

KADIR HAS UNIVERSITY
GRADUATE SCHOOL OF SCIENCE AND ENGINEERING



SECURE LOYALTY CARDS IN MOBILE

İBRAHİM FIRAT VERAL

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IBRAHİM FIRAT VERAL

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SECURE LOYALTY CARDS IN MOBILE

İBRAHİM FIRAT VERAL

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APPROVED BY:

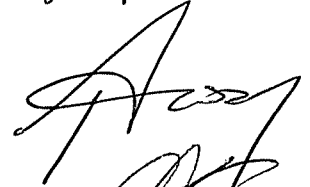
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"I, Ibrahim Fırat Veral, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis"

IBRAHİM FIRAT VERAL



ABSTRACT

SECURE LOYALTY CARDS IN MOBILE İBRAHİM FIRAT VERAL

Master of Science in Computer Engineering

Advisor: Asst.Prof.Dr.Arif Selçuk Öğrenci

JANUARY,2014

In this study, it is intended to develop a loyalty application by utilizing NFC technology, used by an increasing number of devices today, and QRCode, which has begun to be used in many sectors. It is aimed to collect all discount cards and mark cards taken from each company and safely use them. Barcode reading is performed for devices with an Android software and NFC support while card reading is performed devices without NFC by using QRCode. When the application is run; the barcode is scanned and is approved by the system, operations related to the card will start. The cashier will use the card by reading the NFC Tag or QRCode provided by the application within a second.

The system, in the most basic sense, consists of four main components. The first one is a cell phone operating on Android. The second one is an Android mobile application that keeps cards safely. The third one is a reader that enables barcode reading. And the last one is a server, belonging to a company, on which user data, passwords, and campaign and mark cards are kept. In short, this projects aims to enable the use of all loyalty cards with a single Android application on your cell phone.

The application comprises the hardware components. One is an NFC supported Android cell phone that is needed to actively use the application. Another one is a loyalty card registered on the system. The last one is a host computer which will keep user data and, in the next phases, data provided by campaigns of the application.

The reason I have developed this application is that the number of loyalty cards have dramatically increased, and they have become widespread in today's competitive world. It has become impossible for users to have all of their cards with them. Besides, these cards are not safe. Thanks to this application, the cards will be kept together, and customer data will be hold safe.

ÖZET

GÜVENLİ MOBİL SADAKAT KARTLARI

İbrahim Fırat Veral

Bilgisayar Mühendisliği, Yüksek Lisans

Danışman: Yrd.Doç.Dr.Arif Selçuk Öğrenci

OCAK,2014

Bu çalışmada, günümüzde kullanılan ve cihaz sayısı gittikçe artan NFC(Near Field Communication) teknolojisini ve artık birçok sektörde kullanılmaya başlayan QRCode teknolojisini kullanarak Sadakat Kartı uygulaması geliştirmek hedeflenmektedir. Her bir şirketten alınan indirim ve puan kartlarını bir araya toplayarak güvenli bir şekilde kullanıma olanak veren bir uygulama amaçlanmaktadır. Herhangi Android akıllı cihazı kullanarak (NFC desteği olanlar için NFC ile kart okutma, NFC olmayan cihazlar için de QRCode desteğiyle) kart okutma işlemi gerçekleştirilmektedir.Uygulamamızı kullanarak; Sadakat kartında yer alan Barcode'u taratıp sistem tarafından da onaylandıktan sonra sadakat kartı uygulama içinde kullanıma açılmaktadır daha sonra ilgili mağazada kasiyere, uygulamada çıkan NFC Tag'ini veya QRCode'u bir saniye içerisinde okutarak karttan yararlanmaya başlanmaktadır.

Sistem en basit biçimiyle, dört ana parçadan oluşmaktadır. Bunlardan birincisi Android işletim sistemini kullanan bir cep telefonu. ikincisi kartları güvenli bir şekilde tutabileceğimiz bir Android mobil uygulama üçüncü olarak uygulamadaki kartı okutmamızı sağlayacak bir barkod ve NFC okuyucu ve son olarak da kullanıcı bilgilerinin, karta gelecek olan password bilgilerinin , kampanya ve puan bilgilerinin tutulduğu herhangi bir şirkete ait sunucu. Kısacası projenin amacı cep telefonunuzdan bütün sadakat kartlarınızı sadece tek bir Android uygulama ile kullanmasını sağlamaktır.

Donanımsal olarak uygulama üç ana parçadan oluşmaktadır. Bunlardan birincisi uygulamayı aktif bir şekilde kullanabilmek için NFC destekli bir Android cep telefonu. Sistemde kayıtlı olan bir sadakat kartı ve uygulamadaki kullanıcı bilgilerini ve ilerideki aşamalarda uygulamanın kendi kampanyalarını sunabileceği bilgileri tutabilmek için bir sunucu bilgisayar.

Bu uygulamanın amacı; rekabetin gittikçe arttığı bir ortamda sadakat kartlarının kullanımını günden güne artmaktadır ve kullanıcının bütün kartları yanında taşıması mümkün olmamaya başlamıştır ayrıca bu kartlar güvenli de değildir. Bu uygulama ile birlikte hem kartlar tek bir uygulama ile bir arada bulunacak hem de müşterilerin bilgileri güvenli bir şekilde tutulacaktır.

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To My Family

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List of Abbreviations

ASP	Active Server Pages
API	Application Programming Interface
CA	Certificate Authority
DB	Database
ECMA	European Computer Manufacturers Association
ETSI	The European Telecommunications Standards Institute
GSM	Global System for Mobile Communications
IDE	Integrated Development Environment
HTTP	Hyper-Text Transfer Protocol
HTTPS	Secure Hypertext Transfer Protocol
IEC	The International Electrotechnical Commission
IIS	Internet Information Service
ISO	International Organization for Standardization
IT	Information Technologies
JAVAME	Java Mobile Edition
JDBC	The Java Database Connectivity
J2EE	Java 2 Platform, Enterprise Edition
MS	Microsoft
MSSQL	Microsoft Structured Query Language
MYSQL	My Structured Query Language
MicroSD	Micro Secure Digital

NDEF	NFC Data Exchange Format
NFC	Near Field Communication
ODBC	Open Database Connectivity
OS	Open Source
QRCode	Quick Response Code
PKI	Public-key infrastructure
POS	Point of sale
REST	Representational State Transfer
RF	Radio frequency
RFID	Radio-frequency identification
RPC	Remote Procedure Call
SDK	Software Development Kit
SMS	Short Message Service
SMTP	Simple Mail Transfer Protocol
SOAP	Simple Object Access Protocol
SQL	Structured Query Language
SSL	Secure Socket Layer
TCP	Transmission Control Protocol
TLS	Transport Layer Security
UI	User Interface
UML	Unified Modeling Language
URL	Uniform Resource Locator
WSDL	Web Service Definition Language

W3C The World Wide Web Consortium

XML Extensible Markup Language

3G Third Generation

Chapter 1

Introduction

A customer loyalty card is a marketing tool affecting the customer's shopping decisions, and therefore it has an important effect on the customer's preference for a specific shop as he or she has this card. Companies have the chance to know their customers better thanks to the customer loyalty card system and can see who buys how much from the company. The system enables customers to gain points as they shop from the company and provides each customer with the opportunity to do shopping by gaining special points. Loyalty cards have been used widely in Turkey and around the world for years. Used by a large number of customers, they will become more and more important as competition increases.

Technology improves day by day. Accordingly, smart phone prices fall, and it has become much easier for people to gain access to them. Particularly, it is now possible to find cheap smartphones and other devices operating on Android.

People benefit from discounts and campaigns. They have loyalty cards, yet they cannot have these cards with them all the time. Even if they can, cards will occupy a place in their wallets. The Loyalty Card application (LoyaltyBucket), via a single application, will enable customers to gain safe access to all loyalty cards by using NFC (Near Field Communication) and Barcode technologies. It will also make the use of the cards easier.

The loyalty card application aims to protect user data and other data of a company and to make them used safely.

Chapter 2 and Chapter 3 discuss the use, proliferation, and volumetric size of Loyalty Cards. It also focus on NFC and QRCode technologies which enable data to be read and written. Besides, REST and SOAP protocols, which are Web services, and security standards are also examined in detail with some examples. Aside from these, this chapter deals with the Android architectural design.

The purpose, extent, goals, and success criteria of the system are explained in the Software Requirement Analysis chapter. Furthermore, the Deployment Diagram demonstrating the basic operation of the system is found in this chapter. UML diagrams to be used are drawn and explained in detail in this part. The architectural design of the software, UseCase phases, design patterns that were used, and the activity diagram are also clarified in the chapter.

Chapter focuses primarily on the programming language that was adopted and the reasons for its use. Similarly, tools and frameworks in use are mentioned, and specific components that were used in the application are explained in detail. Moreover, hardware tools are tabulated, and the reasons for their use and methods are discussed.

The discussion and conclusion chapter focuses primarily on the shortcomings of the system. It includes suggestions for improvement. It is discussed whether the web service, safety precautions, and android software architecture will be sufficient in case of an increase in the size of the project. In addition, possibilities to improve the system are examined, and a conclusion is drawn. Additionally, the chapter discusses the size of a user group that the application can reach with the creation of a business model. It also tries to explain how a commercial income model can be formed.

Finally, the UserManual and Appendix contain a detailed and diagrammatic explanation of the user interface of the Android program. The user interface is also described in detail. In addition, this chapter includes some code documents of the application.

Chapter 2

Loyalty Card

2.1 What is a Loyalty Card?

The loyalty card system is an application that aims to make customers prefer a company and supply their needs from the same company. The biggest benefit, which a customer loyalty card must provide a brand with, is to obtain a regular customer group. Companies aim to gain regular customers in the long run. Thus, loyalty cards are crucial for them.

The general administrative aim of these programs is to remunerate the loyalty of customers with special services and discounts and to enhance loyal behavior by having a grasp of the benefit of long-term business relations. Loyalty programs intend to increase the presence of regular customers through discounts, cash payments, free products, or special services provided by both retailers and manufacturers.

Loyalty programs first became a current issue with the launch of AAdvantage program by American Airlines in 1981. It has been reported that almost half of American population is a member of at least one frequency program and recorded that some programs grow 11% annually. Although the number of credit cards in people's wallets decreases, they still have 7 or 8 different retail cards with them. From a more general point of view, one can say that each customer loyalty program ultimately aims to increase profits, income, and market shares.

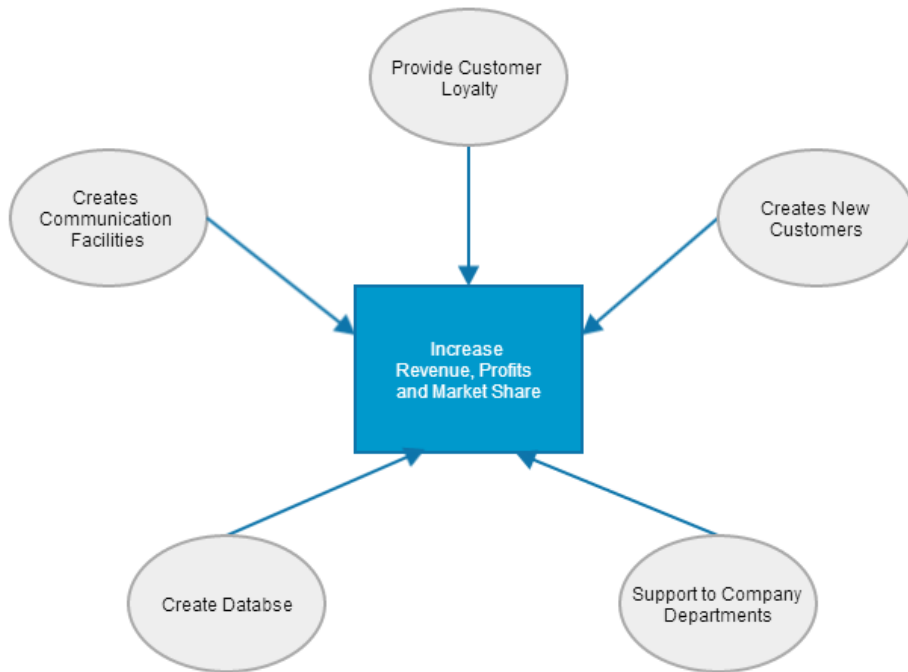


Figure 2.1: The 5 Main Aims of Loyalty Programs [4]

2.2 Benefits of Loyalty Cards

From a more general perspective, the purpose of the Loyalty Program is to increase profits, income, and market shares. Realizing other purposes is also important in that they function as a bridge between mid-term and long-term purposes. (As seen Figure 2.1)

- Immediate discount at checkout
- Giving points to customers for buying certain products
- Giving free products in exchange for points
- Shopping cheques in return for points

2.3 Loyalty Card Applications and Their Benefits to Firms [6]

- General Motors released a multipurpose credit card. This card enabled a 5% discount in the sale and rent of cars.
- American Express offered their intensive card users two airline tickets in a 6-month period.
- MCI “Friends and Family” is an incentive program offered to make friends and relatives members of the company.
- Migros, which launched the first Loyalty Card in Turkey 14 years ago, has over 8 million loyalty cards and the rate of active use is 85%.

A number of leader companies and airlines such as American Express, General Motors, Holiday Inn, Toyota/Lexus, John Deere, and Shell have been successful in implementing some plans on Customer Loyalty Programs. Benefits obtained as a result of an effective loyalty program application are listed below: [5]

- High customer loyalty, low price sensitivity, and a strong brand attitude,
- Access to information about consumers and consumer trends,
- High average sales (depending on cross sales and more profitable sale prices),
- The ability to target special customer sections,
- Increasing success in implementing product connotation,
- Access to low cost price of serving loyal customers,
- Loyal customers' recommendations on their favorite brands,
- Equipping the company with a positive status and image.

2.4 Sample Loyalty Card Application Projects

FidMe developed in France, users statically enter the number of any card and have the code number of the card with them.

KeyRing, users statically enter the card number and keep in the application by converting it into a barcode. Moreover, there are weekly discounts based on locations. It is not actively used in Turkey.

Cafe Nero Loyalty Application produces a QRCode after shopping at a Cafe Nero checkout. After the QRCode is scanned by a barcode reader at the checkout, a signet appears on the screen. When there are nine signet areas on the screen, a free coffee is prepared. Special promotions are offered to different application users.

Migros Magazam is an application that enables the use of Migros's money club card through mobile phones. In addition, the application shows the nearby Migros stores and includes recipes and service evaluation features.

Chapter 3

Smartphones and Android

Smartphones are mobile phones that provide users with more opportunities and better connection. They can be thought of as portable computers integrated into mobile phones. Yet, most phones can run applications based on platforms such as Java ME. Smart phones usually enable users to install and run more advanced applications. Those phones need an OS(Operating System), especially Android Operating System.

3.1 Architectural Design of Android

As the Android technology that is adopted has a multilayered architectural design, so will this project. It contains an advanced application development frame. This frame enables easier application development by operating on a virtual machine called Dalvika. This Android system also has an integrated browser and includes SQLite that makes it possible to keep data. Android, which supports media formats such as MPEG4, H.264, MP3, AAC, AMR, JPG, PNG, and GIF, can also support features like 3G, WiFi, Bluetooth, and EDGE depending on the device. Its most striking feature is perhaps the extension developed for Eclipse. Hence, it has become much easier to develop contentful applications through eclipse.

The architectural design of the project is explained in Figure 3.1.

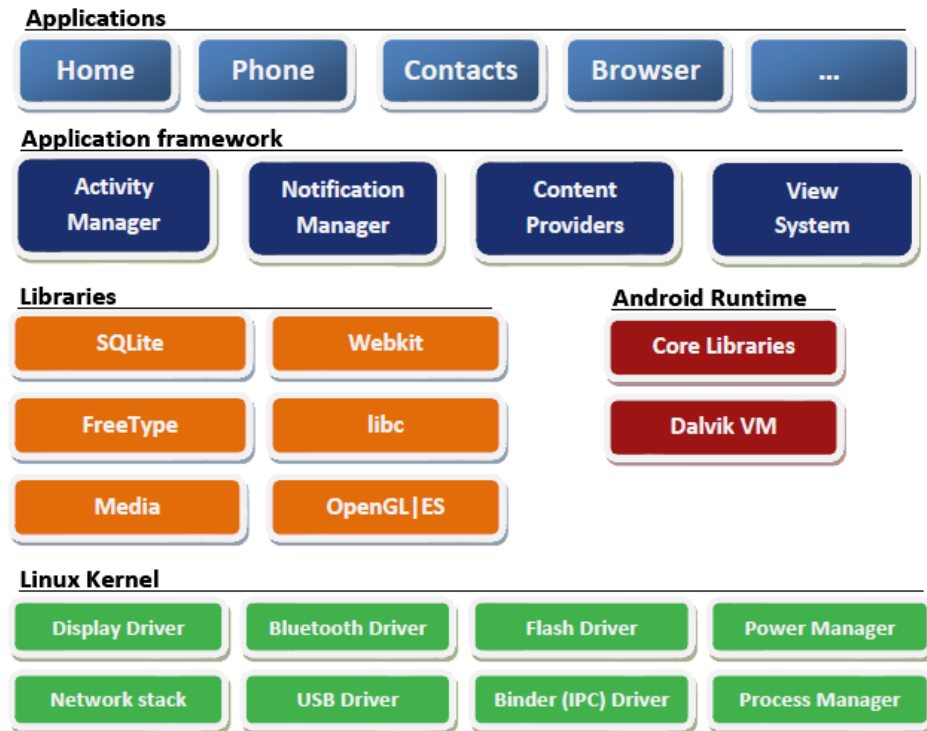


Figure 3.1: The Architectural design of Android [8]2010

[7]

3.2 The structure of Android can be separated into the following components:

- Application Layer,
- Application Frame,
- Libraries,
- Android Runtime,
- Kernel Level.

Application Layer is the layer which directly interacts with users. Basic applications such as an e-mail client, sms program, calendar, Google Maps, and phonebook and 3rd party software installed later are within the scope of this layer.

Application Frame offers a very rich platform for Android software developers. Developers can easily and smoothly access to various data in their software such as hardware data, location data, and background services. Furthermore, applications may share their own services with other applications and can access to services offered by them.

Application Libraries was not forgotten to add the open source libraries essential for Android. These are situated in Android and usually written in C and C++ languages. Libraries are used to form the basis of a more advanced application frame. For example, SQLite functions as a database keeping data of applications. Similarly, Webkit serves as an engine for integrated browsers. They are usually accessed via application frames.

Android Runtime has a virtual machine enabling upper layers to function. This virtual machine is called Dalvik. It is preferred by Google particularly because it was designed for machines with low memory and makes it possible for multiple virtual machines to run at the same time.

Android was built upon Linux kernel 2.6. Linux kernel 2.6 was developed with the support of necessary drivers. They are all essential drivers such as display drivers, WiFi drivers, Bluetooth drivers, and keypad drivers. Besides the general operating system, power management and memory management are at this level. Android uses Linux kernel for low-level tasks and has basic Java libraries.

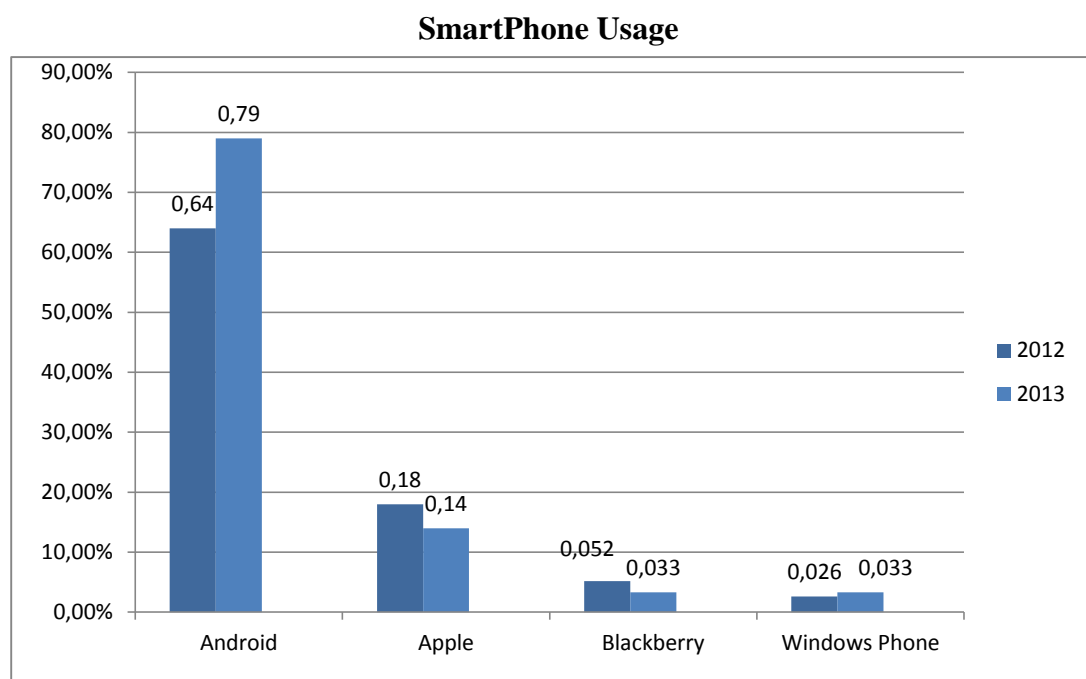


Figure 3.2: Rate of smartphone use in the world [9]

Smartphones becoming more common day by day, the exponential increase especially in the number of Android devices, and their dominance over the market indicate that loyalty card applications can be actively used.

Chapter 4

NFC(Near Field Communication)

4.1 What is NFC?

[10] NFC is a wireless communication technology that allows data transfer between devices within a few centimeters. NFC operates at 13.56 MHz and transfer data at 424 Kbits/second. A feature of NFC is that it functions smoothly as a special wireless network platform.

[11] p.10,2013 NFC technology was developed by a partnership between Sony and Philips towards the end of 2002 and approved by ECMA International (European Computer Manufacturers Association) in December, 2002. It was acknowledged as a standard by ISO/IEC (International Organization for Standardization/ International Electrotechnical Commission) on December 8th, 2003. Two standards for NFC were developed by ISO/IEC and ECMA. These are ISO/IEC 18092/ECMA-340 NFCIP-1 and ISO/IEC 21481/ECMA-352 NFCIP-2. NFC Forum was founded by Nokia, Sony, and NXP on March 18th, 2004 to develop this new generation technology.

4.2 Architecture of NFC

A standardized technology architecture, initial specifications, and tag formats for NFC-compliant devices were introduced by NFC Forum in June 2006. Among them are Data Ex-change Format (NDEF), three initial Record Type Definition (RTD) specifications for smart poster, text and Internet resource reading applications. Can be seen in Fig4.1

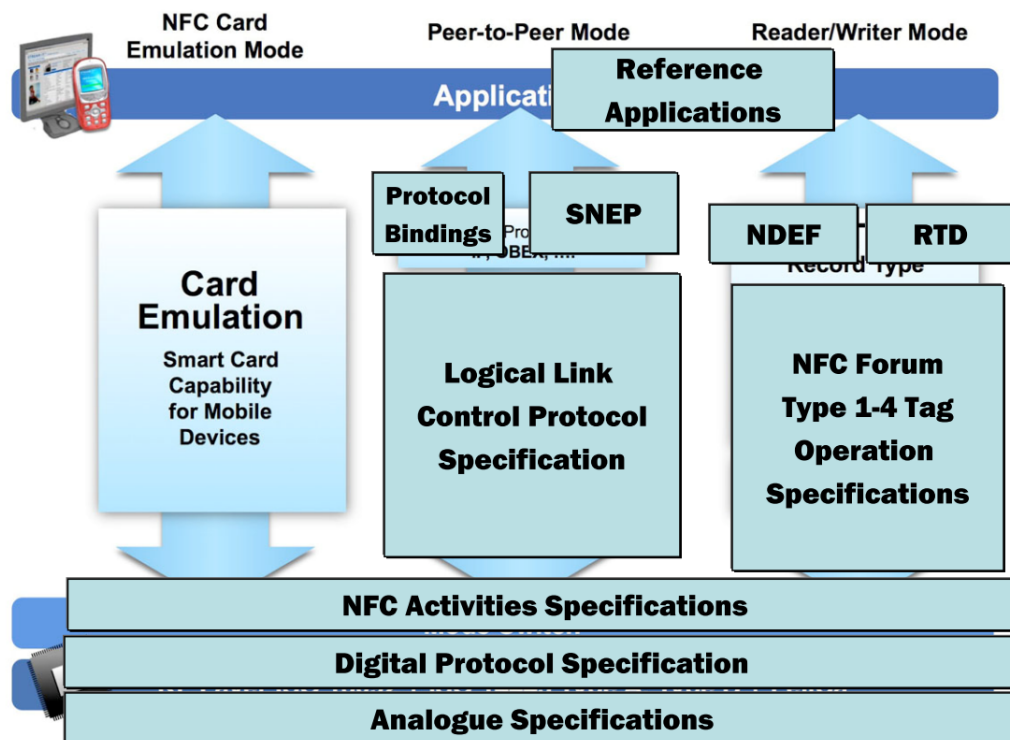


Figure 4.1: Architecture of NFC [12]

[2] p.2 NFC technology enables data communication at three operation modes, which are reader/writer mode, card emulation mode, and peer-to-peer communication mode.

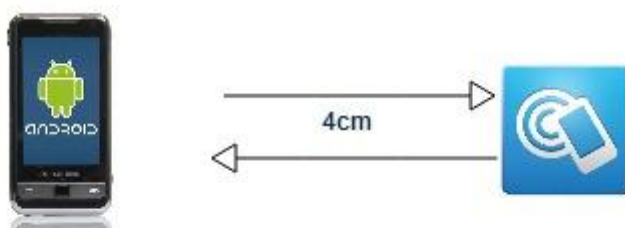


Figure 4.2: Reader/Writer Mode

Reader/writer mode as seen in Fig 4.2, complying with ISO14443 standard and RF (Radio Frequency) interface, creates a magnetic field covering 4 cm of the NFC-enabled mobile device and starts by touching the NFC-compliant passive tag. Thus, NFC-enabled mobile device can read data on the NFC tag, change data stored on the tag, or write new data on it. Smart Poster applications are an example of widespread NFC applications using reader/writer mode.

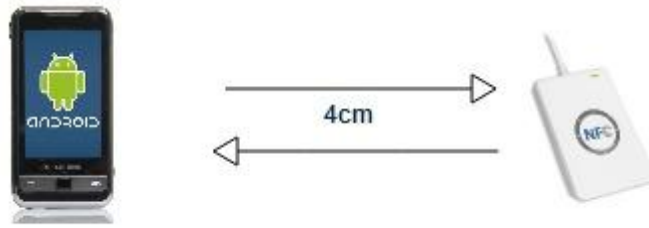


Figure 4.3 Card Emulation Mode

NFC-enabled mobile devices in card emulation mode can be seen in Fig 4.3 can act like a standard contactless smart card and can store a large amount of important data to be used to that end. Thanks to the magnetic field created by the NFC reader, a touch of the NFC-compliant mobile device leads to the transfer of data on the device to the reader. This mode offers safe data communication and enables many contactless payment systems and electronic ticketing systems to function.

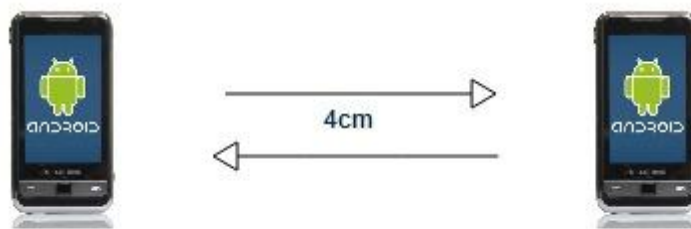


Figure 4.4 Peer-to-peer Communication

Peer-to-peer Communication Mode as seen in Fig 4.4, standardized with ISO/IEC 18092, makes data exchange possible by connecting two NFC-compliant devices. Data transfer occurs when a NFC-compliant mobile device approaches to another one. A number of innovative applications such as sharing business cards and data between the people can be developed in peer-to-peer communication mode.

4.3 What is the primary area of NFC?

The primary area of use of NFC concerns electronic devices such as wireless components of home or business systems or wireless headsets on phones.

By reading the rf tag, many processes such as payment, access, and ticket pass can ve performed on a WiFi-supported device.

NFC is used by a wide variety of mobile applications:

Paying by touching or approaching wireless point of sale (POS) readers

- read data
- win special offers, coupons, or discounts from smart posters or smart billboards.
- keep tickets for transportation and park access
- keep personal data for access to secure buildings.

[11] There are several benefits of NFC such as:

Intuitive: NFC interactions do not require more than a single touch.

Versatile: NFC has a wide area of use ranging from industry to environment.

ISO, ECMA, and ETSI standards, which are universally implemented, underlie NFC technology.

Technological: NFC quickly and easily facilitates the installation of wireless technologies.

Natural Security: As NFC operations are short-ranged (a few centimeters from the contact distance), they are safe.

It Can Operate Together: NFC can operate with contactless card technologies in the external environment.

Safety-Ready: NFC built-in skills support safety applications

Each application using NFC has specific safety requirements. For instance, payment operations require a very high level of security while retail offers do not necessitate such a level.

Loan and debt payment applications using NFC are safe because personal data containing financial data such as the account number and card expiration date are kept in a safe zone of the phone. This zone is called the “secure element”.

[14]Although all NFC applications do not require security, the applications which are included in financial transactions or certain mobile market applications like coupon need secure element. The mobile phone stores the secure applications and/or account information and supplies the security layer of the application.

Secure element (secure memory and operating environment) is a dynamic environment where the application code and data are stored securely and on which the secure applications operate. Element is found in chips (generally smart card chip) where high crypto methods are practiced. The element supplies limited memory for other functions like application and ciphering, deciphering and marking the data packs.

Secure element can be implemented both on an individual smart card like SIM/UICC (it has been implemented most of the mobile phones used now), and SD card in a mobile phone. Secure element implementation can be chosen by both the service the cell phone operator implements or by your payment service (for SD card applications) supplier.

4.4 What is the difference between NFC and RFID(related to radio frequency identification)?

[11] Both NFC and RFID are wireless technologies, but NFC uses relatively shorter distance and it is used for more protected applications (like payment). On the other hand RFID uses relatively longer distance (contact distance) and has less security support and includes simpler applications.

GSM operator companies in Turkey perform studies on NFC

There are nearly 40 thousand MasterCard PayPass point where you can use NFC Sim Card, which is presented in the partnership of Garanti Bank, and there are 265 thousand contactless POS (tap&go™) point worldwide.

Turkey added Visa's NFC feature to MicroSD cards. This feature, which provides that the cell phone and operator have independent NFC property, will be one of the innovations presented by Visa in Turkey and gives information about the future.

Avea's NFC Sim Card is considered to be the first in the world. With the help of special NFC module added to cell phone, this innovation enables mobile payment regardless of the device model through near field communication.

Chapter 5

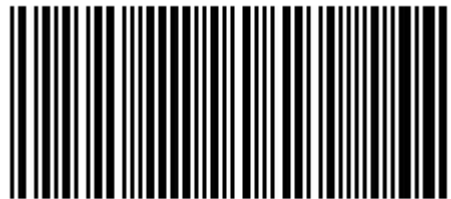
BarCode Technology

5.1 What is BarCode?

Barcodes are basically a way of cheaply printing machine readable information on objects. There are many different kinds of barcodes, ranging from only being able to store a small number to several thousand bytes. Barcodes are often associated with the scanning of items at the cash register in most stores. These barcodes encode data by using several vertical lines with varying widths. As seen in Fig 5.1

5.2 1D Barcodes

[13] 1D barcode is the code type most people are familiar with. These symbologies are based on multiple side by side vertical bars of different widths. As seen in Fig 5.1



12345-6789000

Figure 5.1: 13 digit 1D Barcode

1D barcodes are not very space efficient since the bars do not carry any data along the height of the symbol. This is due to the scanning process based on horizontal scan lines. The redundancy in the height of the symbol compensates for slightly misaligned scans.

5.3 2D Barcodes (QRCode)

[15],[24] QR code is a type of barcode that can hold more information than the familiar kind of barcode scanned at payment points around the country. The “QR” stands for “quick response,” a reference to the speed at which the large amounts of information they contain can be decoded by scanners As seen in Fig 5.2. They were invented in 1994 in Japan and initially used for tracking shipping. As the code can be easily decoded by the camera of a BlackBerry, iPhone or other smartphone, this technology is increasingly accessible to the average person.

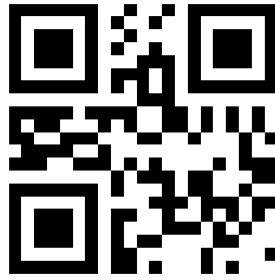


Figure 5.2: 2D Barcode

As the barcodes become popular and the facilities they supply are internalized, the market needs a barcode type that has enough capacity for more information, for different typefaces and for storage. At the same time the market needs smaller barcodes.

The information stored in the barcode is limited; and when the storage capacity is increased, barcode field increases. QrCode is created to supply these demands.

You can see QR codes in billboards, magazines, on maps; shortly you can see it everywhere. In this sense QR Code is pretty common in Japanese; it is possible to see it everywhere. It is used as common as SMS.

You can use QRCode almost in all areas such as technology, shopping, tourism, automotive and real estate. QrCode is used in many areas such as for making a phone call, for text messaging, for sending mails, for shopping.

5.4 QrCode Safety Margin

A QRCode requires a “silent zone” (a blank space) around which no information exists. This zone is an open space surrounding QRCode. Nothing is printed in this zone. QRCode needs a blank space across “4 module” around itself. It is necessary for the code to be read perfectly and smoothly. Safety margin can be seen in Fig. 5.5

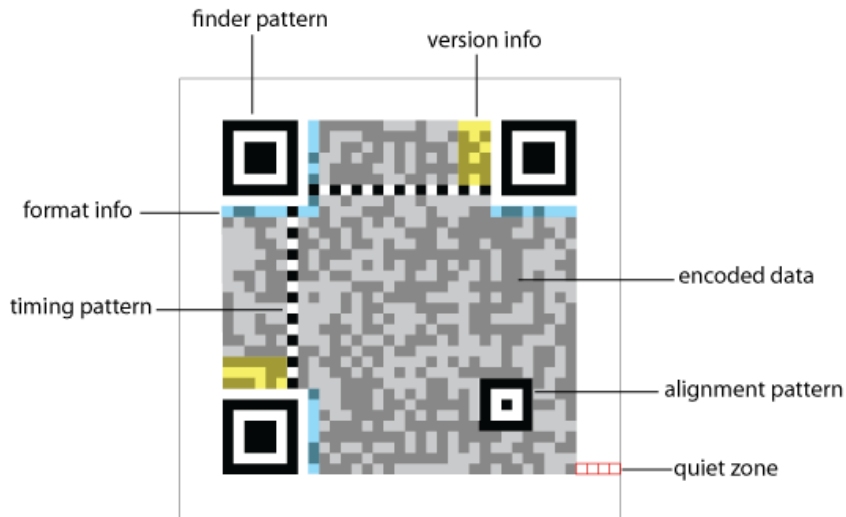


Figure 5.5: Safety Margin [16]

[16]Elements or patterns of QRCode are as follows:

Finder Pattern: It is used to identify and read the QRCode 360 degree. It is not advisable to make changes on it, otherwise QRCode may not be read.

Format Info: During the QRCode is read, the scanners read the information here. Includes information like QRCode’s error recovering rate and mask pattern.

Timing Pattern: Timing Pattern is consisted of small black/white small squares between two Finding Patterns. They move coordinate information.

Version Info: It identifies QRCode version. Each QRCode version’s storage capacity and error recovering rate are different.

Encoded Data: The data that is going to be read by QRCode scanner.

Alignment Pattern: In the situation of bent or curved QRCode, QRCode makes the scanner determine this error and make arrangements accordingly. It is not advisable to make changes in this area.

Quiet Zone: A blank space which should be left around the QRCode in order to reach optimum readable level. Advised blank space width is 4 modules. A module is the smallest one pixel element in QRCode (see the image above). Or let’s describe it as such: Each small tatch in the QRCode is a module.

5.5 QRCode PROJECT(İşbankası Parakod Application)

With the help of QRCode, parakod application which takes part in İşbankası's İşcep makes it possible to do shopping without bearing a card. In order to use this application you should put into service the card you wish such as ATM card, credit card or maximum card. In addition to this, it is possible to pay your bills in the same way via invoice payment process option.

Chapter 6

SOAP AND WEB SERVICES

[20]Web Service is a technology and also a solution to the insufficiency of the concepts of space and time between various platforms of today's technology in the globalized world.As it is understood from its name Web Service are usually implemented with the HTTP protocol. In the accesses done with HTTP protocol, Web Services operates with SOAP (Simple Object Access Protocol) in the form of XML. With the help of this form, it is possible to access Web Services from every platform and to serve in all kinds of coding languages.

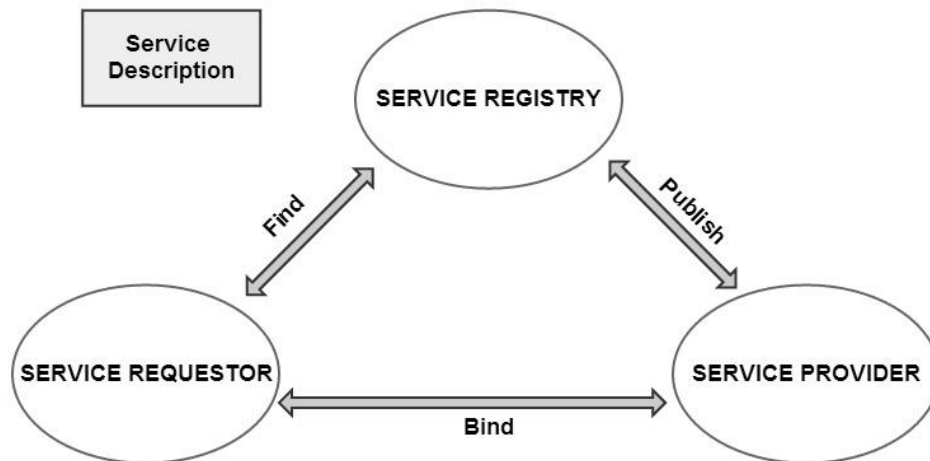


Figure 6.1: Web Service System[18]

[21]Web services model depends on the interaction of three main units as seen in Fig 6.1

- Service Provider: Service Provider enables requesters to access services existing in the verifier. Service provider states how to call this service by registering the web services definition existing its own website to service registry.
- Service Requester: They are the requester applications using the web services existing in the service provider by calling. It finds and calls the necessary parameters and the information about how to call web service from service registry.

- **Service Registry:** It keeps the web service definitions service providers publish and enables them to be found when they are needed. By scanning the service registry, service providers information about the services they want. Service registry involves definition information about how to call each service.

6.1 The Advantages of Web Service Usage

[19]Web services operates independently from the platforms. Thus, Web Services work in all modern application platforms easily. Besides they do not have to work on the same operating system. A web service written on Windows server can be called by a Linux client and we can open the functions of the application on web. Since it uses HTTP, it is secure on internal security. Data communications are not interrupted by firewall. As the platform is independent, we can use the web service we write in other projects. Thus it is time and cost efficient. While integrating our project's files to server, we can reduce the risk of causing a problem by using the web service addresses.

6.2 Web Service Operation

[21]Client application prepares a SOAP message formed with XML. This application sends the message to web server. The web server takes the required parameters by parsing the received SOAP message. And it is send to required object's required function. The operating function sends the return value to web server. Web server sends the return value to the client by forming with XML. Client application takes the message and uses it in necessary place. The message from client to server is called SoapRequest, and the message sent to client is called SoapResponse.

Before starting our project, we must understand how our web services should be. In the table below, you can see various web service sorts.

Type	Explanation
One-Way	The process sends request, no response.
Request-Response	The process sends request, response comes.
Solicist-Response	The process sends request, and waits for the response.
Notificiation	The process sends request, does not wait for the response.

Table-1: Web Service Sorts

6.3 WSDL(Web Services Description Language):

[22]WSDL is a language identified to define and locate web services. WSDL is a W3C standard. In this sense, it resembles IDL (Interface Definition Language) that is used in distribute programming. Web service defines the information like processes, incoming and outgoing message formats, web and port addresses. A web service definition document involves the main elements below:

- Types: Identifies the data types which are going to be used in messages.
- Message: Identifies the messages which are going to be used in communication.
- PortType : Identifies the methods web service includes and related messages.
- Binding : Identifies the data formats which are going to be used in processes and messages.
- Port: Identifies the service points which are formed by binding and web services. Web address is the URL that operates on the service.
- Service: Cluster of ports used.

6.4 Web Service (SOAP)

[22]XML is a messaging method used for carrying information between the client and the server. Primarily it can be used to integrate different systems to each other. Since all web services send message up to standard, they are platform free. It means a web service client we create with Java by using Jax-WS can call an iPhone service with Objective-C.

Communication standard of the web services is SOAP (Simple Object Access Protocol). It is a standard defined by W3C. XML is a standard used by web services to serve data. WSDL (Web Service Description Language), identifies the interface of the web service serves. WSDL identifies the return types and parameters of functions existing in the web service. With the help of disco(Discovery Protocol) all web services in a server are organized. UDDI standards enable web services' organization on web.

6.5 Web Service (REST)

[23]REST is an architecture related to client-server communication. Besides developing in parallel with HTTP protocol, it is used in the **World Wide Web** system, which we all know today. The services using the REST architecture are called RESTful service. The main idea is instead of supplying data connection via complex architectures like SOAP and RPC, supply it via HTTP. The main cause of this is that the system we call **World Wide Web** uses HTTP protocol. Contrary to SOAP and RPC RESTful services are simple and light. . The services using the REST properties(REST mimarisini kullanan servislere RESTful servis denir.) are called RESTful service.

- They are Platform free. (It is not important that the client is Windows and the Server is Linux)
- They are language free.
- They operate on HTTP.
- They are flexible and they can be extended.

6.6 REST AND SOAP [23]

Advantages of the REST over SOAP are as follows

- It is light and can be extended easily.
- When compared to SOAP, incoming and sending data width is very small.
- It is easy to design and to implement, it does not require any extra tools.
- It operates on HTTP and it is platform free.

Below are advantages of the REST over SOAP

- It is easy to consume, it comes together with a scheme.
- It is type-safety, it does not require validations.
- It has got many development tools.
- Its security implementation is easier than that of the REST, there are many available structure.

Chapter 7

Security Standards

7.1 Certificate Authority

[25]Certificate Authority is used to create certificates for the servers and users in network, and it is also used to administer the certificates. Certificates are used to support Public Key Infrastructure and identity validation.

7.2 What is SSL(Secure Sockets Layer)?

[25]Secure Sockets Layer protocol developed by Netscape in 1994 provides safe encrypted data communication on Internet. The basis of encrypting is based on Public Key Cryptography. SSL protocol used to provide secure communication on the web has been developed and has been named TLS. TLS protocol provides communication for client-server applications by preventing them from being eavesdropped and it also prevents original data from being changed. It works on the application layer.

When a connection request from the client arrives to server, primarily, client validates the SSL certificate coming from the server. The validation of the certificate provides that the client has been connected to the intended server.

After the validation of the certificate, client and server communicate with each other on an encryption key used for encrypting the data transmitted during the connection between the client and the server. Thus, a third party's monitoring the communication is prevented.

7.3 SSL Operation

[26]SSL is an encrypting method based on the usage of the keys named public and private key. It enables software be encoded in digital media. After the keys have been created, two keys are given named Public and Private. A private key stays with you, and the other key is sent to the people you want to establish communication. The person who wants to send a message to you, secures the message he or she wants to send and sends to you. Even if that message is withheld on the way, your private key is needed in order to solve the code of this message. According to the complexity of the SSL method (40 bit, 128 bit), even if someone finds the private key, it takes up much time to solve this message even with the most advanced techniques. Consequently, SSL enables the message to be transmitted securely, without being monitored by the third party, between two computers in communication with each other.

7.4 Public Key Cryptography

[1],[27]Public Key Cryptography, is an encrypting system in which different keys are used for the processes of cypher and decypher. Both communicating sides have a pair of keys. One of the keys that constitutes these key pairs is secret key and the other is open (not secret) key. None of these keys can do both cypher and decypher.

There is only one owner of the secret key. With the help of the secret key, the side that has the secret key can solve the cypher of the information encrypted with his or her own open key, can create his or her own digital signature or can prove his or her identification (authentication).

Open key can only be created by the owner of the secret key and it is open to public access. Even the keys are different from each other, mathematically, they are related to each other. With the open key, the information is encrypted in the way that only the owner of the secret key can solve it. Moreover, with the open key, the owner of the secret key's digital signature and the validity of the identity of the owner can be checked.

7.5 The example security precaution structure used in Facebook [28]

With its 750 million users, Facebook is one of the most secure websites in the world and there is a security standard to protect the user profiles. Furthermore, it is one of the rare systems that use Open Authentication.

Facebook Access Token:

When you want to connect Facebook Login via an application, a temporary precaution is taken by Facebook API and this is called Facebook Access Token. Access token is necessary for a user and it is also necessary to make the user's pages and graph APIs useable.

One cannot access the objects below without using access token;

User, User/feed, User/friends, User/posts

Photo, Photo/comments, Photo/likes, Photo/picture, Photo/tags

Status Message, Status Message/comments, Status Message/likes

The feature of Access tokens is that they have timeframe. There are two kinds of timeframes as short-dated and long-dated. They enable you to have Access Token via server to server. Primarily, the system gives short-dated application access token lasting one or two hours. Afterwards this short-dated access token is transformed into long-dated access token by generating in the Facebook server. Long-dated Access Token has 60 day duration and enables you to administrate Facebook pages.

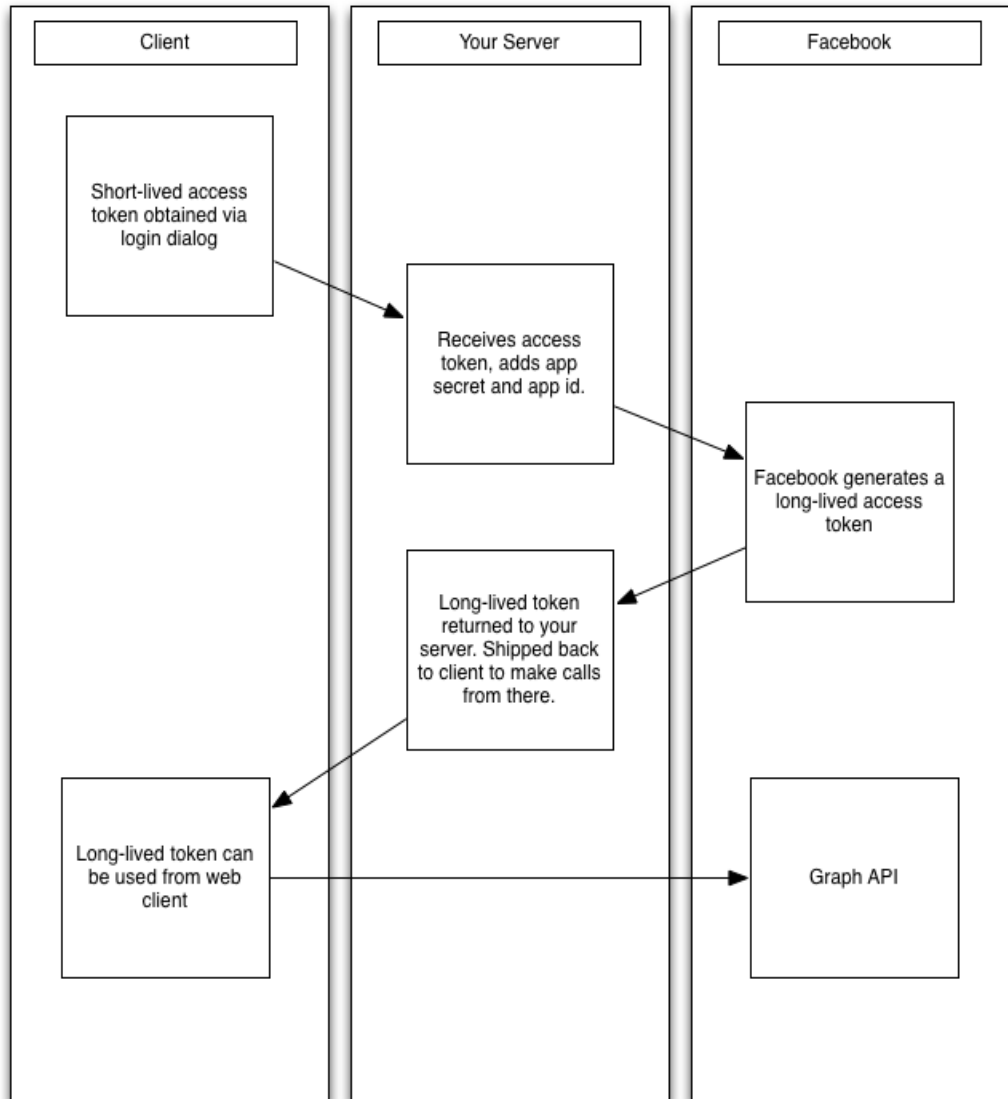


Figure 7.1: Facebook Access Token [28]

Chapter 8

Detailed Analysis of the Software and the Deployment Diagram

LoyaltyBucket loyalty card application is a software that enables user to benefit from discounts at stores. It aims to protect user data and other important data of a company and to make them used safely.

LoyaltyBucket loyalty card application will save users from a number of unnecessary cards and enable them to gain discount points.

Goals and Success Criteria

- a system that will become a good advertisement field as the number of users and discount cards increase,
- a system in which user data can be stored safely,
- a system that is open to development as the discount cards have a wide area of use and they are used for shopping,
- a system making it possible for people to easily have their discount cards with them,
- a system enabling adaptation to rapid changes in the the field of information technologies and contributing to the development of technology as well as benefiting from existing technologies

Creating such a system is the primary goal.

LoyaltyBucket runs on phones using Android 2.3.3 or higher.

There are several constraints to be satisfied by Loyalty Bucket:

- LoyaltyBucket does not operate without internet or 3G connection.
- It only runs on phones using Android 2.3.3 or higher.
- It will run on Java Android platform.
- No data other than names, surnames, and dates of birth will be stored in the database of the application.

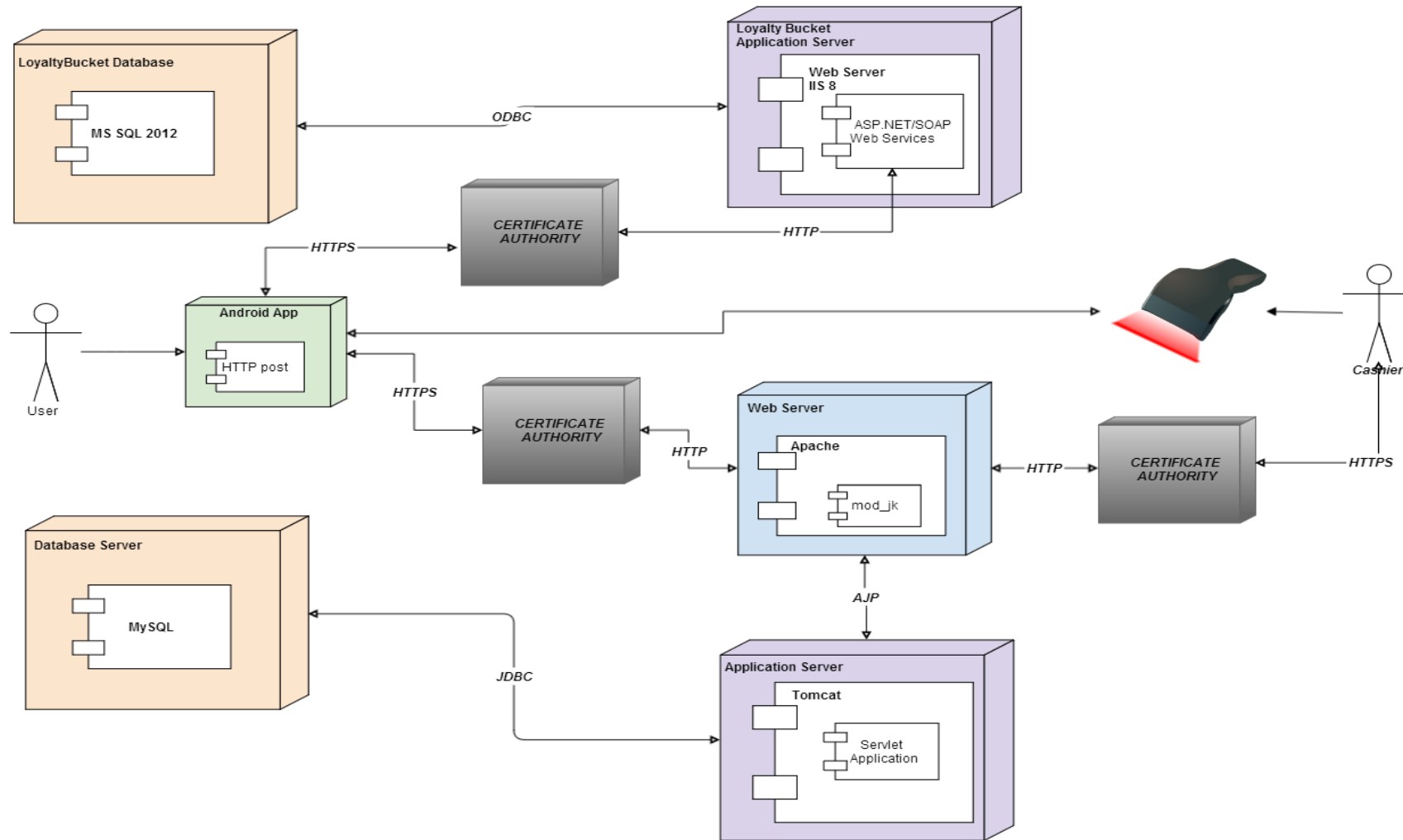


Figure 8.1: Deployment Diagram for JAVA and MYSQL Systems

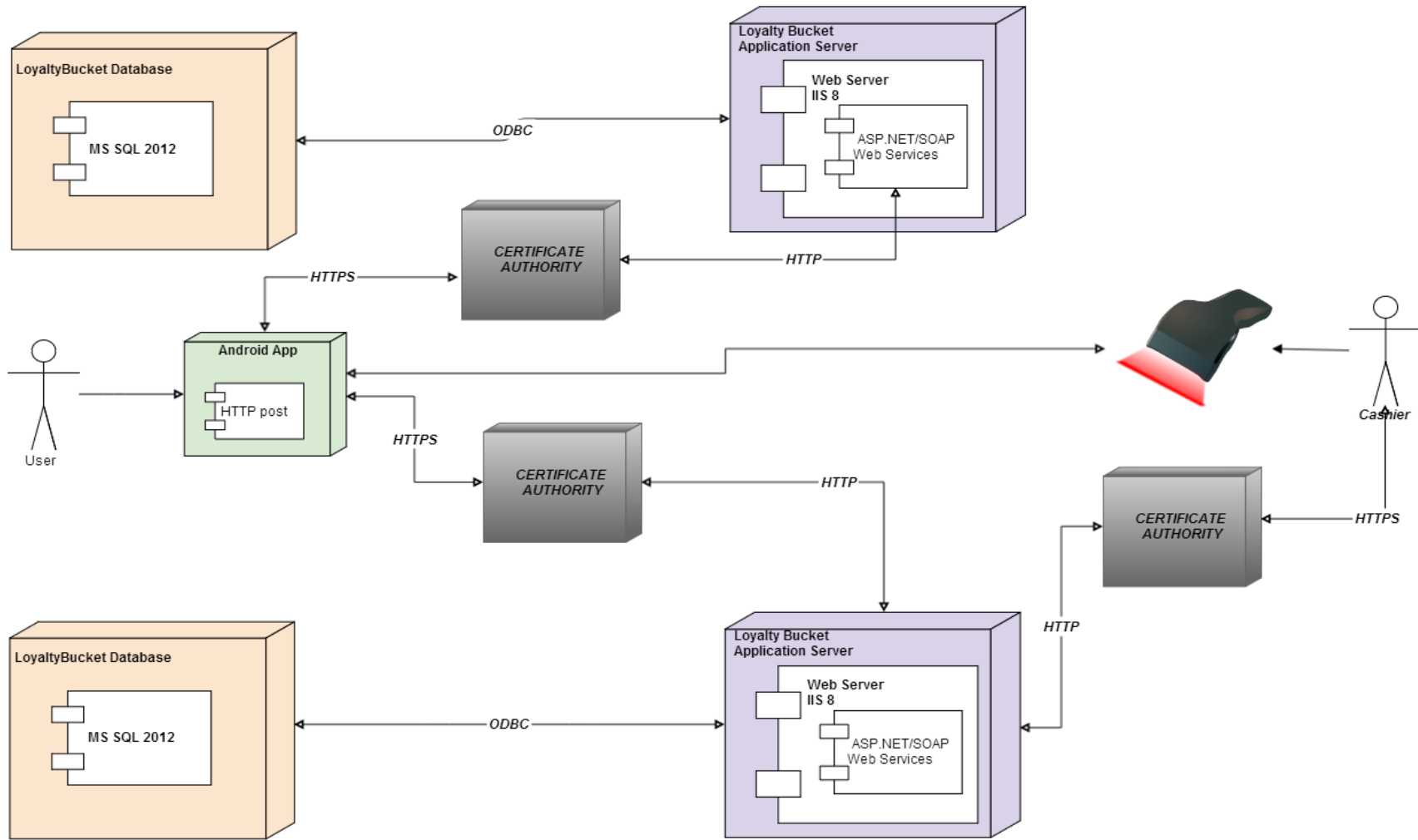


Figure 8.2: Deployment Diagram for ASP.NET and MSSQL Systems

8.5 AN OVERVIEW OF THE SYSTEM

The application is basically composed of four components. These are the Database, Web Service, Android Application, and Barcode reader. The Database contains two different databases. One stores company data, and the other one stores customer card data. MSSQL Server 2012 was adopted in the database which will be used for the application. IIS8 (Internet information services) was used as the Web server. Two different diagrams were created for database used by companies. Aside from MSSQL and IIS web server, Apache web server, ORACLE, and MYSQL database can also be used. In Android client application, SQLite was used so that it would record offline data and send these data to the server when online.

8.6 GENERAL OPERATION OF THE SYSTEM

As seen in Figure 8.1 and 8.2;

First, the application is installed into the Android device by the user. Then, data are sent to the system on web server through the company database. Data go through some security phases before they are sent to the system. Damages and losses might occur in data if exposed to attacks. Thus, a safety layer is created with Certificate Authority for data on web service. Certificate Authority is a coding method based on the use of public and private keys. Data are locked from two sides, secured by the public key, and encrypted until they reach the system. When data reach the system, they are decrypted by the private key and can be used. The database within the application reaches the Android device by using the same keying system and enables communication between the server and the client. Users choose discount cards they want to use via the system. The tag on the chosen card is scanned by a shop assistant, and the card is approved by the system.

Chapter 9

Requirements

Loyalty Card requirements are divided into two groups, which are functional and non-functional requirements.

9.1 Functional requirements

Functional requirements of the Loyalty Card system are discussed under the following subheadings.

Show the Loyalty Card List

Cards are sent by the contractor companies of the Loyalty Card application and transferred to the application. Hence, users will be enabled to choose the cards they have.

- **Add Card ID**

Users, who have chosen the cards they have in the Loyalty Card application, will be enabled to send the cards' ID to the system.

- **Read Card ID**

Users define the IDs of their cards, and the system verifies them.

- **Send SMS**

The system of the company sends an SMS to the Android phone after the card ID is verified.

- **Insert SMS**

An SMS is sent to the user's Android phone in order to check whether the discount card belongs to him or not. The user will then be enabled to enter the SMS code.

- **Send Signup Info**

After the card ID and the SMS code operation are approved, the system of the company sends some data on the user to the application.

- **Show Signup Info**

Once the card ID and the SMS code operation are completed, user data will be displayed, transferred to the application system, and updated through here.

- **Show the Loyalty Card List**

On this screen, the user can see all the cards that he has defined and use them.

- **Show Mark Money**

Users can see accumulated points of their cards and can use them here.

- **Show Campaign**

Users can see campaigns defined specially for themselves and benefit from them.

- **QRCode**

Users who want to use their cards via QRCode are provided with a temporary password by the system of the company. This password is converted into QRCode and then used.

- **NFC**

Users who want to use their cards via NFC are provided with a temporary password by the system of the company. This password is tagged by NFC and then used.

9.2 Non-functional requirements

- **Availability**

Ease of use in the Loyalty Card application is crucial. This is because it is a fast operation running on the device and appeals to all ages. Therefore, the menus should be easily and quickly accessible for the user to start using the card immediately.

- **Reliability**

Data protection and security is very important in the Loyalty Card application. While there may be completely different companies, there may also be various companies operating in the same field. These companies have user data. Loss of or damage to data will lead to severe consequences both for the companies and the quality of the application. Security standards are adopted to ensure security for data in the application. A security certificate is created with Certificate authority.

- **9.2.3 Performance**

The system should be running at an acceptable speed. No matter how the database connection speed of incoming result speed, and the capacity of the network connection are, they should not be in such a state that will be noticed by the user. The application performs better than other development tools (cross development tool PhoneGap Appcelerator...) if it is developed natively. In addition, it is intended to enhance the performance of the application with some software specifications.

- **9.2.4 Supportability**

The database of the application must support the foreign key. Besides, devices should have Android 2.3.3 or higher and the NFC feature so that everything will function properly.

- **9.2.5 Implementation**

Adapting UML diagrams for the system to Java and Android codes. It is explained in detail in the software design section.

- **9.2.6 Interface**

In the Loyalty Card application, active loyalty cards are listed on the opening screen. The user registers into the system by clicking on the card he or she has and starts to use it after selecting NFC or QRCode in the mycard section. The interface of the application is explained in detail in the user manual section.

- **9.2.7 Privacy Requirement**

A number of encryption methods were used to secure the privacy of users. These are encrypting data with NFC and QRCode, ensuring the use of card by dynamically sending constantly changing passwords with expiration dates, and providing data privacy by verifying passwords, which is carried out by sending SMS to phones registered to the name of the user.

Detailed explanation for security and privacy issues can be found in the implementation section.

Chapter 10

MODEL OF USE

After having a grasp of the system to be modelled, detailed scenarios of use will be created regarding the demands of the client. Thus, demands will be understood and expressed.

Scenarios of use are the chain of events between the system and the actors. For this reason, determining the actors first will make it easier for the scenarios to be prepared.

10.1 Determining The Actors

When the demands in the project are analyzed, four main actors stand out:

Consumer: Consumers download the application to their phones and install their cards on the system to the application. Then, they start to benefit from the cards.

Cashier: It enables users to use the card by reading the barcode after the shopping via a scanner.

Company System Database It stores loyalty cards and user data.

Application Database: It stores some user data within the application.

The number of these actors is enough. Otherwise, the system would be more complex. Furthermore, it is sufficient to meet the fundamental demands of the project. After determining the actors that will take part in the system, we will model it based on the scenario groups discussed in the functional requirements section.

10.2 the scenario groups:

Use case seen more detail of displayed in Fig.10.1

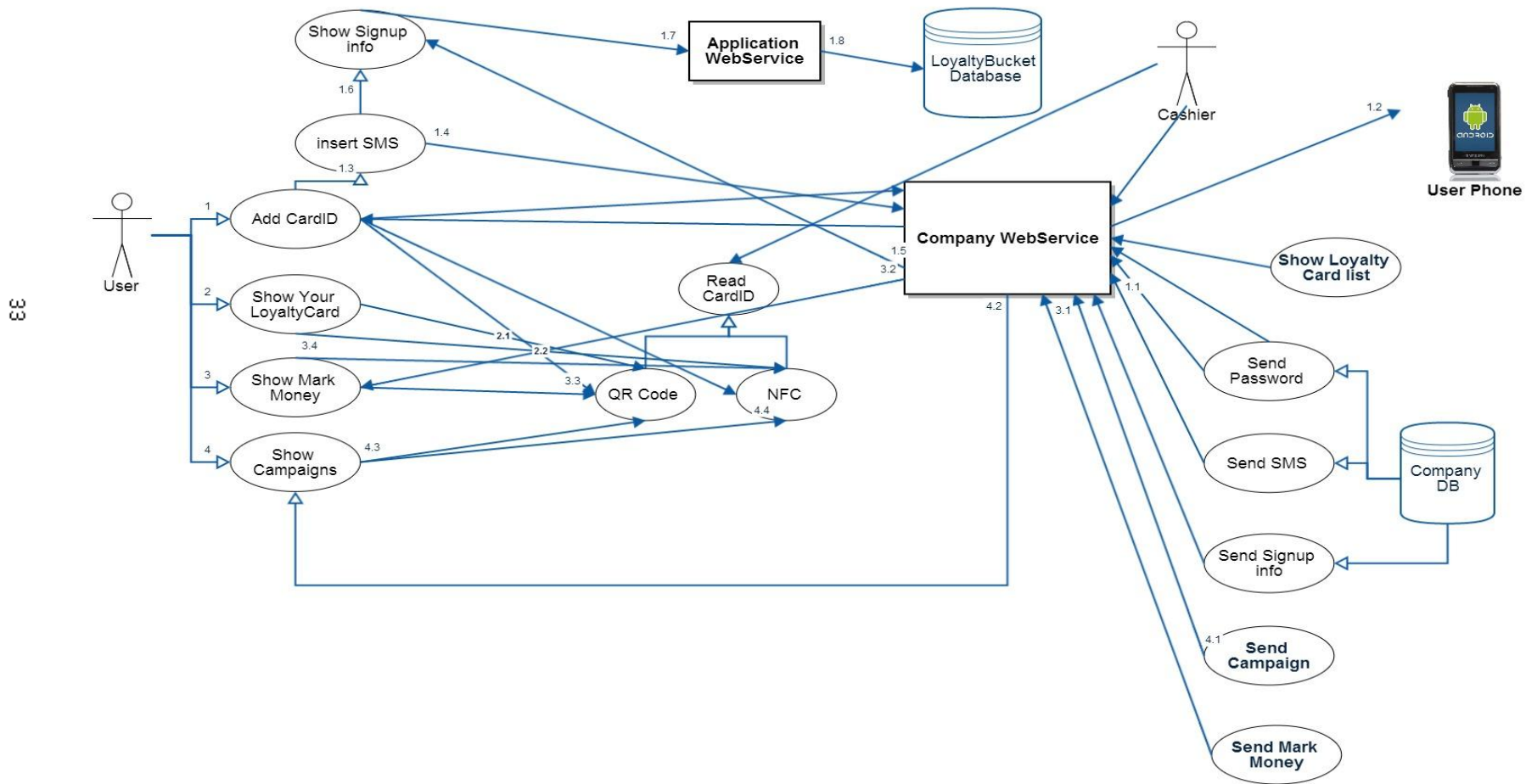


Figure 10.1: User Case Diagram

Name:	Add Card
Actors:	User
Preconditions:	Coming data from Web service in order to list the cards in the system.
Extension Point:	Insert SMS
Successful Scenario	Existing loyalty cards are listed. Users introduce their cards to the system and skips to the next page. If there is no Internet connection (A1)
Alternatives:	A1. The application gives a warning and recommends the Internet connection be checked again.

Name:	Insert SMS
Actors:	User
Preconditions:	The user's cell phone should receive an SMS password from Web Service.
Extension Point:	Sign up information
Successful Scenario	If the user enters SMS information, and this is verified by the system, he or she skips successfully to the next page. If there is no Internet connection (A1) If the SMS password is entered wrongly (A2)
Alternatives:	A1. The application gives a warning and recommends the Internet connection be checked again. A2. SMS pass If SMS pass is entered incorrectly three times, the card becomes invalid.

Name:	Display Sign up Info
Actors:	User
Preconditions:	Upon correct entrance of SMS information, user data are received from Web service.
Extension Point:	
Successful Scenario	User data are provided. Data are also stored in SQLite and transferred to the system of the application when there is Internet connection. If there is no Internet connection (A1)
Alternatives:	A1. The application gives a warning and recommends the Internet connection be checked again.

Name:	Display your loyalty card
Actors:	User
Preconditions:	Data of the loyalty cards registered to the system must be received via Web service
Extension Point:	NFC, QRCode
Successful Scenario	The cards to which users are registered are listed. Users click on the cards they want to use. Then, they choose whether they will use the card by generating a QRCode or through NFC. If there is no Internet connection (A1)
Alternatives:	A1. The application gives a warning and recommends the Internet connection be checked again.

Name:	NFC Control
Actors:	
Preconditions:	
Extension Point:	
Successful Scenario	When the NFC usecase is clicked on, whether the device supports NFC or not is checked.
Alternatives:	

Name:	NFC
Actors:	
Preconditions:	
Extension Point:	
Successful Scenario	When the NFC usecase is clicked on, information on the hardware condition of NFC is displayed. If NFC is closed (A1) If NFC is open (A2)
Alternatives:	A1. The application gives a warning, and the user is informed. A2. The environment for the reading operation is provided.

Name:	QRCode
Actors:	
Preconditions:	
Extension Point:	
Successful Scenario	The user is informed so that necessary operations will be carried out when he or she wants to use the card through QRCode.
Alternatives:	

Name:	Read Card ID
Actors:	Cashier:
Preconditions:	A password should be sent from Web service to generate a QRCode and to fill an NFC Tag. And the duration of the password must not exceed 1 minute.
Extension Point:	NFC, QRCode
Successful Scenario	The cashier scans the QRCode and NFC via a scanner and sends them to the system of the company to be verified via Web service. After they are approved, card can be used. If there is no Internet connection (A1)
Alternatives:	A1. The application gives a warning and recommends the Internet connection be checked again.

Name:	Display Campaigns
Actors:	User
Preconditions:	Campaign data of the user must be received from Web Service.
Extension Point:	NFC, QRCode
Successful Scenario	Campaign data of the user are provided. If there is no Internet connection (A1)
Alternatives:	A1. The application gives a warning and recommends the Internet connection be checked again.

Name:	Display Mark Money
Actors:	User
Preconditions:	Campaign data of the user must be received from Web Service.
Extension Point:	NFC, QRCode
Successful Scenario	Point data of the user are transferred. If there is no Internet connection (A1)
Alternatives:	A1. The application gives a warning and recommends the Internet connection be checked again.

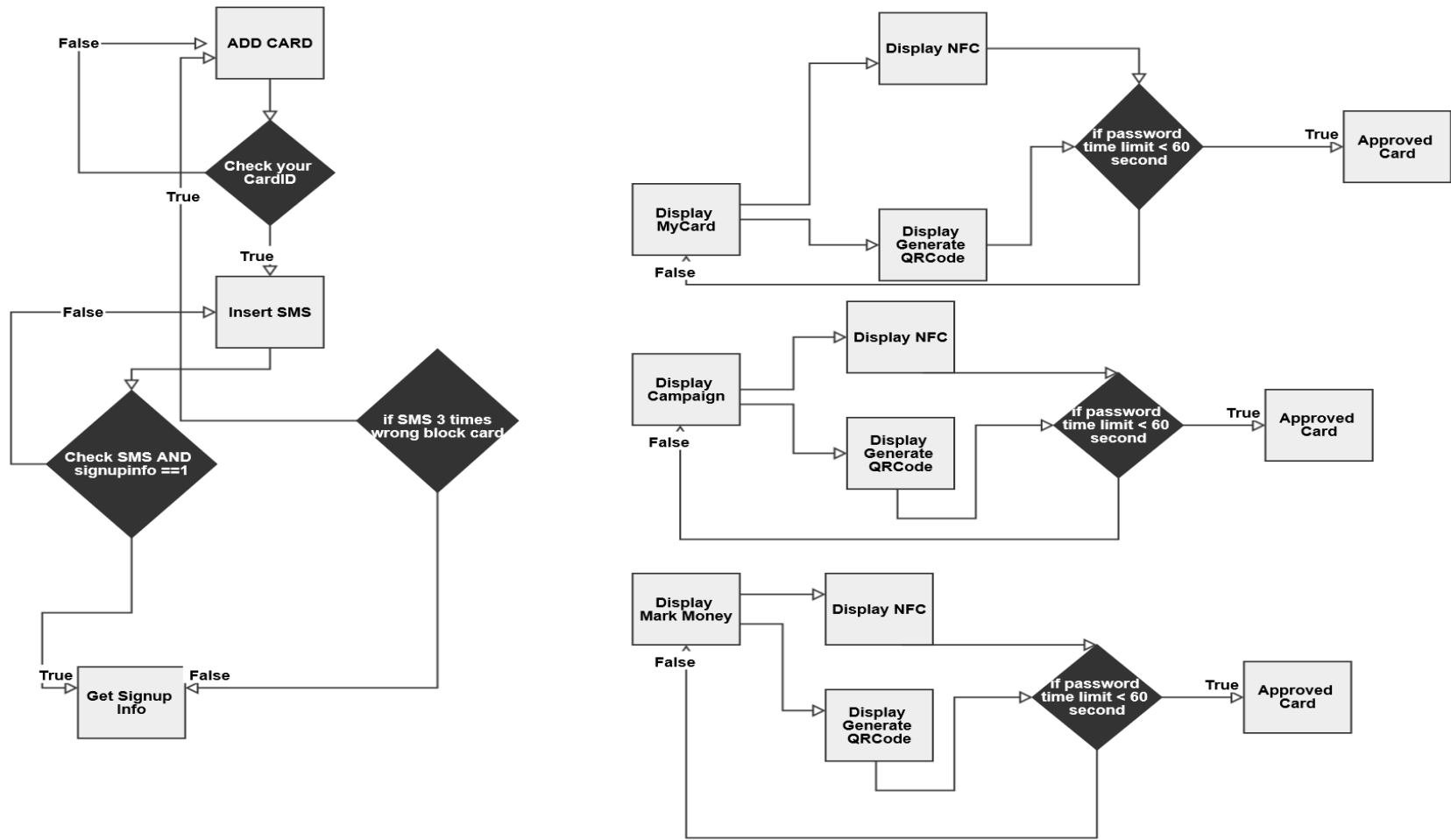


Figure 10.2: FlowChart Diagram

10.3 GENERAL STRUCTURE OF DATA FLOW DIAGRAM

General flow(As seen in Fig 10.2) of action are described below where The user clicks one of the cards registered to the system, and enters the number of this card. He or she must have Internet connection to do that. After the company verifies data, it sends an SMS password to the user's cell phone. Once the user correctly enters the password, user data are received from Web service, and the card can be used also if SMS pass is entered incorrectly three times, the card becomes invalid.

MyCard section displays the cards the user has and that are registered in the application. When the user want to use a card, QRCode and NFC options appear. If the device supports NFC, the QRCode option is selected. The system of the company sends a dynamically and constantly changing password which expires after 60 seconds. It is loaded into QRCode or NFC. Then, within this period, the card can be used.

In the campaign section, there are certain campaign which are created by the system of the company whose cards the user has. Campaign have a time period and last for a determined duration. The user clicks on a campaign and chooses either QRCode or NFC. Then, a 60-second password comes from the system of the company, and it is loaded into QRCode or NFC. During this period, the user can benefit from the discount. If 60 seconds pass, the application runs back to how it was before, and the system generates a new password again. It is sent through Web service.

In the mark money section, system sends points to be used in shopping. The number of points depends on how much the card is used. The user moves towards a card to see how many points have accumulated. The number of points is then displayed. When the user wants to use these points, he or she chooses either QRCode or NFC. Then, a 60-second password comes from the system of the company, and it is loaded into QRCode or NFC. During this period, the operation of using card points is approved.

In addition, there is an automatic update system which enables additional modules and bug fixes. Thanks to this, when a change is made in the program, Apk(Android application package) in the server side is updated, and the application downloads the updated apk(Android application package). This helps us save time and operate faster.

Chapter 11

ARCHITECTURAL DESIGN CLASSES

11.1 Design Pattern to be Used by Android Web Service

Professional software systems are composed of the combination of many components. A number of teams operate independently. They run on various components that make up the system. A component comprises one or more classes prepared to fulfill a duty.

In order to avail of the services of a component, the input and output of the component designed for the external world are used. Component communicates with the outer world only through these input and output and completely hides its inner world. These communication points are usually programmed by using the Facade design template.

The Facade design template is a programming approach. In all programming approaches, as codes get longer, their intelligibility decreases considerably. It sometimes becomes completely unintelligible. This problem has existed since the beginning of programming. Struggles to cope with this problem are ongoing. An important programming approach that emerged during this process is Facade design template.

In the design given below, outer components such as Addcard and showcard provides communication with the external world through AndroidProgramFacadeImplementation class.

AndroidProgramFacadeImplementation class can be defined as an interface. Thus, the service provided by the component based on the place it is used can be changed without tagging the class (client). To that end, various Android Program Facade implementation classes are programmed in the component. An interface implementation, required by Android Program Facade Implementation in accordance with the requirements of the user class, is created and given to the user class. The diagram in Fig 11.1 below shows that it is possible to create very flexible links among the parts of the system by using interface classes. Interface classes should be preferred in order to create flexible and maintenance friendly systems.

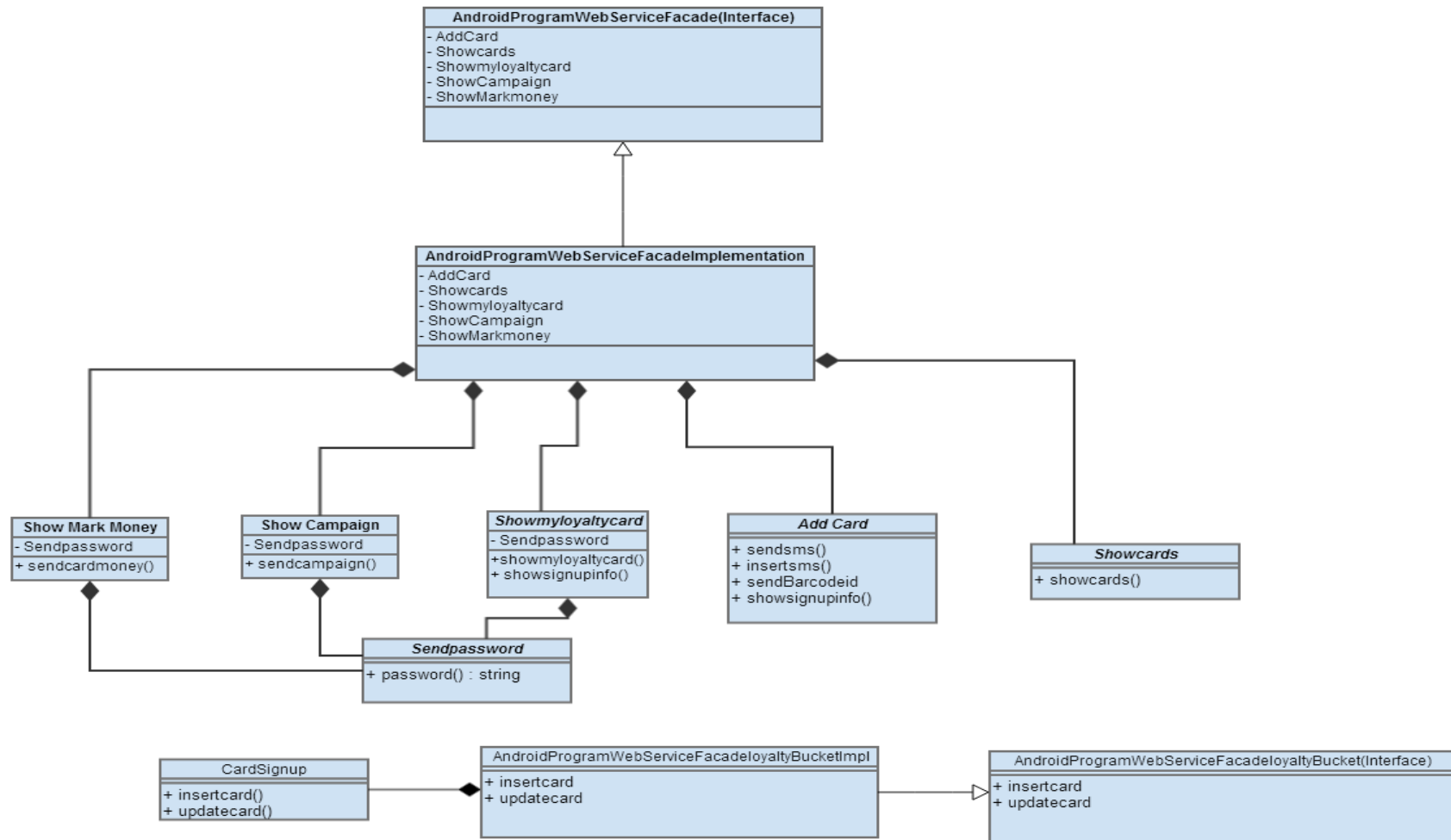


Figure 11.1: Web Service Facade Diagram

11.2 Android Program Web Service

- **Android Program Web Service Facade**

Android Web Service carries out the main tasks of the system based on the design pattern, and this system is an interface that basically sustains the system. This interface was built to facilitate implementation.

- **Android Program Web Service Facade Implementation**

This class implements Android Program Web Service Facade, and thanks to other subclasses, it includes main functions of Android Program Web Service in a way that does not lead to code complexity.

- **AddCard**

This class shows the phases of the card before being added, and adds the card to the application by performing certain methods.

The sendBarcodeid() is the function that sends the ID of the barcode existing in the system of the company to the system.

The insertsms() function generates a random number between 1000000 and 9999999 once the barcode ID is accurately entered and sends it.

The sendsms() function checks the accuracy of the SMS value generated by the system. It performs this by sending the value back to the system.

The showsignupinfo() is the service that sends user data to the loyaltybucket application of the company system after the confirmation of the SMS information.

- **ShowCards**

This class contains the method that enables the application to list the cards registered to the system of the company.

The showcards() makes it possible for loyalty cards registered to the system to be listed.

- **Showmyloyaltycards**

This class enables the use of users' cards. It also sends methods that includes user data of these cards. In addition, it uses the password classes so as to generate QRCode and NFC required for the use of the cards.

The `showmyloyaltycards()` is a service that enables sending the user's cards to the application. Thus, the user can see the cards he or she has on a list in the mycard section.

The `showsignupinfo()` sends user data of the card to the application.

- **ShowCampaign**

This class includes the method showing the campaigns of the card added by the user. It also the password class for generation operations.

The `showcampaign()` lists the campaigns belonging to the user.

- **ShowMarkMoney**

This class includes the method that enables the user to use the points of the cards he or she added. It uses the password class to generate QRCode and NFC.

The `sendcardmoney()` is the function which lists the points of the card the user added, and it enables these points to be used.

11.3 Android Program WebService LoyaltyBucket

- **AndroidprogramWebServiceFacadeLoyaltyBucket Facade**

`AndroidprogramWebServiceFacadeLoyaltyBucket` carries out the main tasks of the system based on the design pattern, and this system is an interface that basically sustains the system. This interface was built to facilitate implementation.

- **AndroidprogramWebServiceFacadeLoyaltyBucketFacadeImpl**

This class implements **AndroidprogramWebServiceFacadeLoyaltyBucket**, and thanks to other subclasses, it includes main functions of Android Program Web Service in a way that does not lead to code complexity.

- **CardSignUp**

This class produces web services for the database of the application. It send the user data of the added card to the system and includes the service method that enables the update of these data.

11.4 SAMPLE SERVICE METHOD

The Loyaltybucket application services are discussed with two examples. Whether the company system is created with JAVA or ASP.NET makes no difference. However, as there is no contracted company yet, both ASP.NET and JAVA were used as examples.

- **insertcard() function ASP.NET**

Function queries are embedded in the database by using the stored procedure. Necessary parameters were entered with ADO.NET, and the insert method was run. Below are the spCreateSignupUser store procedure that is used for the insertcard method and the insertcard() method.

- **Advantages of Using Stored Procedure [29]**

- 1) As it runs in the database and keeps data such as query plans in the memory, it performs very well when running on the data in the database.
- 2) It is cleaner than the SQL method embedded in the application code.
- 3) It can be advantageous in terms of security since SQL codes are kept in the database.
- 4) Because SQL codes are not embedded in the application code, port operations from a database to server to another server type (e.g. from SqlServer to Oracle) become easier.

```
USE [LoyaltyBucket]
GO
ALTER proc [dbo].[spCreateSignupUser]

    @name nvarchar(50),
    @surname nvarchar(50),
    @email nvarchar(50),
    @userName nvarchar(50)

AS
BEGIN

    SET NOCOUNT ON;
    insert into LoyaltyUser(Name, SurName, Email, UserName) values
    (@name, @surname, @email, @userName)

    return 0;

END
```

```

[WebMethod]
    public bool insertcard(string Name, string Surname, string Email,
string Username)
    {
        bool sonuc = false;
        using (SqlCommand comm = new SqlCommand("spCreateSignupUser",
DBConnect.ConnStr))
        {
            comm.CommandType = CommandType.StoredProcedure;
            comm.Parameters.AddWithValue("@name", Name);
            comm.Parameters.AddWithValue("@surname", Surname);
            comm.Parameters.AddWithValue("@email", Email);
            comm.Parameters.AddWithValue("@username", Username);

            if (comm.Connection.State == ConnectionState.Closed)
                comm.Connection.Open();
            if (comm.ExecuteNonQuery() > 0)
                sonuc = true;
            comm.Connection.Close();

            return sonuc;
        }
    }
}

```

- **ShowCards() function in JAVA**

The showcard function is a web service required for the listing of the loyalty cards with the launch of the application. Some adjustments must be made so that the server will send the web service. As SOAP is used in the application, Apache Axis 2 and Apache Tomcat are also used. Java web services are called by using MySQL database. Therefore, it is necessary to add the mysql-connector library to the Tomcat folder so as to make a connection. Axis2 and Tomcat are briefly discussed below.

[30]Apache Tomcat: Tomcat is a Java based web application container. In other words, it is possible to view an Internet page composed of Html codes on a browser without any need for a software. However, pages created with programming languages such as asp and java need servers. And Tomcat is a server software. Tomcat is a java server. In order for you to be able to display web applications developed with Java, server options of Apache Tomcat on your computer must be adjusted.

[31]Axis 2: Axis 2 is a core machine created for web services. It can be called a project developed by Apache, which enables people to design and write by using SOAP. It supports Java and C programming languages. It also supports Rest and Spring Framework

Below are some of the features of Axis 2:

- New XML process core model, AXIOM (AXIs Object Model)
- A blocking and non-blocking client API (application programming interface)
- WS-Addressing support
- Support for HTTP (Hypertext Transfer Protocol), SMTP (Simple Mail Transfer Protocol), and TCP (Transmission Control Protocol)

Chapter 12

DATABASE DESIGN

Two different groups of databases will be used in the LoyaltyBucket application. One of them is the application's own database. The other one is a database used by each company. The application will not enable direct access to data in databases used by companies. As there is no contracted company in the project yet, a database architecture design was created on a minimum-level structure for the application to actively run. Below is the database designed for the smooth functioning of the application.

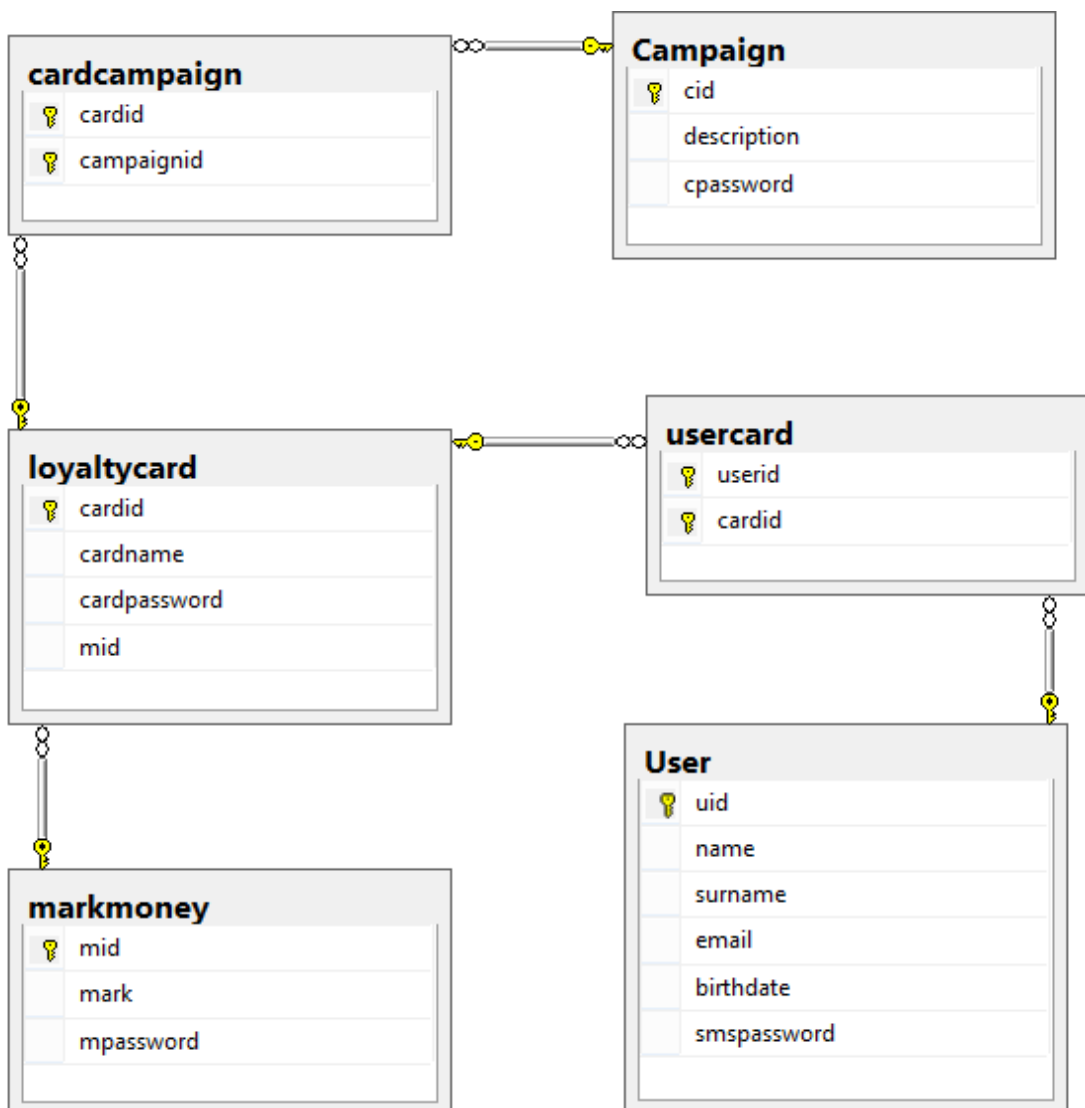


Figure 12.1: System Database Design

In the diagram above, minimum fields for the user are defined on the user table. There are fields for name, surname, e-mail address, date of birth as well as SMS password, which is necessary for the security of user data.

The campaign table contains the definitions of the campaigns, and the password field required for the use of campaigns is defined.

The markmoney table has the mark field and the password field necessary for the use of mark. On the loyalty card table, which affects the operation of the system, there are the cardname field, in which the card name can be entered, and the cardpassword field, required for the use of card. In addition, several associations are defined, and abbreviations are added to associations by the use of a foreign key. The mid field is the ID area showing the points of the card and is associated with the markmoney table.

The usercard table is linked to the user and loyaltycard tables. This table was created by taking into account the fact that each user might have more than one card.

The Cardcampaign table is linked to the loyaltycard and campaign tables. This table was created by taking into consideration the fact that one card might have more than one campaign.

12.1 What is a Foreign Key and when is it used?

The use of a foreign key enables the association of tables. It is used to restrict the values that will be entered into certain columns with a range in a column of another table. When restrictions are made, values entered into the table are regarded as data located on the table associated with the Foreign Key. Hence, restrictions are made. If it is intended to make associations without using a Foreign Key, values that are not present in the range of the primary field of the associated table can easily be entered into the table which is associated.

Chapter 13

IMPLEMENTATION

This part focuses on the appropriate development of the Android Client after the completion of the design of the Loyalty Card application's database and the creation of web services. First, the class diagram of the application was created here, and each phase of the application is examined on this diagram. Besides, security measures in use are explained. In addition, software and hardware tools used in the application are also mentioned. Besides, Android and external libraries used in the application are discussed in detail.

Since the application appeals to everyone, 2.3.3 version of Android is used so that the application will reach a wider range of users.

13.1 TOOLS in USE

Programming Languages in Use

In programming, Oracle's Java platform's JDK 1.6.0 and JRE 6 are used. The reason for the use of Java is that Android SDK only operates on Java and that it is object-oriented. The ability to write more standardized codes, offered by object-oriented programming, when project codes are written, and the resultant opportunity to produce simple solutions make code writing easier. Another reason for the adoption of Java is that it has a wide package library. While some parts of the codes can be more difficultly written with mid-level programming languages such as C, these parts are written more easily with Java.

Software Tools in Use

Eclipse is used as IDE because Android SDK and all the other components operate compatibly on Eclipse. Apache Tomcat is used as the server for Web Services. Tomcat is preferred as it is a fast server. Android SDK is used in order to write an Android program. SDK includes all Android versions. However, Android 2.3.3 is used so that the application will reach a wider range of users. As there were no server when the application was written, web services were run locally. Those services are run on the emulate on the 10.0.2.2 IP and on Tomcat's 8080 port. Thus, local services are called as 10.0.2.2:8080. SOAPUI is used to check whether web service functions properly. This program enables one to enter certain inputs into applications so that correct output is given. As databases of web services are flexible, they are examined differently. However, MySQL is used in this section of the application. This database was preferred because it is the most comprehensive and useful free database.

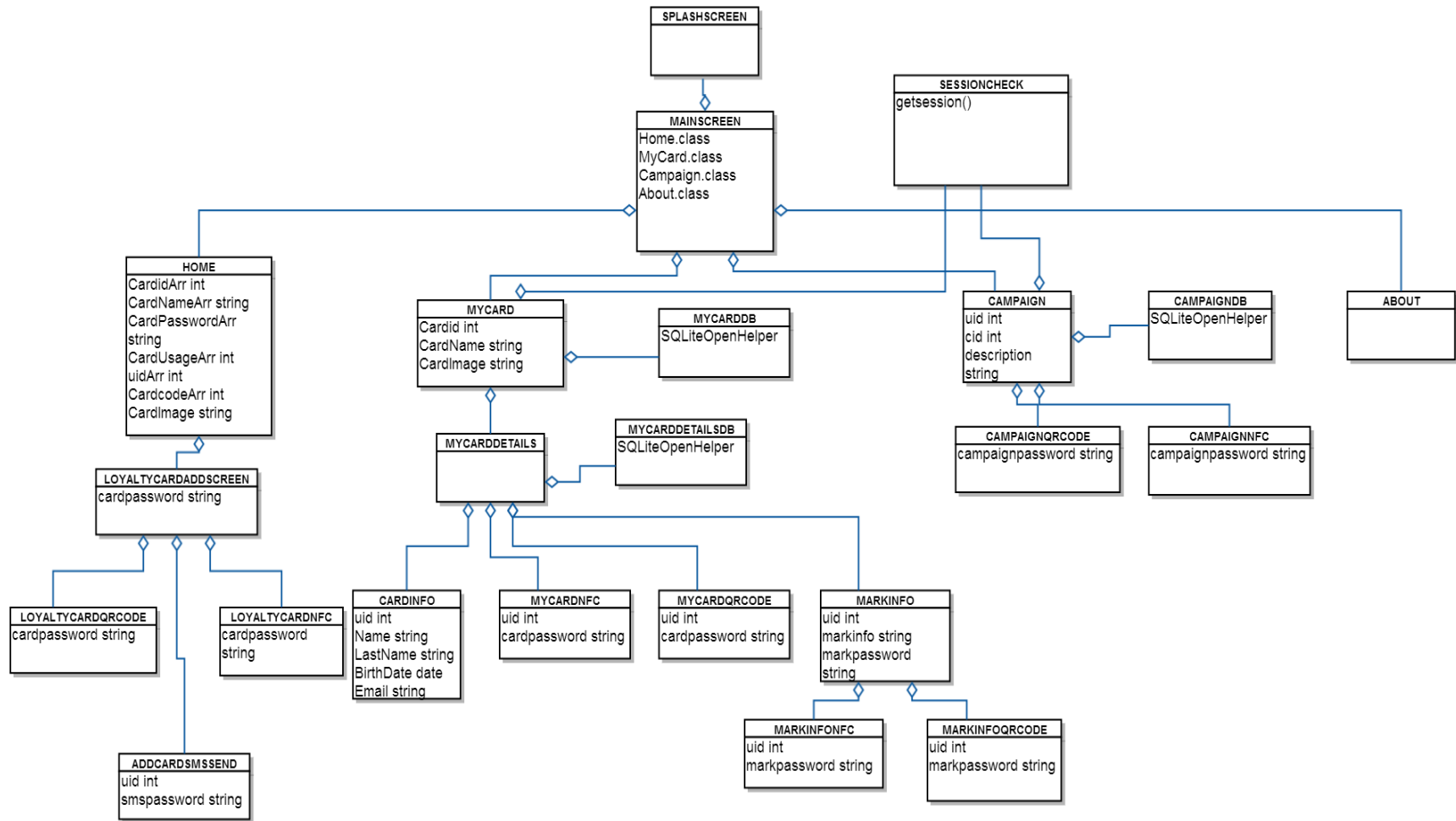


Figure 13.1 Class Diagram

13.2 Security Measures Adopted in the Application

Some safety precautions were developed during the development of the LoyaltyCard application and discussed in the section. The components in use and security features of protocols will be examined altogether as items.

1) The user must send the card's ID to the system to register his or her card among other discount cards used in the application. After this operation is approved, an SMS password is sent to the user, who is registered to the company in question. The user can begin to use the card after entering the password he or she received. Thus, it is now possible to confirm whether the one who entered the card information is the real user or not.

2) The user starts to use the card by clicking on NFC or QRCode technologies. Also, he or she can use campaigns and accumulated points of the card by doing this. When the card is in use, the systems send a password for the card, campaign, and points. This password is for a single use. The system automatically generates a new password for each use. Furthermore, each password has an expiration duration. Therefore, creation of a dynamic password system prevents security risks and precludes static and multiple use of the same campaign.

3) NFC is a technology operating in a short distance. Two NFC-compliant devices must be at least 4-10 cm close to each other for NFC to operate. Devices that enable the enhancement of coverage area of NFC send off electromagnetic waves. These waves can be perceived physically. Thus, it is very difficult for the user data on the user's cell phone to be stolen.

4) The loyalty card application uses a security certificate so that no data will be erased between the company database and system database, and also between the system database and application. Another purpose of that is to prevent any losses and external attacks. Data are encrypted. Hence, external factors cannot steal data until they reach the application.

13.3 Important Components Used in the Application

In this section, patterns used in the implementation phase of the application and libraries are explained in detail. First, information about the component is given, and then the reason for its use in this application is discussed.

SQLite [32]

SQLite and how it operates on Android are explained here. It is an independent database library and engine the use of which is simple. It does not occupy much space and can be used smoothly on mobile devices. It is open source coded. SQLite can be used with tens of programming languages. The reasons for its preference are that it does not occupy much space and performs data operations at the desired speed. SQLite database supports TEXT NUMERIC INTEGER REAL NONE data types. The use of SQLite in the application enables all of the user's cards to appear each time. It will be further discussed in the classes.

ksoap2: In order for chosen system data to be taken and for the Android client to connect to SOAP web service, ksoap2 library is used. When SOAP web service is called, ksoap2 library makes things easier for us. The use of the client api will enable the application to get data in the database, and we will request them.

zxing: Pronounced "zebra crossing", ZXing is an open-source and multi-format 1D/2D barcode image processing library. It is implemented in Java and has ports to other languages. We focus on the use of the built-in camera on mobile phones to scan and decode barcodes on the device, without getting in contact with a server. Yet, one can use the project to encode and decode barcodes both on servers and desktops. Zxing library enables the creation of QRCode so that cards, campaigns, and points in the application can be used.

SMSmanager: It manages SMS operations which include sending texts, data, and SMS messages. One can obtain this object by calling the static method SMSManager. We have been able to send SMS to the user's cell phone by using SMS manager, which has existed since Android level 4, while first registering the card to the application.

[11] NFC Android Beam: It enables simple peer-to-peer data exchange between two devices running on Android. It is essential that the application trying to send data to another device is in the foreground. Furthermore, the device which receives the data should not be locked. When the device sending data is sufficiently close to the device receiving data, it first displays the "Touch to Send" UI. It is up to the user to decide if he or she is going to send the message to the device receiving data.

An activity is able to send solely one NDEF(NFC Data Exchange Format) message at a time. Therefore, if both are set f, setNdefPushMessageCallback() has a priority over setNdefPushMessage().The general guidelines must be as follows for the use of Android Beam:

- The data sending activity should be in the foreground. The screens of the devices must be unlocked.
- The user must enclose the data that is being sent in an NdefMessage object.
- The data receiving NFC device must support either the com.android.npp NDEF push protocol or NFC Forum's SNEP (Simple NDEF Exchange Protocol). Devices on API level 9 (Android 2.3) and API level 13 (Android 3.2). Both SNEP and com.android.npp are a must on API level 14 (Android 4.0) and later.

AutoUpdate: An automatic update module was added to fix new features or missing and faulty parts. Thus, it is possible to easily add new versions to the application thanks to the autoupdate feature. The functioning of the autoupdate mechanism is based on versioning. The system is based on the version code in the Android manifesto document. There is a document named Version.txt in the server section of the application. The application compares the version code written here with one in the manifest. If the one in the server is bigger than the other one, the first installs the new apk, and the user does not need to do anything else for that. Internet connection is enough for the application to perform. When the application is first run, it is possible to install its latest version if a message such as “A new update was found. Install it.” pops up on the screen.

It takes the version code in the manifest document.

```
serverversionName = GetVersionFromServer();
```

It takes the version code in Server

```
textUrl = new URL(textSource);
BufferedReader bufferReader = new BufferedReader(
    new
InputStreamReader(textUrl.openStream()));
String StringBuffer;
String stringText = "";
while ((StringBuffer = bufferReader.readLine()) !=
null)
{
    stringText += StringBuffer;
}
bufferReader.close();
versionName = stringText;
```

[33]HashMap: Map interface was designed to keep key-value pairs together. Map data structure is the software equivalent of functions in mathematics. It is frequently used in software architecture. It is possible to give ID numbers to objects in the software and to form a key-value relationship between this number and the object. In this way, we can easily access to any object through the ID number. Java map interface does not restrict anything. It is not certain whether key-value pairs added to map will remain in the same order. HashMap is the most famous class that authenticates Map interface. HashMap creates an array index from the given key with the hash function. The value given is also placed into the memory in this array index. Hash functions are fast in that they use very basic mathematical processes. Hence, accessing data in HashMap happens in a certain period.

Bundle: It is used for sending parameters from an activity to another. The onCreate method is defined as bundle in classes.

```
public void onCreate(Bundle savedInstanceState)
```

13.4 SYSTEM PROPERTIES AND DESIGN

Classes of the project and their structures are discussed here. There may be some additions to or subtractions from these structures because the requirements of the project are constantly changing and being updated. You can find codes in detail in the Appendix section.

SplashScreen: This class constitutes the opening screen of the application. By using a thread, it directs the user to the home page after showing the image created by xml for 4 seconds.

MainScreen: This class enables access to main classes as a tab under the application. Home, MyCard, Campaign, and About tabs can be accessed through this class.

Home: The Home class lists all the registered cards in the application. The user first chooses the card he or she wants to use in this class. Here, web service, created to list the cards by using SOAP, is called. The user benefits from ksoap2 library. The returned value is stored via XML. The XML parsing method is used to extract values in xml. Then, values are viewed as a list thanks to HashMap.

LoyaltyCardAddScreen: Here, the user enters the number of the card he or she wants to add. There are three options in this section, which are manual access, sending via QRCode, or NFC. SOAP provides the service of sending card confirmation number.

LoyaltyCardAddScreenDB: The application uses SQLite here. The user of the entered card ID is detected. Then, SQLiteOpenHelper is called so that the user ID will be registered to the SQLite database. The registered user ID is called again.

LoyaltyCardQRCode: This class performs the operation of adding cards to the application via a scanner. It runs the barcode scanner by using the zxing project and sends the barcode to the system after reading it.

LoyaltyCardNFC: This class enables the reading of a card that has an NFC tag by using the NdefMessage and NdefRecord features of Android.

AddCardSmsSend: Thanks to the Android SMSmanager feature, 4 digit passwords, which change for each use and are specific to the user, are sent to cell phones. The user enters the password that is received in edittext through the service, and it is confirmed.

MyCard: This class calls the operations for the use of the card. User data in the database appears here. Card data, which come from web service as xml based on the user ID, are parsed and shown in the application with the layout inflater.

MyCardDB: It brings card data of the user one more time when he or she saves card data into SQLite structure, which is used in the application.

MyCardDetails: This section calls the service that displays card data. Card data are viewed as a list.

MyCardDetailsDB: This class stores some card data in SQLite.

CardInfo: This class stores user data, name, surname, e-mail address, and date of birth. It extracts these data from SOAP service system. In addition, data in edittext are changed and updated. Updated data are delivered to the system again.

MyCardNFC: This class writes the password, which comes so that the card can be used by the utilization of the NdefMessage and NdefRecord features of Android. The password is written in a way that the reader can read it.

MyCardQRCode: Here, the system, which randomly changes, sends a password. This password is converted to QRCode. Then, it is scanned with a barcode scanner, and the card can be used. QRCode is coded with the core2.0.jar library.

MarkInfo: This section shows the number of points the card has. It displays the latest card data, received from web service, in the application.

MarkInfoNFC: This class writes the password, which comes so that the mark can be used by the utilization of the NdefMessage and NdefRecord features of Android. The password is written in a way that the reader can read it.

MarkInfoQRCode: Here, the system, which randomly changes, sends a password. This password is converted to QRCode. Then, it is scanned with a barcode scanner, and the marks can be used. QRCode is coded with the core2.0.jar library.

SessionCheck: This class enables us to introduce all the tables in SQLite and the display of the user's cards when he or she launches the application.

Campaign: In the campaign section, user-specific campaigns of the card can be viewed with arraylist. Campaigns, called with SOAP, can be used by clicking on them.

CampaignDB: It enables campaign operations to be saved in SQLite and displayed.

CampaignQRCode: Here, the system, which randomly changes, sends a password. This password is converted to QRCode. Then, it is scanned with a barcode scanner, and the campaign can be used. QRCode is coded with the core2.0.jar library.

CampaignNFC: This class writes the password, which comes so that the campaign can be used by the utilization of the NdefMessage and NdefRecord features of Android. The password is written in a way that the reader can read it.

About: This class gives general information about the application by using the Android XML interface.

Besides, there should not be any problem with the Internet connection, and the system needs to be connected to web service. In this step, the Internet connection between the bank and Android web service is crucial rather than the client's connection. This is because money points and campaigns are used at this point, and transactions should roll back in case of a disconnection.

13.5 Design of the Help System

A Help file about the use of the program will be prepared. It will be accessed by clicking on the help menu of the program. This file demonstrates the functions of the interfaces and the functions of the program which concern the user.

Chapter 14

DISCUSSION AND CONCLUSION

This section discusses the opportunities in the future of the system and focuses on what kind of an income and business model can be created for the project.

14.1 Crossing the Chasm [34]

When Everett Rogers published his book in 1962 which puts forwards the diffusion of innovations theory, the question he was trying to answer was this: How, why and how much can technology ideas, technology products, or technology approaches become more common and how fast can they dominate the market?

The intercultural rate of acceptance of a technology idea, product, or approach follows a curve called S. Rogers schematizes this curve as such:

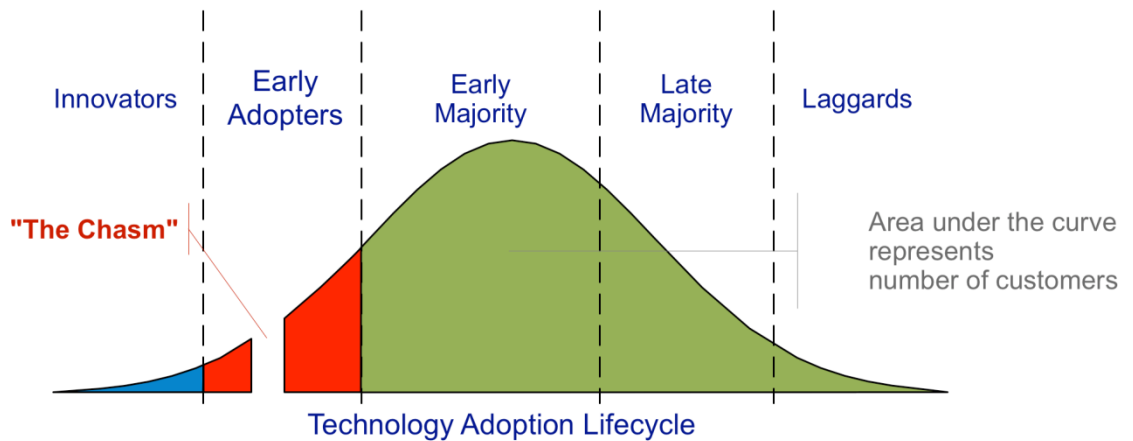


Figure 14.1: Crossing the Chasm [35]

There is a big trench between Early Adopters and Early Majority in the technology arena. Transition between these two segments is not easy, and a vast majority of companies fail as they cannot surpass this trench.

There are 5 main parts in the spread of technology: knowledge acquisition, persuasion, decision making, implementation, and confirmation of results. These five processes interact as such:(As seen in Fig 14.1)

1. The person or the institution starting the innovation informs people about the subject.
2. Other people or institutions assume an attitude towards the innovation.
3. People are provided with the opportunity to adopt or reject the innovation.
4. This new idea is put into practice.
5. The accuracy of the decision and implementation is discussed.

14.2 Bussiness Model

An analysis of the diffusion process of technology reveals that the diffusion of the business model is a process which must be handled extremely cautiously after the software project has been developed. The Loyalty Card application will spread more easily and be used more commonly thanks to the efficient use of discount cards, which have a global high potential, and the orientation of the rapidly developing technology towards mobile services. It is aimed to increase the use of the application in the first phase. Then, the application will be a good advertisement area as the number of users and companies, which are contracted for the loyalty card application as an income model, increases. This is because the main objective of the application is shopping. Additionally, the application allows the sale of products at reasonable prices by the use of personal campaigns, as in the case of opportunity sites. Moreover, a rewarding system can be implemented. Brands can give points to those who visit their stores by using location APIs and the Loyalty Card application. Brands want to reward their customers. Thanks to the application, brands can see how many times customers visit their stores, how much time they spend, and how loyal they are to the brand.

Chapter 15

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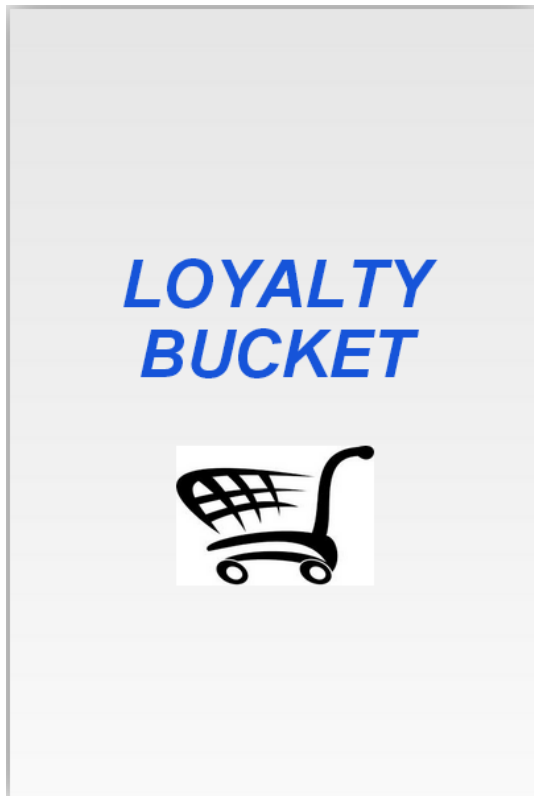
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[37] Emir Husni, Sugeng Purwanto E.S.G.S 2012 International Conference on System Engineering and Technology *Shopping Application System With Near Field Communication (NFC) Based on Android* September 11-12, 2012, Bandung, Indonesia

Chapter 16

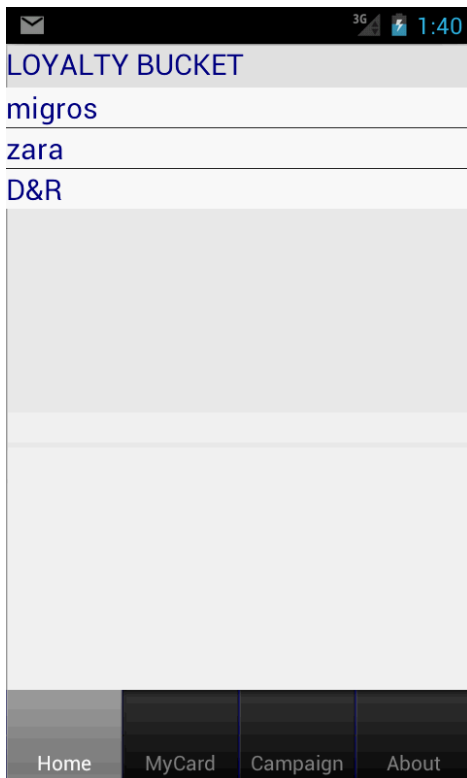
USER MANUAL

1.page



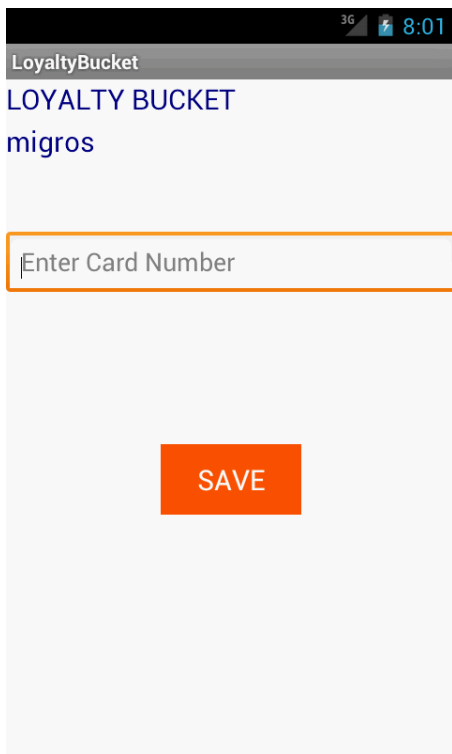
The first page is the one that the user encounters when he or she runs the application. We also use this page to show our logo. This page stays on the screen for about 5 or 6 seconds. Connection with web service can asynchronously be provided in the background.

2.page



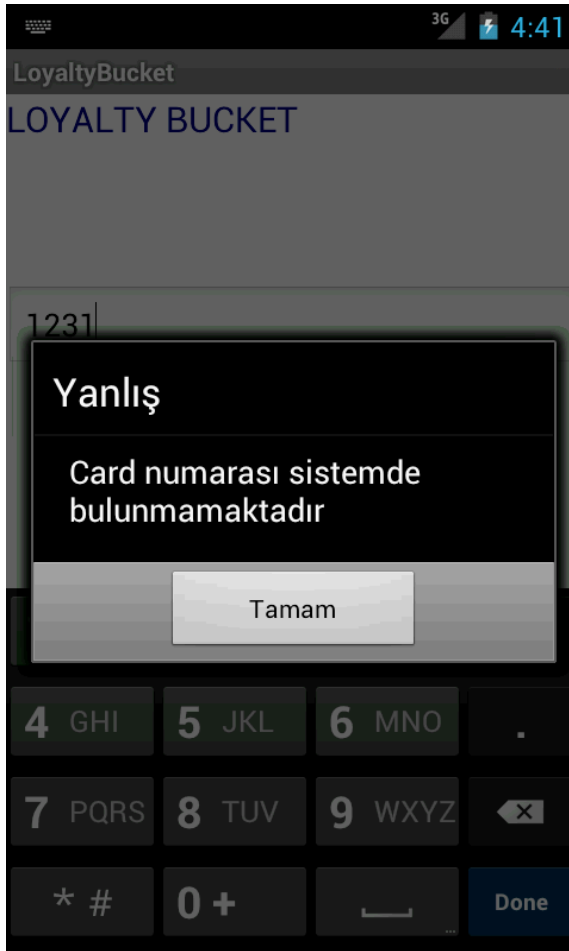
The second page displays all the registered cards using to a listview. In addition, the menu can be viewed as a table below.

3.Page



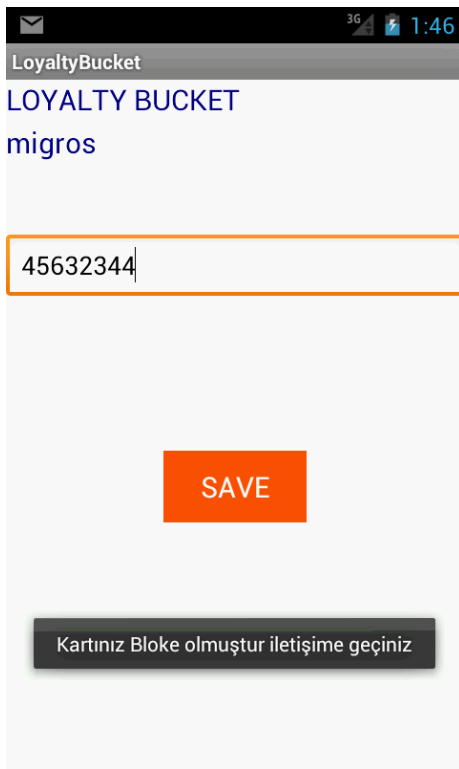
This is the section where people can add their cards. They can choose the cards that they want to scan.

4. Page



If a card the number of which is not on the system is entered, information is shown on the dialogue screen.

5.page



If the card is blocked, it becomes invalid, and this is shown as a message at the bottom.

6.Page

LoyaltyBucket

vodafone

The latest Android™ range has now landed

Play, browse and watch with free smartphones from just £30 a month

Includes 6 preinstalled games

PlayStation Certified

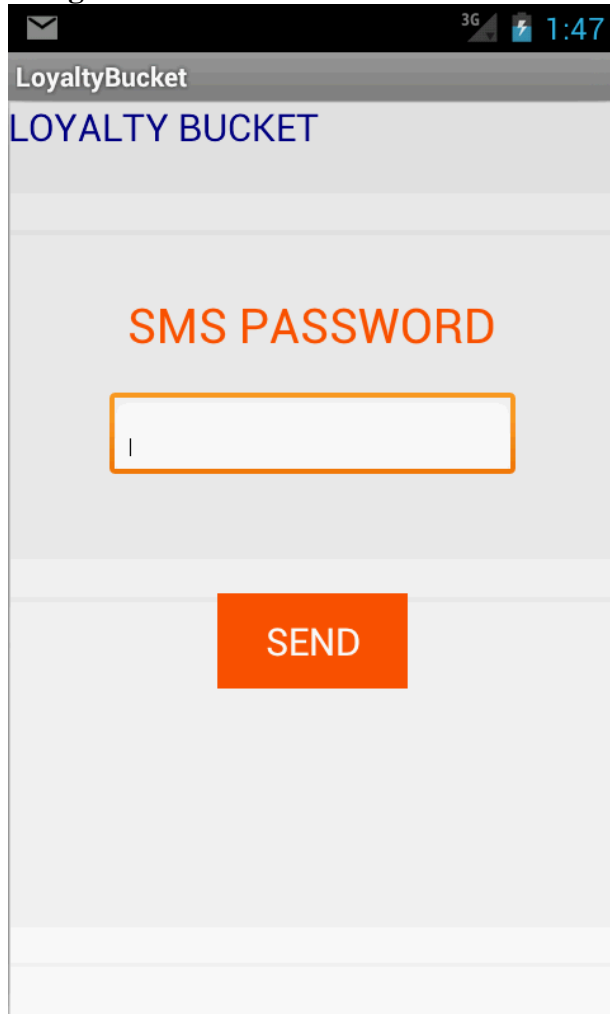
Free Sony Ericsson Xperia™ Play	Free Sony Ericsson Xperia™ Arc or HTC Desire S	Free SIM only on a 12-month contract
£35/month	£30/month	£10/month
900 minutes	600 minutes	300 minutes
Unlimited texts	Unlimited texts	Unlimited texts
500MB	500MB	500MB

Call 08080 XXX XXX today

Search online for 'Vodafone deals' or go to

Advertisements are shown by the database. Advertisements can be closed by clicking on the x mark on the upper right corner.

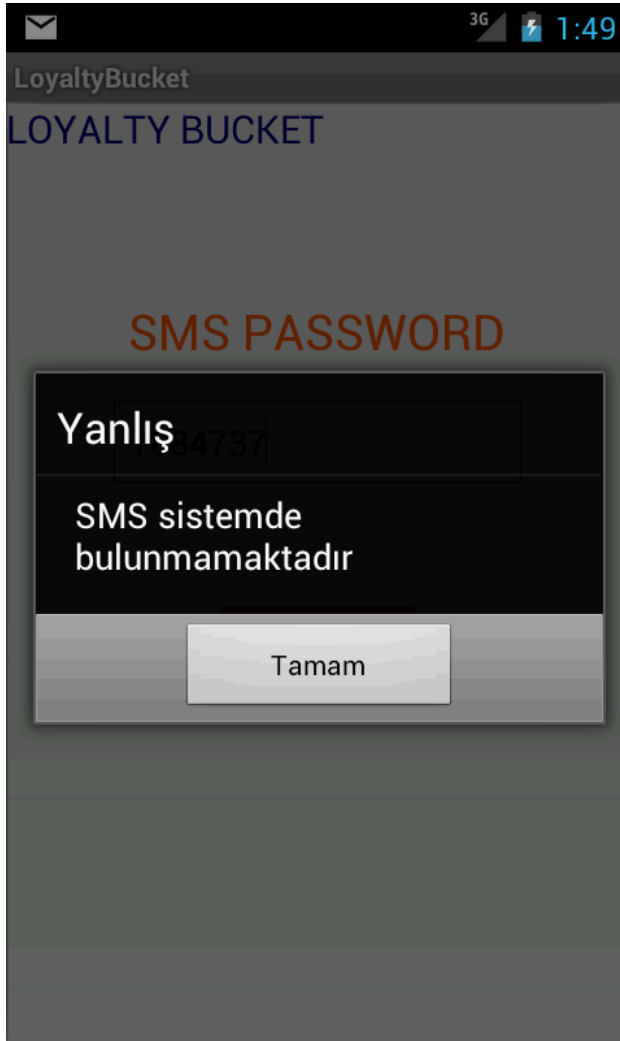
7.Page



The screenshot displays a mobile application interface. At the top, there is a status bar with a mail icon, 3G signal strength, a battery icon, and the time 1:47. Below the status bar is a header with a mail icon and the text 'LoyaltyBucket'. The main content area features the text 'LOYALTY BUCKET' in blue. Below this, the text 'SMS PASSWORD' is displayed in orange. Underneath is a white text input field with an orange border and a cursor. At the bottom of the form is an orange button with the text 'SEND' in white.

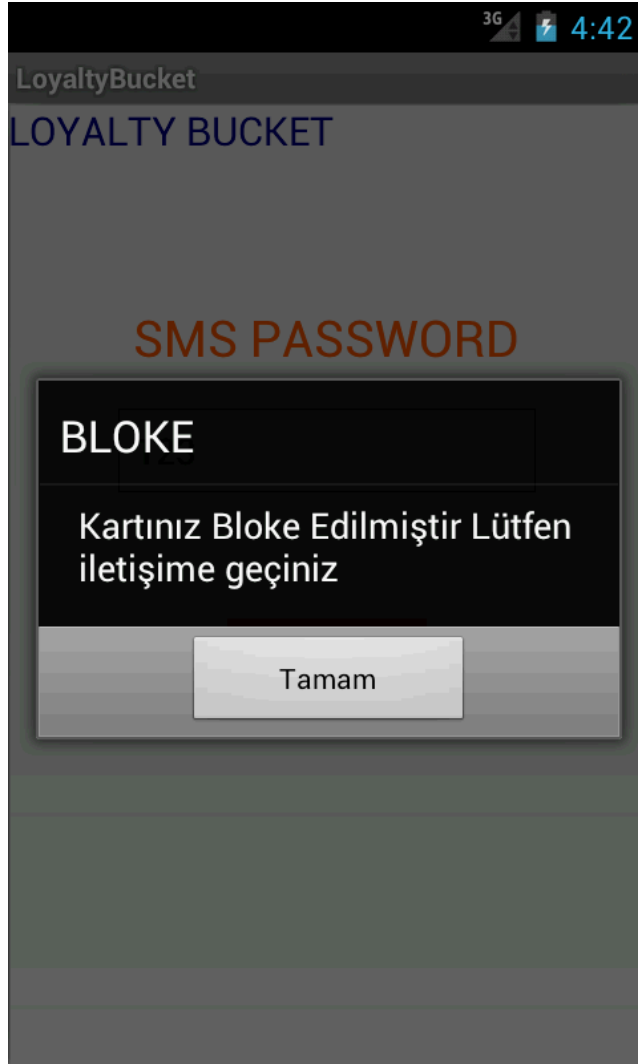
Once the card is accurately read, a screen on which the SMS password that is sent to the cell phone can be entered appears. The password is entered onto this screen, send button is clicked, and sent to the system with web service.

8.Page



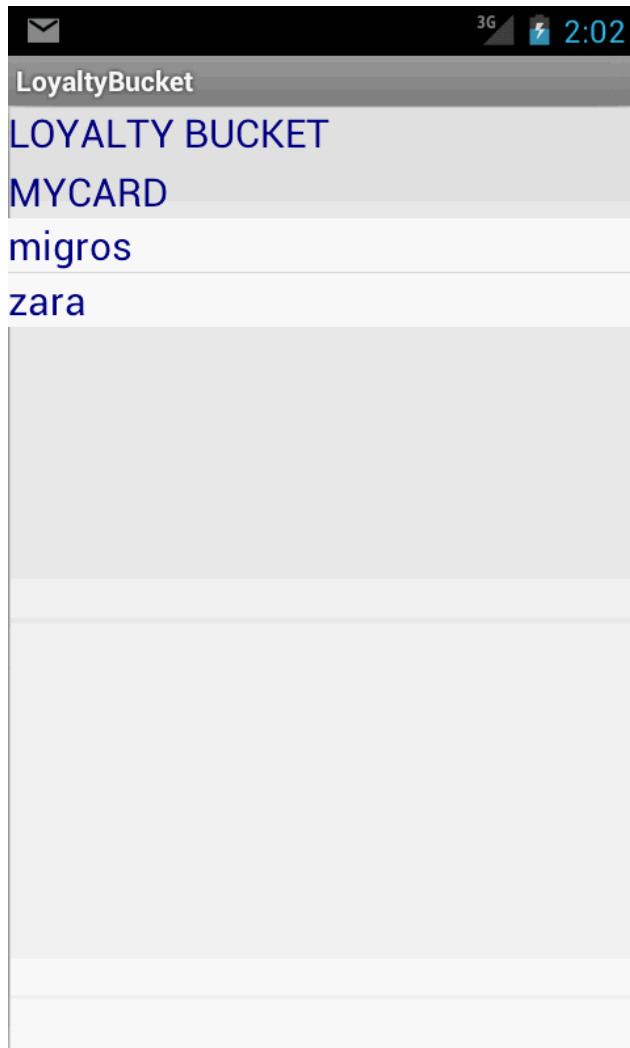
If the received SMS password is entered incorrectly, information is provided as a dialogue message.

9.Page



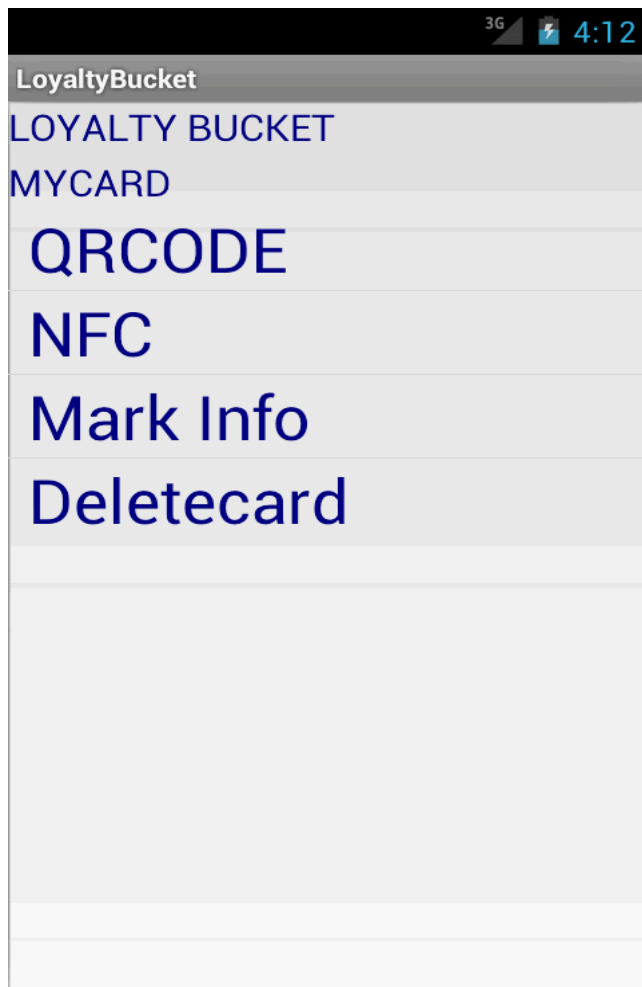
If the SMS password is entered incorrectly three times, the card is blocked, and information is provided in a dialogue message.

10.page



After IDs of the user's cards are confirmed, all of them can be accessed from MyCards tab.

11. Page

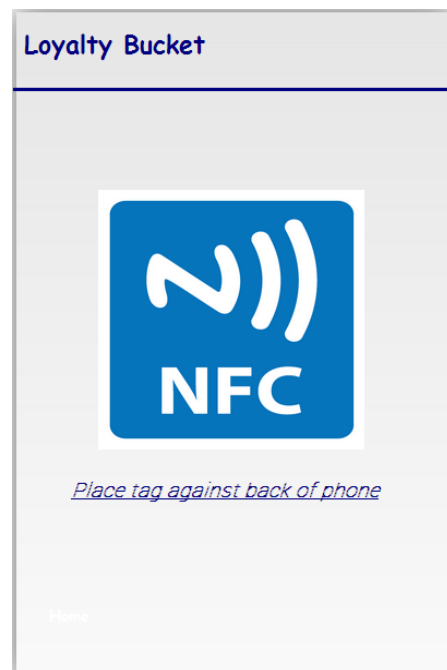


This is the screen where the card can be used once the SMS is confirmed. In this section, we can choose the standards for the use of the card. We can also view card data and points accumulated in the card. When we do not want to use the card any longer, we can delete it here.

12.Page

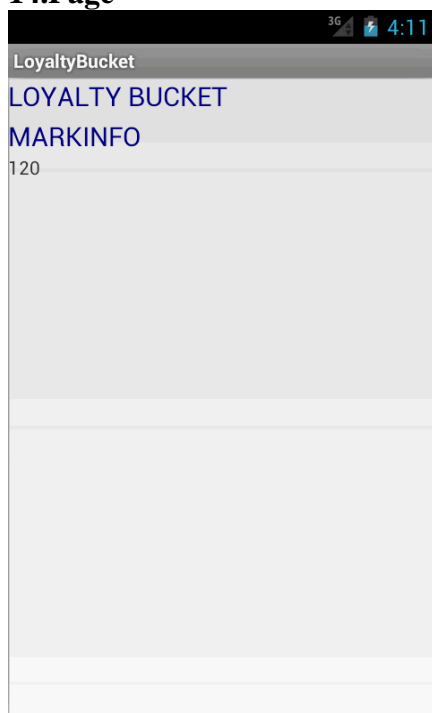


13.Page



When the QRCode section is clicked, the application generates a QRCode considering data from web service so that the card will be read. Similarly, when the NFC section is clicked, the user is directed to the screen where data can be transferred as NFC.

14.Page

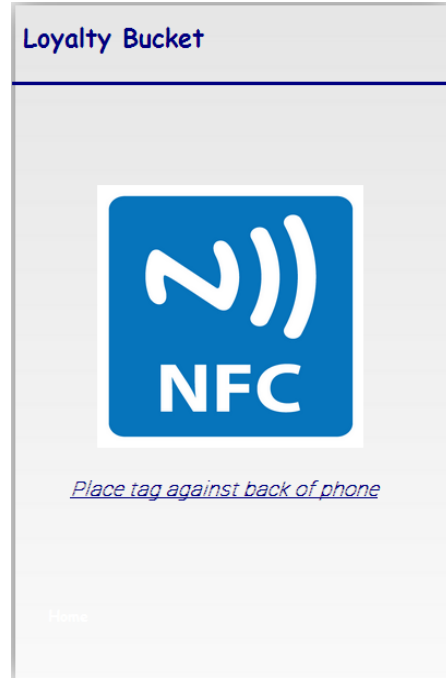


The Mark Info section displays points the user gained by shopping with the card.

14. Page

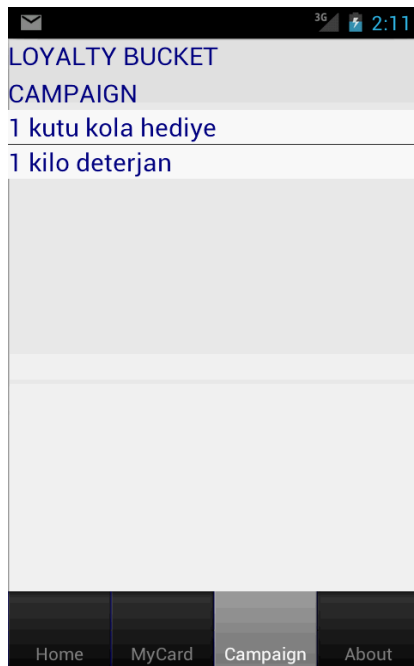


15. Page



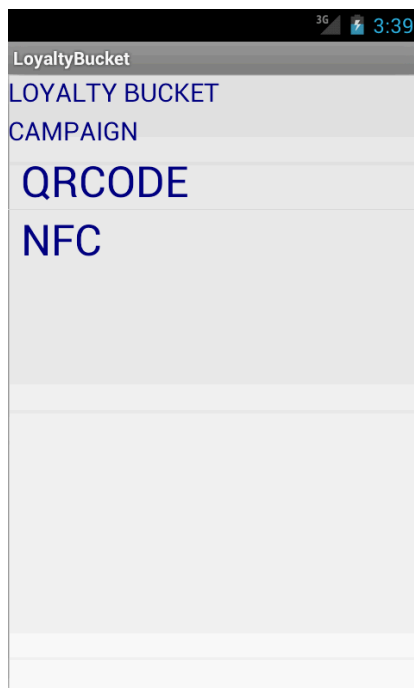
When the QRCode section is clicked, the application generates a QRCode considering data from web service so that the marks will be read. Similarly, when the NFC section is clicked, the user is directed to the screen where data can be transferred as NFC.

16. Page



After the card is clicked on in the campaign section, the screen with the list of the card's campaigns and discounts appears. Campaigns here are updated on a regular basis. The user clicks on the discount he or she wants to use and skips to the other screen.

17. Page

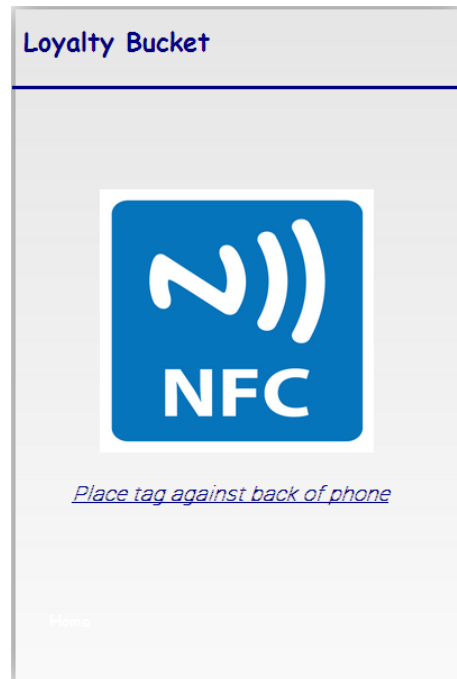


On these screens, the user performs the reading operation of his or her discount coupon by choosing either QR Code or NFC.

18.Page



19.Page



When the QRCode section is clicked, the application generates a QRCode considering data from web service so that the campaign will be read. Similarly, when the NFC section is clicked, the user is directed to the screen where data can be transferred as NFC.