Demo: Uno — A Sharing Infrastructure for Smartphone Sensors and Files

Jilong Liao
Electrical Engineering and Computer Science
University of Tennessee
Knoxville, TN 37996, USA
jliao2@utk.edu

Qing Cao
Electrical Engineering and Computer Science
University of Tennessee
Knoxville, TN 37996, USA
cao@utk.edu

Abstract

Current smartphones have been equipped with different kinds of sensors and enhanced by powerful mobile operating systems, such as Android OS, iOS, Windows Mobile, Blackberry and Symbian OS. These advantages, however, are not fully utilized by operating smartphone only in isolation. Therefore, we demonstrate *Uno*, a platform that is specifically designed to allow people to share resources in smartphone environments. *Uno* allows users to cooperate by sharing their files and sensors under a strong privacy protection. The fundamental idea is to map a smartphone to a networked node by the means of tagged objects in the distributed sharing system and to treat sensors and resources as sub-objects to the smartphones. Sensors or resource sharing are based on different attributes' settings in the system. Furthermore, *Uno* also supports a user with multiple smartphones. A *Uno* prototype implemented in Android OS [1] with full features will be shown in this demo.

Categories and Subject Descriptors

C.2.1 [**Computer-Communication Networks**]: Network Architecture and Design—*Wireless communication*

General Terms

Design, Experimentation, Performance

Keywords

Sensor Network, Sensor Sharing System, Smartphone, Distributed System

1 Introduction

Recently, multiple sensors have been integrated into a smartphone: accelerometer, gravity sensor, light sensor, soundmeter, pressure sensor, proximity sensor, etc. Most smartphone sensing applications concentrate on the standalone personal usage of such sensors for various purposes. However, sensors on the smartphone can be much more useful if they are connected and shared by people. Those sensors can not only reduce the cost of deployment but also introduce much more flexibility for application purposes, compared to single-phone uses. For example, in shared environments, location sensors can be used for purposes such as obtaining traffic information, or pinpointing interesting places for traveling purposes. Generally, sensor and file sharing can be very promising for the emergence of a new apps on smartphones.

To accomplish this goal, the role of a smartphone and its sensors are the fundamental issues which should be addressed. However, this goal is challenged by the fact that smartphones contain very sensitive privacy information, such as the phone call history or personal files, that should not be easily shared or used. Traditional ways to share information between computers, therefore, are not suitable for the unique environments of smartphones. Therefore, an object oriented method is proposed in our system prototype *Uno*.

2 System Design

Uno is an object oriented system that uses client/server working model. Clients are mobile smartphones that work on a limited battery while server is always powered, and runs control services, schedules tasks and protects privacy of sensors and files. Each sensor in the smartphone is tagged with several attributes, like owner, device and access list.

Briefly, Uno works as follows. During runtime, a client should contact its server before working on its tasks. Upon receiving such requests, server looks up the client information in its databases. The server contains four databases: users, devices, sensors and resources, which are used to handle the request of the client, and to manage accessibility and authentication issues. Finally, after being approved, the client will share its own sensors and obtain access to the sensors of its neighbors. Obviously, this approach follows a centralized privacy control approach. To ensure that the server keeps records of all smartphones, each smartphone will periodically send out a heartbeat message[2] to the central server so that it is always marked alive in the system and visible to other sharing smartphones.

3 Demonstration Proposal

3.1 General View

In the on-site demonstration, conference audience will be able to first observe an operation tutorial on the Android

SenSys'11, November 1–4, 2011, Seattle, WA, USA.

smartphone, then they will be able to operate the smartphones by themselves.

We will provide five Google Nexus S smartphones which are equipped with ten types of sensors: accelerometer, gravity meter, gyroscope, lightmeter, magnetic field sensor, screen orientation sensor, proximity sensor, location (GPS), soundmeter and vibration sensor. On the other hand, compiled installation package will be made available for download, so that participants can use their own smartphones to carry out similar experiments.

In addition, we have developed a server side GUI that will also be presented during the demonstration to provide additional informatinon on the status of the demo.

3.2 Demonstration Setup

Uno system will be deployed in a public wireless network connected to a single router, where both smartphones and a server will be present. The topology is shown in Figure 1.

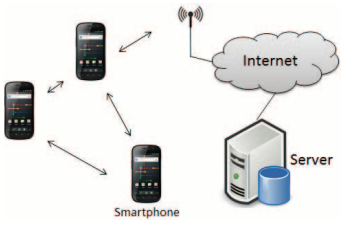

Figure 1. Demo Network Topology

The provided Google Nexus S smartphones will use the *unoAndroid* prototype with the full featured platform which contains the followings:

- *Local Resource Explorer* allows a user to browse its local resource in the local file system in the same way as a Linux file explorer, plus a preview feature.
- *Network Smartphone Explorer* allows smartphone users to browse other sharing resource in the system which are stored in other smartphones. Sensor objects can be found in the smartphone's */Sensors* directory and they are only visible to authenticated viewers.
- *Local Sensor Monitor* gives a monitor view so that the smartphone owner can read the sensor measurements directly.
- *Sensor and Resource Sharing Settings* authorize smartphone owners with the right to set their sensors with three privacy settings: public, private and offline, which means sharing with everyone, sharing only with trusted people, and local use only, correspondingly.
- *Remote Instant Reading and Logging* are the interfaces that allow remote users to access sensor readings. Such users may also request remote logging after they are authorized, a feature will also be demonstrated.
- *File Thumbtack* will cache the target network file that is stored in other smartphones. This operation will be demonstrated together with actions such as copying and pasting.
- *Multiple Smartphones per User* offer convenient management of smartphones owned by a single owner that allows each phone to operate multiple other phones.

3.3 Expected Experience

Once this platform is started, audience can set up their own sharing settings. After that, other people can see them in the network, then choose either to read instant values or to obtain a file. By using file thumbtack features, people can retrieve, for example, the files that contain logged sensor readings. The relevant screenshots are shown in Figure 2.

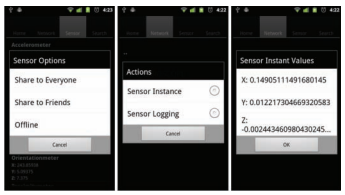

Figure 2. *unoAndriod* Sensor Actions

At the same time, on the owner side, they can monitor their own real time sensor readings. They can also change the access privilege settings of other users. Such changes are propagated immediately to all other smartphones in the system, as illustrated in Figure 3.

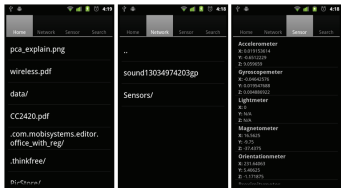

Figure 3. *unoAndroid* Main Views

Finally, on the server side, an administrator can monitor every connection to the server so that certain exceptional cases can be handled, which recovers the system from failure and protects user privacy in emergency.

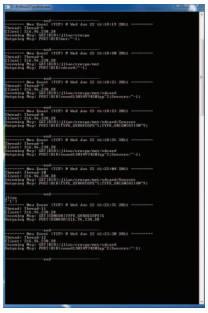

Figure 4. Server Monitor Screenshot

4 Acknowledgements

This paper was supported in part by National Science Foundation under Grant NSF CNS 0953238.

5 References

[1] http://www.android.com.

[2] S. Ghemawat, H. Gobioff, and S. Leung. The Google File System. In *ACM SIGOPS Operating Systems Review*, volume 37, pages 29–43. ACM, 2003.