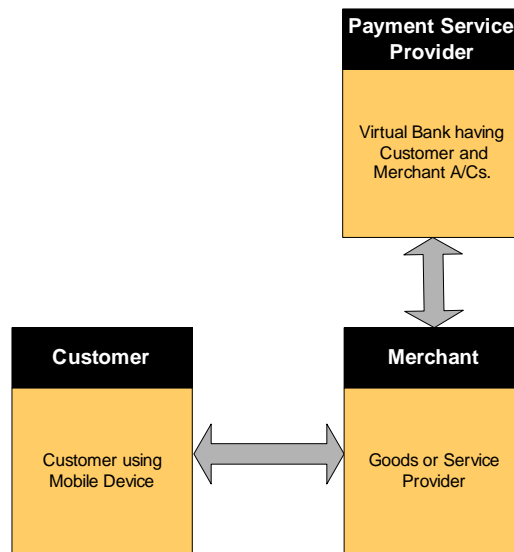


RoverPal - A Mobile Payment Application

Introduction

Online shopping has been a favorable experience with most of us. Still, we come across instances where we are out on shopping and we run out of cash and have forgot to carry the card/s. Mobile shopping is the solution suggested by the technology addressing this problem. Mobile shopping is a concept where we can shop anywhere and pay using the mobile device in our pocket. This kind of payment is known as Mobile Payment. Mobile payment is nothing but processing a payment for goods or services with a mobile device such as a mobile phone, Personal Digital Assistant (PDA), or other such device. The [Figure 1](#) shows the Mobile Payment System Architecture.

Figure 1 Mobile Payment System Architecture



The Open Handset Alliance™, a group of more than 30 technology and mobile companies have come together to accelerate innovation in mobile and offer consumers a richer, less expensive, and better mobile experience. Together they have developed Android™, the first complete, open, and free mobile platform. Android is a Linux-based and open source, and aspects of the platform will be made available to handset manufacturers for free under the Apache license. Therefore, now the market is ready for a number of Android based applications that support mobile payment.

Objective

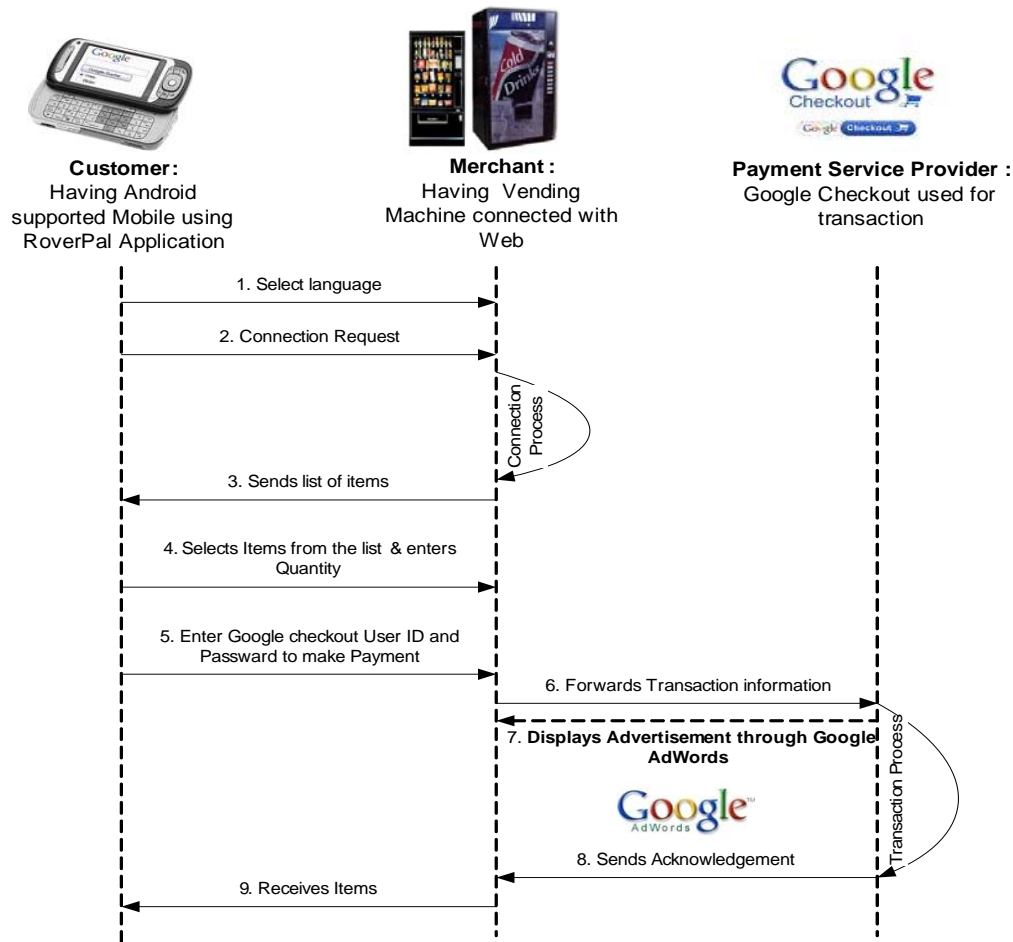
This white paper aims at providing an overview on the development and usage of a mobile payment application for mobile phones (using Android OS). The application is named as RoverPal. RoverPal is developed for using mobile payment at vending machines.

RoverPal - A mobile payment application

RoverPal is an application that implements Mobile Payment concept and uses the Android platform. RoverPal processes a payment for goods and services using an Android specific mobile device from the Vending Machine.

The following items represent the major components of the RoverPal System. See [Figure 2](#).

Figure 2 RoverPal System Overview

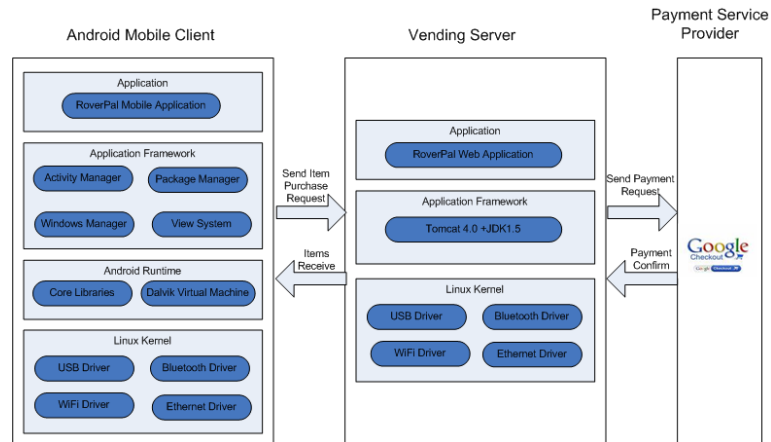


As shown in the figure, the application consists of a mobile client (Android), a vending machine server (TomCat) and a payment service provider (Google Checkout). The RoverPal application on the mobile client initiates the process by requesting the product details from the vending machine server. The RoverPal application on the vending machine server provides the relevant information. The mobile client then orders the items required. After order confirmation, the client will be provided a payment gateway to pay. The vending machine server already has the merchant account with the payment service provider. The mobile client will create a new account (in case of a new user) and pays using that payment gateway on the mobile device itself. After the vending machine server receives the payment confirmation from the payment service provider, it will issue the items ordered.

RoverPal System Insight

This section will discuss on some more details for each of the modules shown in the previous section. See the [Figure 3](#) below for system structure in detail.

Figure 3 RoverPal System Insight



RoverPal Mobile Client (Android)

The RoverPal application uses Android, which is an opensource mobile OS, on the client side.

Android delivers a complete set of software for mobile devices: an operating system, middle ware and key mobile applications. Android is built on the open Linux Kernel. Furthermore, it utilizes a custom virtual machine that has been designed to optimize memory and hardware resources in a mobile environment. Android provides access to a wide range of useful libraries and tools that can be used to build rich applications. For example, Android enables developers to obtain the location of the device, and allows devices to communicate with one another enabling rich peer-to-peer social applications. In addition, Android includes a full set of tools that have been built from the ground up alongside the platform providing developers with high productivity and deep insight into their applications.

Android includes a set of core libraries that provides most of the functionality available in the core libraries of the Java programming language. Every Android application runs in its own process, with its own instance of the Dalvik virtual machine. Dalvik has been written so that a device can run multiple VMs efficiently. The Dalvik VM executes files in the Dalvik Executable (.dex) format which is optimized for minimal memory footprint. The VM is register-based, and runs classes compiled by a Java language compiler that have been transformed into the .dex format by the included "dx" tool.

The application uses Ethernet Linux driver from the available drivers in the stack. Android SDK not being completely open sourced at present, we have used JRE for socket level programming.

Vending Machine Server (TomCat)

The RoverPal vending machine server application is developed in Linux and uses TomCat as a web server. You can download Tomcat 4.0 or later release from the <http://tomcat.apache.org/download-55.cgi>. Install and run Tomcat 4.0 or later from <http://tomcat.apache.org/tomcat-4.1-doc/RUNNING.txt>.

The vending machine server uses lower level ethernet linux drivers, JAVA at upper level and Java Runtime Environment in the firmware. JRE is used for JSP and Servlet programming at the socket level.

Payment Service Provider (Google Checkout)

We have used the Google Checkout as the payment service provider to demonstrate the RoverPal application.

The mobile client connects to the Google Checkout as a buyer and creates a buyer account when logged in for the first time. This is done just as any other client connects to Google Checkout.

The vending machine server connects to Google Checkout as a merchant and creates a merchant account. The Google Checkout API is used for vending machine server configuration using XML. Following parameters are configured at present:

- Item Name
- Description
- Price
- Quantity

Using the RoverPal application

To purchase items using RoverPal follow the steps below:

1. Start RoverPal by clicking on the RoverPal icon.

Figure 4 Starting RoverPal Application



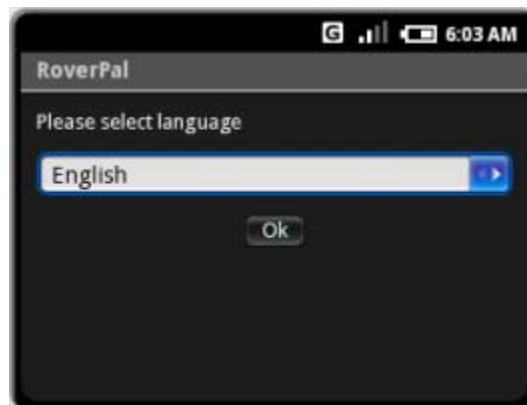
2. The **RoverPal Splash** screen appears as shown in [Figure 5](#) .

Figure 5 RoverPal Splash Screen



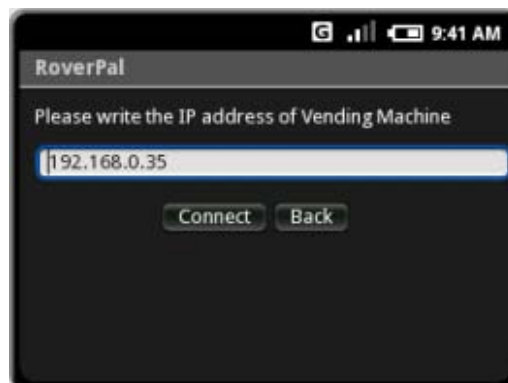
- Next, you will see the Language selection dialog box as shown in [Figure 6](#) Select the **Language**.

Figure 6 Language Selection



- Click **Ok**.
- Enter **IP address** of the vending machine (in this case Linux computer). See [Figure 7](#)

Figure 7 Entering IP Address of the Vending Machine



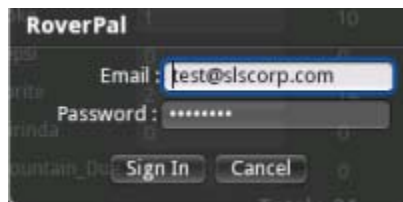
6. Click **Connect**. A connection request will be sent to the vending machine server.
7. On successful connection, item list will appear. Select Items you want to purchase and enter quantities for the selected items as shown in [Figure 8](#).

Figure 8 Selecting Items & Entering Quantity



8. Click **Buy**.
9. Enter Google Checkout **Email id** and **Password** to make the payment. See [Figure 9](#)

Figure 9 Entering Email Id and Password of Google Checkout



10. Click **Sign In**. All the selected items request will be submitted to the vending machine server, after the verification by Google Checkout. Mobile client will be in wait state.
11. Vending machine server displays relevant advertisements through Google AdWords to the client during this transaction process.

Figure 10 Vending Machine Displaying Advertisement throught Google AdWords



12. When the vending machine server receives the payment information from Google Checkout, it delivers the selected items to the customer.

Responsibility

Applications are responsible for managing their internal state regarding purchased features. The application must store state information for persistent storage to allow the end user to continue using a purchased feature when the application is started next time.

Benefits

1. Securely process payments anywhere, anytime
2. Automatically send a payment confirmation via communication media.
3. Automatically send a receipt via communication media.
4. Transaction records are immediately & securely available online
5. Save time & money by reducing paperwork
6. All from one single device!

Future Enhancement

In future, we wish to enhance RoverPal with following features:

1. The long-term goal of the RoverPal is to integrate all legacy payments (those possible with cash, bank transfers, credit cards, etc.) and provide an alternative solution that uses the different channels in a homogeneous way.
2. RoverPal will also target the micro-payments area, especially the lower level as well as values lower than 1¢ (which is not possible via real cash).
3. RoverPal transactions will be conducted independently of the user's location.



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