

Expedite Life with Android Device: A Multi-Sensor and Multi-Utility Mobile Application for Making Life Easy

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Abstract— This paper presents a wireless sensor multi-utility and multi-sensor mobile application which is combining the utilities of sensors and device hardware to leverage user experience. Android Devices are equipped with sensors which provide ability to sense environment, position and motion of a device. Raw data is provided by the sensors on device which can be fused together to create amazing utilities. The proposed system provides user with a interface to register with the application. After successful login user is prompted with a menu of choices sensors, Bluetooth, Wifi, Camera, Voice recorder, Text-to-speech utility, Compass, Detect movement, Tracking current location via GPS, Detecting connectivity, SMS utility, vibrate the device and browsing capability from within single application. Bluetooth and Wi-Fi are the wireless technology standards for communication. Voice recorder is going to use the microphone for recording the voice and it can be played back. Text-to-Speech is going to speak up the same data fed by user. Current location of device is tracked by either Cell tower annotation or GPS. Short Message Service is a service which is used to send text messages. From menu of application camera is launched and picture can be clicked. In case user forgets password an e-mail with the default username and password settings can be sent from within the app to the user. This paper is describing a mobile application which is beneficial for a large group of users. Users of this app fall in a broad category ranging from a layman to person involved in extensive calculation of physical or topographical variations on the surface of earth.

Keywords— Multi-sensor; Fusion of sensors; android sensors; GPS; Android SMS; Android Wi-Fi; Camera; Android Voice Recorder; Android Text-to-Speech; Android Detecting direction; Detecting motion with device; Tilt detection with Android.

I. INTRODUCTION

Sensor is anything which can sense or detect. It can be rightly defined as a converter which measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument^[1].

In general, sensors can be categorized into following types^[2]:

- Acoustic, Sound Vibration
- Automotive, transportation
- Chemical
- Electric current, electric potential, magnetic, radio
- Environment, weather, moisture, humidity

- Flow, fluid velocity
- Ionizing radiation, subatomic particles
- Navigation instruments
- Position, angle, displacement, distance, speed, acceleration
- Optical, light, imaging, photon
- Pressure
- Force, density, level
- Thermal, heat, temperature
- Proximity, presence
- Sensor Technology
- Other sensors

Sensors available on android devices can be accessed by Android Sensor framework^[3]. The framework contains classes and interfaces which can be used to retrieve the output. These results can be fused together to get useful information. Sensors on device can be hardware-based or software-based. Hardware sensors are physical components present in the device. Software-based sensors mimic hardware sensors but they are actually not present on the device.

Android platform provides three broad categories of sensors namely:

- Motion Sensors: Motion sensors measures acceleration and rotational forces along three axes.
- Position Sensors: Position sensors measures the position and relative changes in position of device
- Environment Sensors: These sensors measures the environmental conditions like illumination

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength radio transmissions in the ISM band from 2400–2480 MHz) from fixed and mobile devices, creating personal area networks (PANs) with high levels of security^[4]. Created by telecom vendor Ericsson in 1994,^[9] it was originally conceived as a wireless alternative to RS-232 data cables. It can connect several devices, overcoming problems of synchronization.

The word "Bluetooth" is an anglicized version of the Scandinavian *Blåtand/Blåtann*, the epithet of the tenth-century king Harald I of Denmark and parts of Norway who united dissonant Danish tribes into a single kingdom. The idea of this name was proposed by Jim Kardach who developed a system that would allow mobile phones to communicate with computers (at the time he was reading Frans Gunnar Bengtsson's historical novel *The Long Ships* about Vikings and king Harald Bluetooth).^{[5][6]} The implication is that Bluetooth does the same with communications protocols, uniting them into one universal standard^{[7][8]}

A master Bluetooth device can communicate with a maximum of seven devices in a piconet (an ad-hoc computer network using Bluetooth technology), though not all devices reach this maximum. The devices can switch roles, by agreement, and the slave can become the master (for example, a headset initiating a connection to a phone will necessarily begin as master, as initiator of the connection; but may subsequently prefer to be slave).

Wi-Fi (also spelled *Wifi* or *Wi-Fi*) is a popular technology that allows an electronic device to exchange data wirelessly (using radio waves) over a computer network, including high-speed Internet connections^[10]. The Wi-Fi Alliance defines Wi-Fi as any "wireless local area network (WLAN) products that are based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards".^[11]

A Wi-Fi-enabled device can connect to the Internet when within range of a wireless network which is configured to permit this. The coverage of one or more (interconnected) access points — called hotspots — can extend from an area as small as a few rooms to as large as many square miles. Coverage in the larger area may require a group of access points with overlapping coverage^[10].

Short Message Service (SMS) is a text messaging service component of phone, web, or mobile communication systems, using standardized communications protocols that allow the exchange of short text messages between fixed line or mobile phone devices.^[12]

SMS is the most widely used data application in the world, with 3.5 billion active users, or 78% of all mobile phone subscribers.^[13] The term "SMS" is used as an acronym for all types of short text messaging and the user activity itself in many parts of the world. SMS is also employed in direct marketing, known as SMS marketing^[14]

Short message service is a mechanism of delivery of short messages over the mobile networks. It is a store and forward way of transmitting messages to and from mobiles. The message (text only) from the sending mobile is stored in a central short message center (SMS) which then forwards it to the destination mobile. This means that in the case that the recipient is not available; the short message is stored and can be sent later. Each short message can be no longer than 160 characters. These characters can be text (alphanumeric) or binary Non-Text Short messages. An interesting feature of SMS is return receipts. This means that the sender, if wishes, can get a small message notifying

if the short message was delivered to the intended recipient. Since SMS used signaling channel as opposed to dedicated channels, these messages can be sent/received simultaneously with the voice/data/fax service over a GSM network. SMS supports national and international roaming. This means that you can send short messages to any other GSM mobile user around the world. With the PCS networks based on all the three technologies, GSM, CDMA and TDMA supporting SMS, SMS is more or less a universal mobile data service.

The SMC (Short Message Center) is the entity which does the job of store and forward of messages to and from the mobile station. The SME (Short Message Entity) which can be located in the fixed network or a mobile station receives and sends short messages.

The SMS GWMS (SMS gateway MSC) is a gateway MSC that can also receive short messages. The gateway MSC is a mobile network's point of contact with other networks. On receiving the short message from the short message center, GMSC uses the SS7 network to interrogate the current position of the mobile station from the HLR, the home location register^[15].

HLR is the main database in a mobile network. It holds information of the subscription profile of the mobile and also about the routing information for the subscriber, i.e. the area (covered by a MSC) where the mobile is currently situated. The GMSC is thus able to pass on the message to the correct MSC.

MSC (Mobile Switching Center) is the entity in a GSM network which does the job of switching connections between mobile stations or between mobile stations and the fixed network.

A VLR (Visitor Location Register) corresponds to each MSC and contains temporary information about the mobile, information like mobile identification and the cell (or a group of cells) where the mobile is currently situated. Using information from the VLR the MSC is able to switch the information (short message) to the corresponding BSS (Base Station System, BSC + BTSs), which transmits the short message to the mobile. The BSS consists of transceivers, which send and receive information over the air interface, to and from the mobile station. This information is passed over the signaling channels so the mobile can receive messages even if a voice or data call is going on

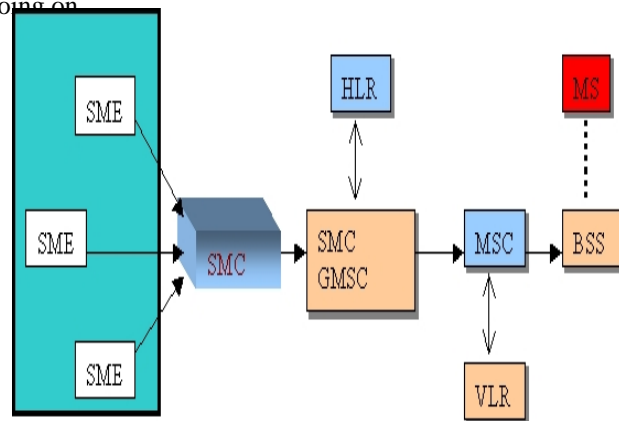


Fig 1, Shows a typical organization of network elements in a GSM network supporting SMS

TTS or (Text-to-speech) feature is added in android platform with version 1.6 which allows device to speak in different languages. This is also known as “Speech Synthesis”.

The TTS engine that ships with the Android platform supports a number of languages: English, French, German, Italian and Spanish. Also, depending on which side of the Atlantic you are on, American and British accents for English are both supported [16].

The TTS engine needs to know which language to speak, as a word like "Paris", for example, is pronounced differently in French and English. So the voice and dictionary are language-specific resources that need to be loaded before the engine can start to speak.

When developing a location-aware application for Android, you can utilize GPS and Android's Network Location Provider to acquire the user location. Although GPS is most accurate, it only works outdoors; it quickly consumes battery power, and doesn't return the location as quickly as users want. Android's Network Location Provider determines user location using cell tower and Wi-Fi signals, providing location information in a way that works indoors and outdoors, responds faster, and uses less battery power. To obtain the user location in your application, you can use both GPS and the Network Location Provider, or just one [17].

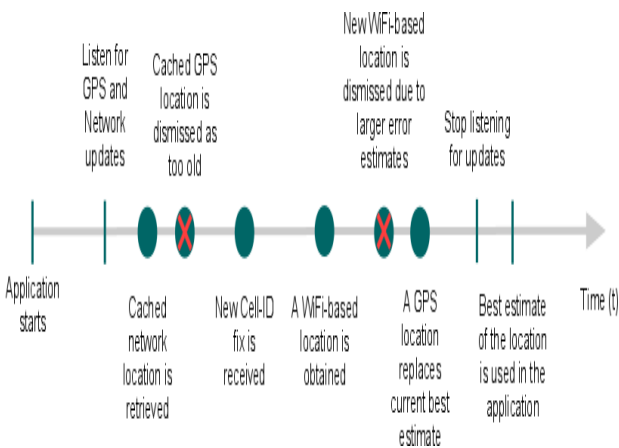


Fig 2 A timeline representing the window in which an application listens for location updates.

The Android multimedia framework includes support for playing variety of common media types, so that you can easily integrate audio, video and images into your applications. You can play audio or video from media files stored in your application's resources (raw resources), from standalone files in the file-system, or from a data stream arriving over a network connection, all using MediaPlayer APIs [18].

The Android multimedia framework includes support for capturing and encoding a variety of common audio formats, so that you can easily integrate audio into your applications. You can record audio using the MediaRecorder APIs if supported by the device hardware [19].

The Android framework includes support for various cameras and camera features available on devices, allowing you to capture pictures and videos in your applications. The

Android framework supports capturing images and video through the Camera API or camera Intent [20].

II. SYSTEM ARCHITECTURE

A platform is an underlying computer system on which application programs can run. A computing platform includes a hardware architecture and a software framework (including application frameworks), where the combination allows software to run. Typical platforms include a computer architecture, operating system and Runtime libraries. [21]

A platform is a crucial element in software development. A platform might be simply defined as a place to launch software. The platform provider offers the software developer an undertaking that logic code (a general term for bytecode, source code and machine code) will run consistently as long as the platform is in place [22].

A platform consists of an operating system, the computer system' coordinating program, which in turn is built on the instruction set for a processor or microprocessor, the hardware that performs logic operations and manages data movement in the computer [23].

As far as android is concerned, Android is neither a language nor a mere operating system powering devices. Android is a platform. Android platform runs programs written in java language. The source code is converted into .dex i.e. Dalvik executables which are deployed in a virtual machine called DVM (Dalvik Virtual Machine). Smartphone and tablet computers are powered by Android operating system.

Android platform architecture includes five layers [24]:

A. Applications layer

It includes all the native applications which were shipped with device and the third party applications

B. Application Framework layer

It includes the application managers like windows manager, location manager, notification manager etc.

These allow developers to use various capabilities of Android operating system

C. Libraries

It includes the core libraries written in C/C++ such as SGL for graphics, SQLite for native database support etc.

D. Android Runtime

It is the engine which empowers applications. It includes Dalvik virtual machine and core android libraries.

E. Linux kernel

It provides abstraction layer between hardware and remaining stack. It includes device drivers and is responsible for handling core services such as power management, memory management etc.

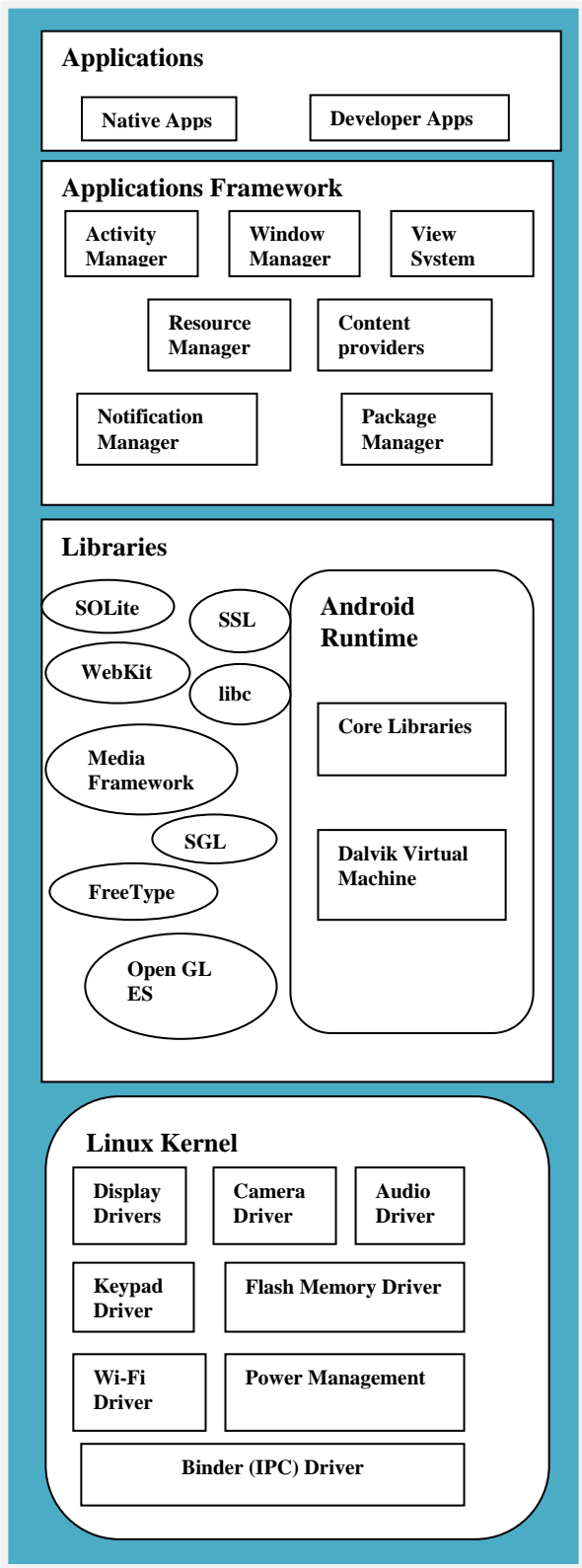


Fig 3 Android Platform Architecture

III. RELATED WORK

Lot of work is carried out as far as sensors, Bluetooth, camera, recorder etc, have been carried out but bringing them altogether was the challenge for this app. Some of the works already done in these fields are described in following lines.

Android Sensor Box detects all available sensors on your Android device, and vividly shows you how they work with amazing graphics. Android Sensor Box also tells you which sensors are supported by the hardware, and provides extremely useful sensor tools that could be used in our daily life [25]

AndroSensor is the absolute all-in-one diagnostic tool that lets you know virtually everything about your device's status. AndroSensor supports all the sensors an android device can have and it will tell you which of them are not supported by your hardware. View in a single screen the data from all devices' sensors in real time. Graphical and text output available for each sensor (graphs are not available for proximity, location and battery info) [26].

Lot of applications are working on the principle of Bluetooth and Wi-Fi. Location Based Reminder in one of the applications based on GPS.SMS is one such utility available in every device and we are using it on a daily basis. Previous work provided the basis of construction of this application.

IV. PROPOSED MODEL

This application is going to integrate different utilities of Android together to make life easier than it is. It shall collaborate different modules which we can individually look as:

- Physical Sensors
- Fusion of Sensors i.e. combining different sensors to get some viable results.
- Bluetooth
- Wifi
- GPS location tracker
- Text-to-Speech
- Voice Recorder
- Camera
- SMS
- Privacy of every user through password verification.

Design of this application included few goals. First goal was to make available all the sensors under one menu. User is provided with a menu of choices from which he/she can make choice according to his/her requirement.

Second goal was to use different sensors to come together and do something useful for a user who doesn't understand what a sensor is all about or its readings are meant for. This included a compass for detecting direction, detecting movement in device and draw graph according to it and detecting tilt of device where a ball shifts its position according to tilt of device.

Third goal was to enable and disable Bluetooth from this application itself. Along with the ease of use to access Bluetooth one can connect other devices with Bluetooth and can carry on conversation with a chat utility based on Bluetooth connection.

Fourth goal was to give a control over Wi-Fi. This section provides user to turn on and off Wi-Fi from application itself. There is no need to go to settings option of device and make device Wi-Fi enabled.

Fifth goal was for Location tracking. This will pop up the latitude and longitude values of current location. Tracking is done via GPS (Global Positioning System). Any layman is now going to know where he/she is. Again users of research and development area can find it useful in their calculations of geo-coordinates. An army man retrieves his location in case of emergency where he cannot wait for the maps to load on screen.

Sixth goal was to include a text-to-speech utility. A tourist or a person who doesn't know how to pronounce a word or alphabet or letter in English can get help from this menu of choices. He/she has to type what he/she wants to hear. Similarly, a person who cannot speak or stammers can make device to speak what he/she want to say.

Seventh goal was to include Voice Recorder. User can record and play back. This choice is included in menu of choices so that a user can make use of microphone of device to record voice. And voice recording has got many advantages. It ranges from a kid recording and playing with his/her phone to a person in intelligence dept. who can silently record a secret conspiracy of any enemy.

Eighth goal was to include Camera in this menu of choices. There is no need to launch camera externally from device's camera option. It can be launched from within application. This gives user flexibility to save or discard the images clicked. Images are stored in internal memory of device. Later on, images can be reloaded from the menu.

Ninth goal was to include the capability of sending SMS from within application. No need to go to messaging tool of device to send text messages. From this multi-utility application text messages can be sent from menu of choices.

Last goal was to include user security and authentication utility. If user is new then sign up as a new user and if user somehow misplaced password or username...User can send a email from application where default settings can be retrieves.

The aim of application was to bring many things under one touch. There are different manufacturers of android devices. Sometimes becomes difficult for users to work around different devices. Say, manufacturer A shall give a menu in device explicitly which can be launched from one touch other manufacturer say, B, has different configuration. For a novice it takes lot of time to configure and get habituated to the configuration when handling a new device. This application can help them.

V. USER INTERFACE

Menu of choices can be touched and selected by user. For sensors user just need to touch the screen and see the output. For Bluetooth, Wi-Fi, GPS location tracker, Voice recorder and camera, buttons are provided user can press and launch these sub-modules respectively. For Text-to-speech, user can type in the box provided and press button to hear the device speak. For SMS, user can enter the contact number and press respective button to send SMS.

Following figures shows some of the screenshots of the application.

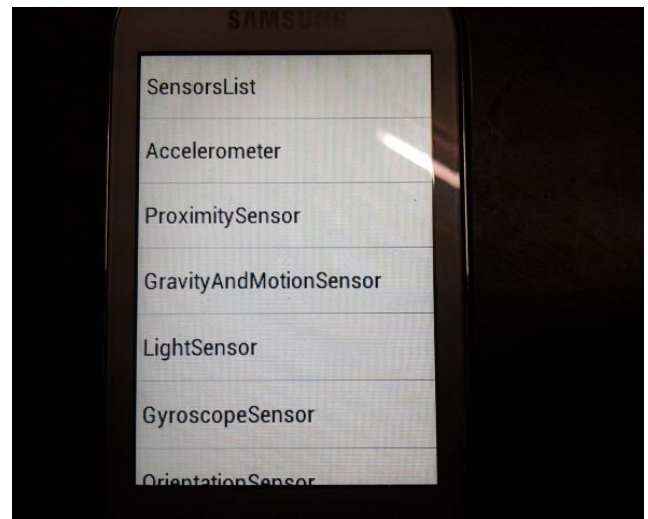


Fig 4 Menu of choices

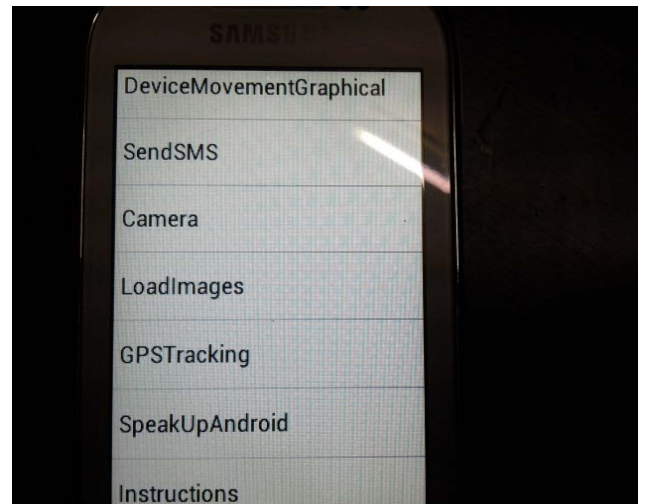


Fig 5 Menu of choices

V. CONCLUSION

This paper presents a practical implementation and integration of different hardware and software capabilities of android powered devices. This paper is based on a research methodology of bringing together different modules under one menu. It makes life of users easy and somewhere it truly shows the smartness of a Smartphone in true essence. This application targets users ranging from a physically disabled person to people who are involved in extensive computations involved in calculating earth's gravitational force. This application supports the devices ranging from Froyo (2.2) to Jelly beans (4.2).

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