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Simulation and Development of Android Applications using Sherlock Micro-Environment Sensing

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Abstract- **Smartphones are the embodied latest technology in every second hand today. Till now the development of android applications was totally based on human-centric perspective. In order to make Smartphones much smarter, thinking from phone's perspective is important. Many simple and effective solutions can be developed for Smartphones enabling them to behave according to their surroundings. Many attempts have been made in this field. Sensors of mobile are able to sense and collect very important data from their immediate surroundings which can be put to maximum use. This information is used to reduce the unnecessary consumption of battery and optimize 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 the immediate environment of the phone up to 10-12 cms. Sherlock is a middleware platform which collects the data collected by sensors in its current context and makes that information available for developer's use. The main concepts used in Sherlock are: local placement detection, backing material detection and phone interaction detection. We use this middleware platform to design and develop some applications which will use the sensor hints and simulate the higher level applications accordingly.**

Keywords: Android, Sherlock, Smartphones, phone-centric android application development, micro-environment, middleware, mobile sensors

I INDRODUCTION

Development of sensor based applications for mobile has grown rapidly over a decade. Most of the systems developed for the simulation of higher level applications neglect the mobility of users and their user friendliness. Even though certain applications are developed for serving a specific purpose it cannot be kept limited within that context area. Traditional sensor based applications make use of extra components, not feasible for use to most of the users. The sensors embedded in them can serve as an extra advantage for developing additional applications there by fully optimizing its use.

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 cms. This data is captured using inbuilt sensors available in most of the Smartphones thereby reducing the cost of adding additional sensors.

Although some previous works have implemented part of similar functionality for simple environments, they cannot be directly combined to an applicable level for practical use with complicated phone situations and user habits. Although some applications are developed already based on similar concept, but they cannot be used to directly simulate the higher level applications of phone and make them behave according to their surroundings, common habit of users and the current state of the phone.

Sherlock is a middleware platform executable on Smartphones. The applications based on it run as daemon process i.e. run in background and don't interrupt the execution of processes running on phone. The sensors (and actuators) which are used for the development are selected by keeping in mind their availability in most of the Smartphones and ease of implementing them to achieve the goal. Thus it results in improvement in phone's performance levels and also reduces the consumption of power hence creating a much suitable and user friendly environment for the user which is the main aim of this system.

II RELATED WORK

Towards accurate object localization with smart phones

This system is used to work upon the concept of distance determination using the built-in sensors and camera. The application is named CamLoc. The system operates on two photos. It enables user to take two photos of an object with the Smartphone from a fixed point and calculate the global coordinates from them. Such an application can be used in

myriad location-based services. It increases the user-friendliness but the chances of error are increased.

The key concept behind CamLoc is to combine both the readings and photos to calculate the distance between users (Smartphone) to that object. Specifically, after launching the CamLoc application on smart phone and takes the photo of the target object. For the second photo user has to just stretch his arm take another one. CamLoc processes these input images and calculates the scaling ratio of target images of object. Along with this calculation, the acceleration recorded during movement of hand to take the second photo is used to calculate the phone's displacement. The distance between the target and the user is computed finally using the well-known lens formula.

Boosting mobile apps under imbalanced sensing data

This concept introduces an interference framework named SLIM. This is based on some machine learning techniques with a goal to accommodate the imbalanced nature of data collected by sensors. There is a lot of unlabelled data collected by sensors which need to be balanced by similarity-based mapping. It is the first model that considers the imbalanced data in mobile sensing. SLIM is about 12% better than the solutions compared to it.

This model just takes the whole data and compares them to the available labeled data and then characterizes them accordingly. Thus new labeled sets of sensing data are obtained that can be put to better use. The system is highly flexible because of two reasons: for interference it can work upon any combination of the built-in sensors of Smartphone and it adopts the methods of traditional learning as basic learners.

Environment sensing using smart phone

This concept allows the usage of a Smartphone to collect data from other phones or sensors. It is mainly used to monitor the parameters related to climatic conditions such as temperature and humidity. Such parameters are an important factor in the changes of environmental conditions of users surroundings. This value can be obtained using distributed devices in different environments which contain sensors with high-resolution and for transferring that data to smart phones wireless transmitters are used. Bluetooth was chosen as the transmission device as it is available in all Smartphones and will be able to work without the availability of Wi-Fi or any network connection. So this interface applies Bluetooth-based sensor to sense temperature and humidity parameters to monitor the environmental conditions using the android phones.

III 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 (i.e. user interface).

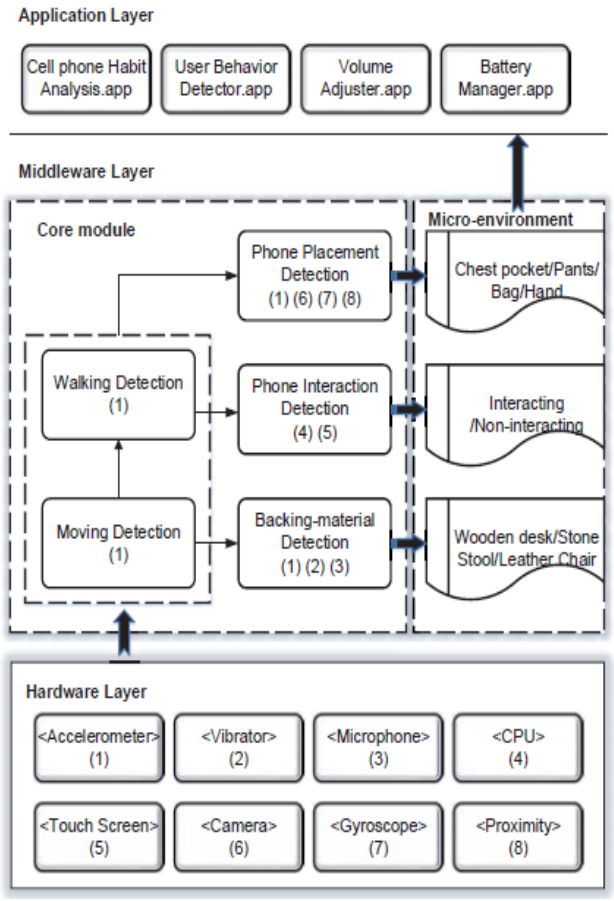

Fig 1. Sherlock System Architecture

IV SENSORS REQUIRED

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 (e.g. metal, plastic). The maximum distance that this sensor can detect is defined “nominal 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 commonly used on Smartphones to detect (and skip) accidental touch screen taps when held to the ear during a call.

The proximity sensors are implemented in Smartphones as Boolean sensors. It returns only two values “NEAR” and “FAR”.

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:

- 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

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 [T].

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 i.e. hard surface and soft surface. 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.

V 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.

VI CONCLUSIONS

The most common problem that Smartphone users face nowadays is rapid consumption of battery. The other drawback of current applications is that they are developed only from the user's perspective. To overcome these drawbacks and optimize the performance of phone a micro-environment sensing framework Sherlock is used to develop some middleware applications from the perspective of phone.
A hierarchical architecture is used for the development process. In addition to that the built-in sensors of Smartphones are also used to record the automatic hints and use those values to perform operations in different applications. They are daemon processes, hence don't interrupt in the functioning of main processes. Over all, the performance is much optimized and battery consumption is also reduced to a considerable extent which is the main goal of this project .

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