dalvik Virtual Machine (DVM) forms the main part of the executive system environment [4].

e) Linux Kernel: The last architecture layer of Android operating system is kernel based on Linux OS, which serves as a hardware abstraction layer between the hardware and the rest of the software stack. The main core system services provided by this layer are memory management, process management, security model, and network system and driver model. This layer consists of drivers like WiFi drivers, keyboard drivers, audio drivers, display drivers etc [15].

III. REVIEW OF LITERATURE ON ANDROID OPERATING SYSTEM

3.1 Android Operating System

A layered approach for application development in Android operating system where they can develop Android application written in Java Programming language to support the nature of the lightweight mobile operating systems is discussed. Their analysis is lightweight SQLite relational database is used for developing Android applications. Holla and Katti (2012) also study Android architecture for developing mobile applications, the security framework of Android operating system and the protection of the applications from the malicious attributes [6]. Mohini et al. (2013) presents a review on Android architecture and its security issues. Authors conclude that Android provides more security than other mobile phone because Android platform is multitasking software, means no application will gain critical access to the components of UNIX based OS which is the most secure OS. Authors analyze that Android has very few restrictions for its developers for developing an application, but for security issues the developers need a unique signature to publish their application on market [14]. Liu and Yu (2011) research that Google launched android, an open source OS based on Linux kernel which acts as an abstraction layer between the hardware and the rest of the software stack. Authors discuss the Android architecture and say that the core system services like security, memory management, process management, driver model are provided by the Linux kernel. Authors also discuss the application framework of Android OS in which the applications are written by Java programming language and run on a Dalvik Virtual Machine (DVM) which has been redesigned and optimized by Google for the hardware features of mobile devices [15]. The power management framework that is used in the Android is discussed by Kundu and Paul (2010). Authors discuss Android architecture with Java code for Dalvik and the .apk format contained in all Android developed applications, also compared the performance of Android Java and Sun embedded JVM which is running on the Angstrom Linux. Their analysis is Android applications are more energy efficient by implementing an optimized dynamic JIT compiler in Dalvik JVM [7]. Primorac and Russo (2012) focus on the architecture of the Android mobile phones. Author's survey that all applications are written in the Java programming language and Dalvik Virtual Machine (DVM) forms the main part of the executive system environment. They also discuss the integration of the speech recognition application in Android mobile devices which enables easier and faster use of smart phones for the elderly, and persons with various disabilities, would have the opportunity to participate in the technological present and feel the benefits of smart phones [4]. Various aspects for the development of

Android applications, the modules and their functions in the Android architecture are presented by Khalil et al. (2012). Authors also proposed system for a voiced based text messaging system utilizing Android phones, and the software engineering challenges. They also discuss Speech Synthesis application which converts the text into either an audio clip to be saved or to be played back on the spot [8].

3.2 Comparison Of Android And Other Operating System

Goadrich and Rogers (2011) present various aspects for the development of smartphone applications. Authors describe the comparison of the android operating system and iOS. While doing comparison, author's analysis that Eclipse with Java is the most popular development environment used for creating Android applications which is more user friendly than Objective-C language with Xcode IDE used for developing iOS applications [5]. The analysis that the speech engine used in iOS produce more natural compared to Android speech engine, but in voice clarity Android scored 90% presented by Al-Saud and Al-Khalifa (2012) while studying the text to speech synthesis of two different speech engines used in current mobile phones (Android and iOS). Authors evaluated the comparison for the text to speech synthesis application developed for the Arabic language [3]. Google entered into the mobile market by launching the mobile platform called Android for mobile devices like PDA, net books and smart phones on 5th November, 2007 as presented by Gandhewar and Sheikh (2010). Authors discuss the Android architecture, its features and conclude that Dalvik Virtual Machine (DVM) is the one important feature which is optimized for low memory requirement. Also they review the comparison of Android with Symbian OS (mostly run in Nokia mobile phones) and Windows mobile and concluded that Android is superior and will become a leader in the mobile platform [13].

3.3 Android Operating System With Integrated Tts Applications

A Bengali Text to speech synthesizer for the Android operating system is developed by Mukherjee and Mandal (2012). Authors describe the implementation of a Bengali speech synthesizer on a mobile device with limited computing power, storage and constrained battery life. ESNOLA (Epoch Synchronous Non Overlap Add) based Concatenative Speech synthesis technique has been used for the speech generation for implementing a fast and small TTS application for the mobile with Partnemes as the smallest units for the concatenation [2]. Gopi et al. (2013) develop Text to speech synthesizer (TTS) for Android platform. Authors implement the TTS for the Malayalam language and use concatenative speech synthesizer technique for developing their application in order to get the two qualities of the output synthesized speech: intelligibility and naturalness. ESNOLA (Epoch Synchronous Non Overlap Add) based Concatenative Speech synthesis technique has been used for the speech generation for implementing TTS application for the mobile with Partnemes as the smallest units for the concatenation [10]. TTS for English and Hindi language on an Android environment is developed by Ahlawat and Dahiya (2013). For Hindi TTS, authors present a two layer process by first getting the input text in Hindi language and then map this whole Hindi data into English language. Authors use concatenative speech synthesis technique in order to get the naturalness quality in the synthetic speech, and the basic unit of speech synthesis used is the phonemes of the English language. Authors separate the input text into English phonemes, stores in the speech database and then generate the synthesized output speech by concatenating the corresponding phonemes stored in the speech database [16]. A bilingual TTS System on Android operating system converts the text into Thai language and English language separately and then plays an audio file for that. Authors develop a

bi-lingual Thai-English text to speech synthesis (TTS) system for Android which synthesizes acceptably natural and highly smoothed speech at a fast response. Saychum et al. (2012) use the hidden Markov model (HMM) based speech unit for the TTS system which processes Thai and English text separately [11]. A Thai speech synthesizer on a mobile device based on Flite, a unit concatenation synthesizer for Thai, an open source synthesis library suitable for implementing a fast and small TTS application is implemented by Wongpatikaseree et al. (2009). They develop a text to speech (TTS) application that can produce an output speech in real time on an average smart phone, focusing more on speed rather than sound quality, also present the comparison of their Filte_Thai TTS and HMM based speech synthesizer, both in terms of speed and sound quality [1]. Wongpatikaseree et al. (2010) study a Thai Text-to-Speech System on mobile devices and found that computational time for the limited resource systems like mobile devices has to be reduced, hence decreased quality of synthesized output sound. Authors use hybrid diphone a speech unit and nonsense carrier sentence a technique to prepare a speech corpus, to improve the quality of sound in terms of intelligibility. Authors survey that TTS system on mobiles devices suffers more from the concatenating joints as it has limited resources to apply a smoothing technique, so technique to prepare a speech corpus with carrier sentences provides a clearer pronunciation than using natural sentences and is more suitable for a unit concatenation technique used in Flite_Thai [12]. The application text to speech synthesis on Android mobile phones for people who are blind or visually impaired is discussed by Shaik et al. (2010). Authors implement and perform the usability study on a fully integrated application to provide mobile access to printed texts for people who are blind or visually impaired by using Text to Speech Synthesis [9]. Authors discuss an application of Android which accepts the word in his voice then searches the word in its mobile dictionary and gets its meaning through voice. Mhamunkar et al. (2013) present the speech to text and text to speech conversion for searching a word meaning through voice. Authors search the word meaning in the mobile dictionary, if not found then search the meaning of the given text over the Wikipedia and stores in the temporary storage for some period of time and generate the synthetic speech output [17]. Authors incorporate the speech synthesis application in the mobile platform for E-learning. The authors use HMM technique for developing the text to speech synthesis for an African language. Roux et al. (2010) says that to read a portion of text aloud the user simply drags a finger from left to right over the text to create a selection, the selection can be further expanded by moving the finger up or down the screen and thus making the selection text to read aloud by lifting up the finger from the screen [18].

IV. CONCLUSION

This paper discuss about the most popular and widely used Android operating system. The Android OS is being used by various mobile manufacturers. Since Android has a very few restrictions for developers, so many applications can be developed for it easily and only a unique signature is required to publish their application on market. The paper reviews Android architecture, comparison of Android OS with iOS, Symbian OS (mostly run in Nokia mobile phones) and Windows mobile and text to speech synthesis in Android OS that can produce an output speech in almost real time on the Android based smart phones, tablets etc. The TTS is an important area of research now-a-days as it is helpful not only for visually challenged people but also for normal people who can use this application while performing various other activities like driving, jogging, etc.

REFERENCES

[1] K. Wongpatikaseree, A. Ratikan, A. Thangthai, A. Chotimongkol and C. Nattee, *A Real-time Thai Speech Synthesizer on a Mobile Device*, Proc. 8th IEEE Conference on Symposium on Natural Language Processing (SNLP), Bangkok, 2009, 42-47.

[2] S. Mukherjee and S.K.D. Mandal, *A Bengali Speech synthesizer on Android OS*, Proc. 1st ACM Workshop on Speech and Multimodal Interaction in Assistive Environments (SMIAE), Jeju, Republic of Korea, 2012, 43-46.

[3] N.B. Al-Saud, and H.S. Al-Khalifa, *An Initial Comparative Study of Arabic Speech Synthesis Engines in iOS and Android*, Proc. 14th International Conference on Information Integration and Web-Based Applications & Services (IIWAS), Bali, Indonesia, 2012, 411-414.

[4] S. Primorac and M. Russo, *Android application for sending SMS messages with speech recognition interface*, Proc. 35th IEEE International Convention on Information and Communication Technology, Electronics and Microelectronics, MIPRO, Opatija, Croatia, 2012, 1763-1767.

[5] M.H. Goadrich and M.P. Rogers, *Smart Smartphone Development: iOS versus Android*, Proc. 42nd ACM Technical Symposium on Computer Science Education, Special Interest Group on Computer Science Education (SIGCSE), Dallas, Texas, USA, 2011, 607-612.

[6] S. Holla and M.M. Katti, *Android based mobile application development and its Security*, International Journal of Computer Trends and Technology (IJCTT), 3(3), 2012, 486-490.

[7] T.K. Kundu and K. Paul, *Android on Mobile Devices: An Energy perspective*, Proc. 10th IEEE International Conference on Computer and Information Technology (CIT), Bradford, 2010, 2421-2426.

[8] R.T. Khalil, A.F. Khalifeh and K.A. Darabkh, *Mobile-Free Driving with Android Phones: System Design and Performance Evaluation*, Proc. 9th IEEE International Multi-Conference on Systems, Signals and Devices, Chemnitz, 2012, 1-6.

[9] A.S. Shaik, G. Hossain and M. Yeasin, *Design, Development and Performance Evaluation of Reconfigured Mobile Android Phone for People Who are Blind or Visually Impaired*, Proc. 28th ACM International Conference on Design of Communication, SIGDOC, S.Carlos, 2010, 159-166.

[10] A. Gopi, P. Shobana, T. Sajini and V.K. Bhadran, *Implementation of Malayalam Text to Speech Using Concatenative Based TTS for Android Platform*, Proc. IEEE International Conference on Control Communication and Computing (ICCC), Thiruvananthapuram, Kerala, India, 2013, 184-189.

[11] S. Saychum, A. Thangthai, P. Janjoi, N. Thatphithakkul, C. Wutiwiwatchai, P. Lamsrichan and T. Kobayashi, *A Bi-lingual Thai-English TTS System on Android Mobile Devices*, Proc. 9th IEEE International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTICON), Phetchaburi, 2012, 1-4.

[12] K. Wongpatikaseree, A. Ratikan, A. Thangthai, A. Chotimongkol, C. Nattee, T. Theeramunkong and T. Kobayashi, *A Hybrid Diphone Speech Unit and a Speech Corpus Construction Technique for a Thai Text-to-Speech System on Mobile Devices*, Proc. IEEE International Conference on Electrical

Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTICON), Chaing Mai, 2010, 1089-1093.

[13] N. Gandhewar and R. Sheikh, *Google Android: An Emerging Software Platform for Mobile Devices*, International Journal on Computer Science and Engineering (IJCSE), NCICT Special Issue, ISSN: 0975-3397, 2010, 12-17.

[14] T. Mohini, S.A. Kumar and G. Nitesh, *Review on Android and Smartphone Security*, International Science Congress Association (ISCA) Research Journal of Computer and Information Technology Sciences, 1(6), 2013, 12-19.

[15] J. Liu and J. Yu, *Research on Development of Android Applications*, Proc. 4th IEEE International Conference on Intelligent Networks and Intelligent Systems (ICINIS), Kunming, China, 2011, 69-72.

[16] S. Ahlawat and R. Dahiya, *A Novel Approach of Text To Speech Conversion Under Android Environment*, International Journal of Computer Science & Management Studies (IJCSMS), 13(5), 2013, 189-193.

[17] P.V. Mhamunkar, K.S. Bansode and L.S. Naik, *Android Application to get Word Meaning through Voice*, International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), 2(2), 2013, 572-575.

[18] J.C. Roux, P.E. Scholtz, D. Klop, C. Povlsen, B. Jongejan and A. Magnusdottir, *Incorporating Speech Synthesis in the Development of a Mobile Platform for E-learning*, Proc. 7th International Conference on Language Resources and Evaluation (LREC), Valletta, Malta, 2010, 1507-1510.

[19] S. Kiruthiga and K. Krishnamoorthy, *Annotating Speech Corpus for Prosody Modeling in Indian Language Text to Speech Systems*, International Journal of Computer Science Issues (IJCSI), 9(1), 2012, 104-108.