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SHERLOCK: Energy Efficient and Continuous Environment Sensing Android Applications

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Abstract - *Now a day's mobile smartphones are used in wide range for various purposes. An application that we are designing is micro-environment sensing platform for smartphone. An application is the platform which records Sensor hints automatically as well as characterizes surrounding of smartphone. We are building a framework which is sensor based which is of user convenience and on the basis of smartphone. Many simple and efficient solutions can be built for Smartphones allowing them to behave according to surroundings.*

Mobile sensors senses and collect vital data from their surroundings which can be utilize at its best. This information reduces unnecessary consumption of battery and optimizes the Smartphone's performance according to its surroundings. In this design we develop android applications using a micro-environment sensing platform: Sherlock. Micro-environment is defined as environment of phone which is about to 10-12 cm. Sherlock is a middleware platform which collects the data acquired by sensors in its current context and makes the data available for developer. The main concepts used in Sherlock are: local placement detection, backing material detection and phone interaction detection. Here we use middleware platform to design and develop applications that will use the sensor hints and simulate the higher level applications.

We develop an application which is both energy optimized and user friendly. The hardware we are using in this platform are GPS, Accelerometer sensors, this platform runs a daemon process on smartphones and provides different information as mobile location, theft detection using sensors, security using pressure sensors, auto call acceptance, process killing for saving battery.

Keywords: *Vibrator, touch screen, camera, gyroscope, proximity sensor, Accelerometer Android, Phone-centric android Application development.*

1. INDRODUCTION

We are living in 21st century which is the century of technology and innovations. Smartphone is an innovative thing that has happened in this world. Today's smartphones come up with wide ranges of sensing computation and storage resources. There are various types of sensors such as Proximity, Accelerometer, Camera, Touch, GPS etc. With the help of this sensor we developed an android application. Most of context aware applications are human centric i.e. the actions performed by users is taken as input and based on that output is determined. (E.g. user is driving, walking, waving hands, indoor/outdoor, at home / in house etc).

Few studies have been done from the phone centric context .i.e. the surroundings of phones is taken as input and based on the data captured and according to that appropriate action takes place.

In this paper, we are developing an application Sherlock, uses phone centric context which works on phone's surrounding i.e. micro-environment capturing data upto approx. 10 to 12 cm. This data is captured using inbuilt sensors available in most of the Smartphones thereby reducing the cost of adding additional sensors.

In previous papers studied, we got some idea to know that all papers target application based on single sensor. The application was made by making use of data gathered by sensors. These applications studied had certain limitation like it consumes more battery as it has to run continuously. As there were no supporting applications for battery saving purpose. So in our paper we are trying to get over these limitations. Our project has certain module like Automatic call picker, Pressure sensor use for security, GPS sensor for location tracing purpose when a wrong pattern or pin entered, soft surface detection in order to activate ringer mode, closed environment identification for battery saving purpose.

As we are using multiple sensors here so we require to write different parsing technic each for sensor we are using. Simillarly, we are taking care of battery optimization.

Our application, a micro-environment sensing platform which automatically records sensor data and provide data to smartphones. The application runs as a daemon process on a smartphone and provides finer-

grained environment data to upper layer applications via programming interfaces.

2. RELATED WORK

The basic aim of micro-environment sensing on smartphones is to provide a more general primitive for new human centric applications, especially in healthcare, behavior monitoring and surface identifying. For example, it is important to ensure that the healthcare monitors are attached to the target user during his daily life, and emerging trends arise to perform such tasks via smartphones. A perceivable smartphone, therefore, would remind its user if it is not carried by its user via, e.g. its built-in speaker. Identifying the phone's micro-environment also opens new possibilities to perform energy saving strategies, which is essential for battery powered smartphones. On detecting being placed in the wooden surface, for instance, it is necessary for phone to make sure that it will not be used in the future, and can switch to certain power saving mode and turn off unnecessary sensors, software and applications. A micro-environment sensor based this android application makes sure with more appropriate inertial based localization and navigation data. GPS helps to estimate user's surrounding. An application deduces phone's fine-grained micro-environment.

3. SYSTEM ARCHTECTURE

As Fig. 1 shows, Sherlock is a daemon process (i.e. the Sherlock process runs continuously in background without interrupting other processes). It captures the data through sensors from hardware layer and sends the captured data to the middleware layer, which determines the micro-environment and simulates accordingly for providing fine-grained environment information to upper layer applications such as Battery manager, Volume adjuster, User behavior detector, and cell phone habit analysis. Sherlock is hierarchical, multistage architecture which provides services to upper level application via programming interface.

Proximity Sensor

A proximity sensor is used for detecting the nearby objects without any physical contact. It emits a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal. There are different types of proximity sensors used for identifying different objects. The maximum distance that this sensor can detect is defined "approximate range". Proximity sensors have a highly reliable and long functional life because they don't include any mechanical parts and there is no physical contact between sensor and the sensed object. Proximity sensors are generally used on Smartphones for detection of accidental touch screen taps when it goes close to ear. The proximity sensors are implemented in Smartphones as Boolean sensors.

Touch Screen

Touch screen is an electronic visual display which senses special stylus or pen and figures. Touchscreen can be use to control how and what should be displayed (e.g. by Zooming the text size, scroll them, for increasing volume etc.). It works in three components

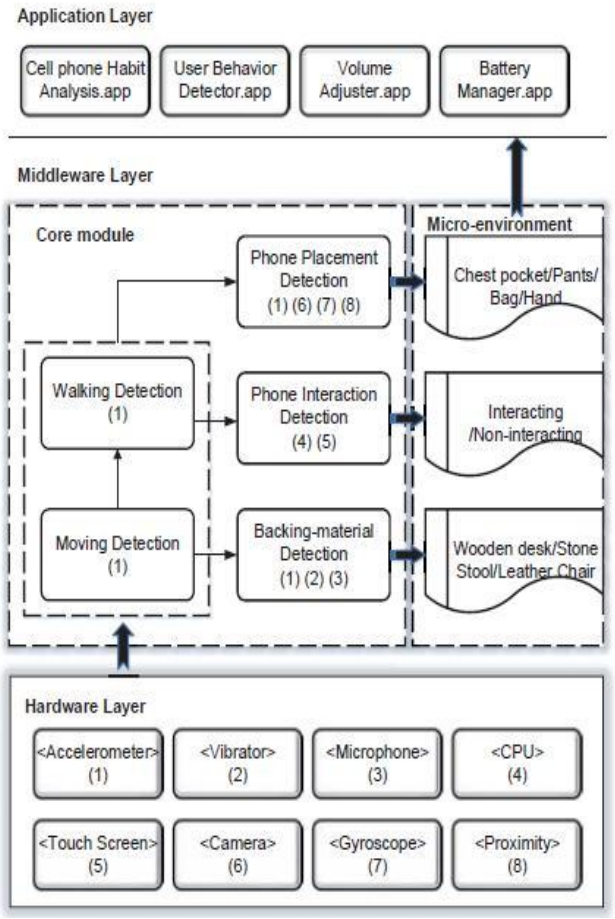

Fig -1: Sherlock System Architecture

- The touch sensor is a panel with a touch responsive surface.
- The controller is a hardware that converts the voltage changes of sensor into the signal that are received by computer or any other device.
- Software, that informs the computers, Smartphones etc. about what is happening on the sensor and the information coming
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Camera

Camera captures the pictures and also records the videos. Mobile phone stores the captured images and videos in DCIM directory in internal memory, we can also store it into the external memory. Nowadays most of the Smartphone uses CMOS image sensor to reduce battery consumption.

The captured images are by default stored with JPEG format, which improves pixel quality. The usual phone camera having fixed focus lenses and smaller sensor limits their performance in poor light.

Magnetic Field Detector

Magnetic field detector measures the strength of earth's magnetic field, that strength is measured in tesla. This sensor measures magnetic field (EMF), it shows current magnetic field values(X, Y, Z) and the length of the vector (X, Y, Z). The values captured by magnetic sensor are categories in two surfaces. Hard surfaces (like wooden desk, metal desk) having always high values compare to soft surfaces (like Sofa, cushions etc.). If the phone (metal) sensor comes in a contact of high magnetic area (metal piece) then it calibrates Mod values that can be used in development of many applications.

Microphone

Microphones are high fidelity sensors that pick up sounds relating to a range of physical phenomena. We can use simple extraction methods for finding parameters that can sensibly map to synthesis algorithms to allow expressive and interactive performance. Microphone captures the sound and converts those sound waves into electricity. Microphone uses electromagnetic induction, capacitance change to produce an electrical signal from sound waves.

4. IMPLEMENTATION

The concept of context awareness and micro-environment sensing can be used to develop many applications based on inbuilt sensors which will be able to simulate the higher level applications of Smartphones.

Automatic call acceptance

It comes under phone interaction detection category. There are some situations in our daily routine when we are not able to pick phone because we need to swipe to pick up a call e.g. stuck in traffic, at railway station, markets etc. In such situations it is possible to pick the call automatically with the help of position of phone with respect to user using proximity sensor. Proximity sensor detects the object in range of 2 to 5 cm.

Closed environment settings

It comes under the local placement detection category. The situations where there is no need of screen light when the phone is in a closed environment like in purse or a bag. So screen light of phone can be turned off while in closed environment. This task can be performed with the help of proximity sensor, thereby reducing the battery consumption.

Noise alert application

Noise alert application comes under the local placement detection concept. The noise around the phone can be monitored using microphone of the phone. This information can be used to inform another user that the area around the phone has crossed a given threshold value. Such an application can be used in medical or teaching areas where we need to monitor the noise levels.

Process kill

This application takes the help of back material detection concept and collects the different surface valves and by comparing it to given threshold it behaves. In process killing applications that have been developed so far just trigger the operating system to search the idle threads or the smaller part of the process and kill them. But we can use threshold set by some values collected by magnetic sensor according to the surface on which it is kept. And this way application can be customized for different surfaces.

Unauthorized access applications

Unauthorized access application works under the phone interaction detection category. It uses the Touchscreen sensor to sense the pressure forces on the screen and returns action. In the field of security many applications can be developed where user can be notified about any unauthorized access. Combined access of screen lock, password retrieval and comparison can help to develop such applications. In this application if the wrong password will be inserted by any user the front camera automatically triggered it captures the photo and save it into the /DCIM directory. E-mail and sms can be triggered from the user's phone to notify any other person about the unauthorized access.

Back material detection

This application works with the magnetic sensors and vibrators for analyzing the back material environment of the phone. As it analyses the back material the application comes under the back material detection category. The surface characterization can be done by acquiring the values obtained by the parameters of magnetic sensors. It will help to increase the volume of phone when it is in ringing mode and on a soft surface.

5. CONCLUSIONS

We present the design, implementation and evaluation of Sherlock, a simple yet practical platform for micro-environment sensing for smartphones via collaboration among built-in sensors. The platform automatically collects sensor hints and characterizes the immediate surroundings of smartphones at centimeter level accuracy, providing fine-grained environment information to upper layer applications. We conduct comprehensive experiments to evaluate our system through a prototype implementation on Android platform. Preliminary experiment results show that Sherlock achieves low energy cost, rapid system deployment, and competitive sensing accuracy.

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