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Department of Computer Science

**Mobile and Service Based Airline Reservation
System for Ethiopian Airlines**

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**Mobile and Service Based Airline Reservation
System for Ethiopian Airlines**

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A PROJECT SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES IN
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List of Abbreviations

MBRS	Mobile Based Reservation System
SITA	Société Internationale de Télécommunications Aéronautiques
IT	Information Technology
ITU	International Telecommunications Union
SOAP	Simple Object Access Protocol
XML	Extensible Markup Language
PDA	Personal Digital Assistant
HTTP	Hyper Text Transfer Protocol
CSS	Cascading Style Sheet
HTML	Hyper Text Markup Language
SOA	Service Oriented Architecture

Abstract

Effective and reliable way of delivering service plays a critical role in helping businesses engaged in the area of travel. Ethiopian Airlines is a company working in the area of aviation in Ethiopia. Booking and selling flight ticket mainly carried out by local and international ticket offices and travel agents around the world. Despite the fact that the airlines currently provides its flight reservation services on its web site ,its usage by its passengers is low specially with local customers as their access to internet is limited. Therefore in this technology dominated era there is a need to enhance ways of business transaction by providing an additional means of connecting to customers.

The use of mobile technologies are so broadening that people are depending on this technology in their day to day activities to effectively communicate and collaborate with each other whether handling their personal or business activities. One of the features of mobile technologies that have come to be broadly used is internet usage, which enables the user to browse for information and be connected to the world using mobile phones. Different mobile based reservation systems are currently being developed globally by different organizations for different purposes in the business world, airline industry, hotel , tourism etc.

After identifying the available current technologies, we have developed web services that will enable customers of the airline use its flight reservation system from their mobile phones which is more convenient and efficient.

This project is engaged in exposing the existing flight reservation system at the airlines for mobile phone users by developing services without disrupting the existing system. In addition to reserving/booking flights, the system also enables passengers to check in to flights, check status of flights, and view information concerning flights from mobile phones that has access to internet.

Keywords- Mobile technologies, mobile based reservation systems, web services, flight reservation system.

CHAPTER 1: INTRODUCTION

1. Introduction

Significant change has come in the Airline industry together with the advancement in technologies. Information technology generates fundamental changes in the nature and application of technology in business. Information Communication Technologies (ICTs) can provide powerful strategic and tactical tools for organizations, which, if properly applied and used, could bring great advantages in promoting and strengthening their competitiveness.

To meet requirements in the business efficiently, many airlines are exploring ways to use their IT infrastructures to transform their companies into more agile, profitable businesses.

Airline companies are implementing computerized systems in providing their services in which case all services that a person could possibly get by going to the airline ticket office, in person, can easily be accessed from his home, working place or any other place. Now a day's airline reservation systems provide comprehensive and integrated modules from scheduling and reserving flights to revenue accounting on an internet based platform. This accessibility ease of service in turn contributes a lot in the cost minimization of providing services.

Just like any other service providing businesses, airlines also stand to gain enormous benefits from mobile devices in terms of operational, accessibility and service innovation. Increased passenger adoption of mobility, coupled with an array of applications and high-broadband capabilities, is creating new passenger touch points, experiences, and capabilities to deliver relevant and personalized services. Many airlines like American Airlines and Air France are going mobile to accommodate the growing trend of tech-savvy consumers and are expanding their mobile marketing strategy to retain customer loyalty.

The number of mobile subscribers in Ethiopia has now reached over 18 million. Of these, 3.4 million mobile subscribers use the system to access internet service [1]. This will open door to many businesses in our country to make their services accessible from mobile phones.

The growth of mobility enabled applications is driven essentially by the same factors that are driving IT and business process change, namely the need to be more responsive, optimize the efficiency of staff resources, and shorten the cycle time of key processes throughout their value chain [2]. This growing trend of customers mobility has forced airline industries to shift from the traditional airline business models to customer mobility based models/service in order to exploit the growth of mobility, and many airlines are experimenting on providing mobility enabled personalized services for customers.

According to an annual survey on airline IT trends, co-conducted by SITA, a global provider of aviation technologies and services leveraging consumer mobile technology remains the hotspot of IT investment. Offering mobile services to passengers has topped the investment list for the last three years with almost the entire industry now investing, or planning to invest, in this area, of which 66% of airlines will make a significant investment. Nine out of ten airlines are planning to sell tickets via mobile phones by 2015, establishing mobile as a mainstream distribution channel for airline tickets. Growing from zero just a few years ago, mobile phones as a distribution channel are expected to generate significant growth in years to come [3].

ITU estimates that by the end of 2013, there will be around 6.8 billion mobile subscriptions globally, with that figure set to near the 7-billion mark in 2014 [4]. Therefore, providing a mobile based service, not only in the airlines sector but also in any other service providing business, is of a vital importance to exploit the possible and available market and to win customer loyalty.

In this very competitive industry Ethiopian Airlines can have enough ground to compete with other airlines and become competitive enough by making its services accessible from mobile. This project will enable passengers to get the airlines reservation services through their mobile phone which is more convenient these days, which in turn enables the airlines to provide its services to mobile user passengers in more convenient and effective way.

1.1. Motivation

Since mobile phone devices are found in the hand of over half of the population on the planet which implies that currently providing a mobile based flight reservation services for airline companies is much worthy than ever.

Traditional airline business model are, hence, becoming no more competitive enough in the industry which pressed many airlines to work on mobility enabled personalized service. In this competitive industry Ethiopian Airlines could benefit from making its services accessible from a mobile as passengers can easily be connected to the services that the airline provides. These ultimately increase passenger satisfaction and reputation of the airline.

1.2. Statement of problem

Mobile devices are fast becoming the place where numerous technologies meet and create applications that are useful for both consumers and businesses across the globe [5].

Ethiopian airlines have had launched web based reservation system which is mainly used by its international customers than local customers. The growth of mobile technologies in an alarming rate has forced many service provider institutions to recognize the importance of delivering content and services to users through their mobile devices. The importance is even more relevant in the airline industry. A Mobile based service will encourage users as using mobiles to get services is more convenient than any other ways. As for Ethiopian Airlines enabling users get access to its services from their mobile phone will allow its customers get service more easily than before.

The problem statement of this project is how to expose Ethiopian Airlines' reservation services for mobile user passengers with minimum cost, in a short time using easy to use technologies and without affecting the existing system responsible for handling flight reservation in Ethiopian Airlines.

1.3. Objective

1.3.1. General Objective

The major objective of this project is to design and implement a mobile based airline reservation system for Ethiopian Airlines using service based approach.

1.3.2. Specific Objective

The specific objective of this project is to

- Review similar works on mobile based airline reservation services and conduct literature review.
- Identifying the data and user requirements which need to be collected and identifying features of the system to be developed.
- To enable mobile users utilize currently working Ethiopian airlines reservation system.
- Design the mobile based airline reservation based on the identified requirements.
- Implement the system using service concepts.
- Test and evaluate the developed system.

1.4. Scope

The research and implementation of this project is strictly a flight reservation system and it doesn't include the following

- Feature that supports payment
- Hotel and car Reservation
- Airport Resource Management
- Extended Airline System Environment
- Property and revenue management
- Baggage handling system

1.5. Limitation

The system will face limitations of mobile devices like Small screen size, difficulty of data input, User agent (browser) inconsistency.

This mostly due to the fact that unlike the desktop web experience, where screen space is liberal, web access is fast and reliable, and data input is facilitated by keyboard and mouse, the mobile web experience is often a small screen, intermittent, one handed experience [6].

1.6. Methodology

The project will be developed using the agile process model as this process model enables incorporating changing requirements at any time in the development cycle. The architecture selected in this project is multi tier client server architecture in which layering provides separation of concerns and better factoring of code, which gives a better maintainability and the ability to split out layers into separate physical tiers for scalability and an object oriented design methodology will be used for design and analyses.

To achieve the objective of this project work the following processes are involved:-

- Literature review

Literature review is the major methodology that involves exploring and studying related works in mobile based airline reservation system. Different techniques and technologies in the area will be explored.

- Requirement Elicitation

The process of requirement elicitation process involves gathering information needed for the development of the system. The requirements will be directly collected from Ethiopian Airlines using different techniques including interviews, observation and system review.

- Testing and Evaluation

The system will be tested for effective implementation of the system requirements.

CHAPTER 2: LITERATURE REVIEW AND RELATED WORK

2.1. Literature Review

2.1.1. Aviation Industry

The use of Information Communication Technologies (ICTs) has changed the way how business are managed and dealt. The airline industry in particular has fostered a dependency on technology for their operational and strategic management. Airlines were early adopters of ICTs and have a long history of technological innovation, in comparison to many other travel and tourism businesses. Now a day's many airline companies are shifting from their traditional way of communication with their customers to using modern technologies. Internet becomes a suitable place to reach out to many customers and potential customers in many businesses. The airline industry is one of them which uses the internet to market its services to a wide range of passengers around the world [7].

2.1.2. Mobile phone Technology

According to ITU the number of mobile phones worldwide outnumbered fixed-line phones for the first time in 2002 [8]. There are a number of reasons for the increasing dominance of mobile phones; importantly mobile phone is more convenient for users.

Mobile phones come in different sizes some are incredibly small and some are considerably big and also the screen size, resolution, and color density varies greatly from device to device [9]. Usage of mobile phones for data communications is growing rapidly this is due to the improved network connections available for users that enabled them to use the internet through their mobile phone in addition to voice communication.

In the recent years, mobile phones have seen a number of innovations which has resulted in a vast variety of devices in the market from simple feature phones to smart phones.

The mobile devices available in the market can be broken down in to a few broad classes [6]:

- Feature Phones:

These are the most common device type. Feature phones usually come in candy bar, clamshell or slider form. They have a 12-key layout and typically come with voice, messaging and data capabilities. They are typically targeted to the general consumer.

- Smart Phones:

Smart phones share the same features as a feature phone with two primary differences: Its ability to run additional third-party applications and a larger screen size. Smart phones typically use a more full featured operating system and they are marketed as advanced multimedia devices to consumers. These devices typically include full office suites for documents and spreadsheets, spelling and grammatical applications. They also feature a full QWERTY keyboard that eases data entry, Global Positioning Systems (GPS) in which users can have access to location aware services, 3G connectivity.

- PDAs:

PDAs have much in common with the smart phone but differ in that much of their functionality is primarily oriented towards organizational tasks rather than voice communications. Another difference is that PDAs often include QWERTY keyboard and stylus in place of the 12-key layout on normal phones. They also feature a larger screen that can often switch between portrait and landscape mode.

- Voice-Only Phones:

These devices are typically extremely low-cost phones aimed at developing markets and are not relevant in the context of the mobile web.

2.1.3. Wireless Communications

The world of telecommunications is a vast and complex place, encompassing mobile, fixed, and internet connections. In past times, telecommunications and data communications were seen and treated as completely separate fields of technology. It is not possible today to talk of one and neglect the other; voice and data communications have converged in both mobile and fixed

networks. The current generation of wireless devices is built using digital technology. Digital networks carry much more traffic and provide better reception and security than analog networks.

The standards that define how wireless communication devices interact are quickly converging and soon will allow the creation of a global wireless network that will deliver a wide variety of services. In addition to voice wireless communication enabled data communication in large scale through a wireless internet. Wireless users internet experience is different from fixed users since wireless devices have limited displays and input capabilities compared with typical fixed devices such as the personal computer [8].

Wireless network capabilities in mobile phones are the main enablers to invent new appealing applications. The wireless technologies available on most mobile phones differ in the supported data rates, the communication protocols used, the communication coverage, and the energy consumption related to it [10].

2.1.4. Wireless Application Protocol (WAP) and Wireless Markup Language (WML)

The Wireless Application Protocol (WAP) is a universal, open standard developed by the WAP Forum to provide mobile users of wireless phones and other wireless terminals access to telephone and information services including the Internet and the Web, as such devices has limitations both on device wise and also on the network capability that connects them so WAP is designed considering the challenges related with wireless devices like limited processor and battery life and also imitations of wireless networks like low bandwidth and high latency as compared with wired connections [8].

WML is designed to describe content and format for presenting data on devices with limited bandwidth, limited screen size, and limited user input capability. WML presents content suitable for wireless devices with small screen as well as large screen size and works with data entry mechanisms that are common to mobile and wireless communication [8].

2.1.5. Mobile Web

Mobile web refers to the web being accessed from mobile devices like cell phones and PDAs. The reach and capabilities of mobile devices has grown phenomenally over the years. Many people are getting used to accessing information from the web over their phones. Any website accessed from a mobile device is mobile web whether it's been intended to work on a mobile or not. The biggest benefit to using mobile web is that the user can access information anytime, anywhere, and when she or he wants. It frees her or him from the boundaries of the desktop and allows accomplishing tasks from anywhere.

The number of mobile phones is more than thrice that of computers in the world. Mobile web can be the means to bridge the digital divide, to bring the power of computer and internet to the rest of the world[9].

2.1.6. Mobile Web Applications vs. Mobile Native Applications

Mobile applications come in two distinct formats: native applications and web applications. Due to differences in their underlying technology, each approach has inherent advantages and drawbacks [11].

2.1.6.1. Mobile Web Applications

Like a traditional web application, a mobile web application is built with three core technologies: HTML (defines static text and images), CSS (defines style and presentation), and JavaScript (defines interactions and animations). Since web applications are browser based, they are intended to be platform and device independent which are able to run on any web enabled phone. The key advantage of mobile web applications over native mobile applications is cross-platform compatibility, allowing them to reach the broadest audience. Web applications are also cheaper and easier to maintain than native applications for the reason they use a cross-platform technologies rather than dealing with the requirements of a specific types of devices [12].

2.1.6.2. Mobile Native Applications

A native mobile application is built specifically for a particular device and its operating system. Unlike a web application that is accessed over the internet, a native application is downloaded from a web store and installed on the device. Native applications have a major advantage over web applications the ability to provide functionalities for device specific hardware and software.

In contrast to their better functionality, for a native application to work across multiple devices, separate versions of the application are required and with the existence of wide variety of mobile devices this is very costly [12].

2.1.7. Web Services

Web service is a set of standards and a programming methods for sharing data between different software applications, moreover web services is a standardized way to distribute services on the internet [13]. A web service enables a platform independent service provision by providing well defined interfaces for distributed functionalities, which are independent of the hardware platform, the operating system, and the programming language.

This will be important for its success when we consider the fact that the mobile computing environment is much heterogeneous in terms of hardware platform, operating system, and programming language it requires a technology that connects mobile systems to a conventional distributed computing environment. Thus, the integration of mobile computing with web services technology will give many advantages as web services provide strong interoperable capability which is the key requirement of mobile computing technology [13].

2.1.7.1. Web Service in ASP.net:

A Web Service is programmable application logic accessible via standard Web protocols. One of the messaging protocols currently used by ASP.net web services is SOAP.SOAP is designed to enable separate distributed computing platforms to interoperate. This aim is accomplished by following the same principles as other successful web protocols: simplicity, flexibility, firewall friendliness, platform neutrality as well as XML based messaging. SOAP is usually exchanged through HTTP which is used by Web browsers to access Web

resources[14]. It is also possible to add extensions to send other data styles for example binary to supports pictures. This possibility of adding extension like security or binary is a part of SOAP's strength in its flexibility. Some examples of extensions are Security, authentication, logging, custom made, binary and many more.

- WSDL: Web Service Description Language

Web Service Description Language (WSDL) is an extension to a web service and compensates for the description document for the web service[12]

A WSDL document describes:

- What the web service does - what kind of methods the web service has and how to invoke them.
- Where the web service is located - the address example a URL
- How to access the service - what kind of data format and protocol that being used.
- Web Services Architecture

There are three major roles within the web services architecture:

- Service provider

This is the provider of the web service. The service provider builds the service and makes it available for consumers.

- Service requestor

This is any consumer of the web service. The requestor invokes an existing web service by opening a network connection and sending an XML-SOAP request.

- Service registry

It is a centralized directory of services. The registry is used as a central place where providers or developers can publish new services or find existing ones. It therefore serves as a centralized clearinghouse for companies and their services.

2.1.7.2. Windows Communication Foundation

Windows Communication Foundation (WCF) is Microsoft's unified programming model for building service oriented applications. It enables developers to build secure, reliable, transacted solutions that integrate across platforms and interoperate with existing investments. Using WCF, data can be sent as asynchronous messages from one service endpoint to another. A service endpoint can be part of a continuously available service hosted by IIS, or it can be a service hosted in an application. An endpoint can be a client of a service that requests data from a service endpoint. The messages can be as simple as a single character or word sent as XML, or as complex as a stream of binary data. Figure 2-1 depicts architecture of windows communication foundation [15].

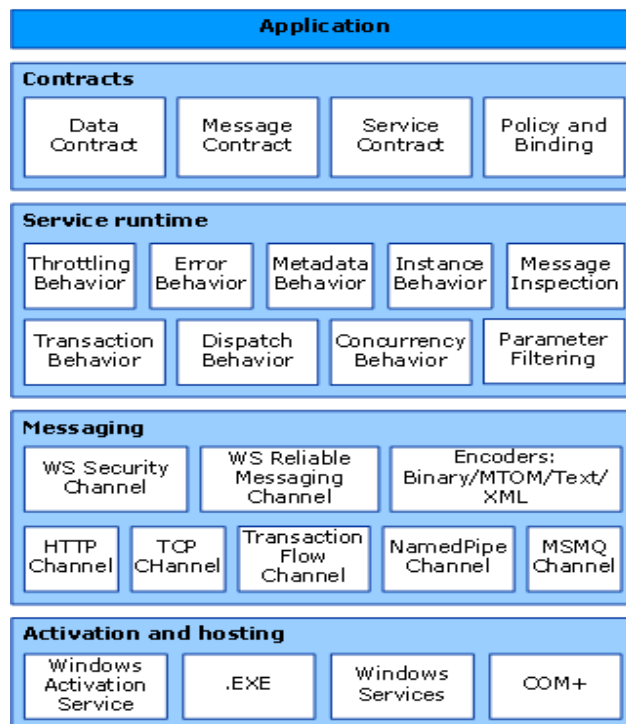


Figure 2-1WCF Service Architecture

2.2. Related Work

There are different airline companies which launched a mobile based reservation system. In most cases native applications are developed to[16] support a specific type of a mobile phone device.

The SOA based Web Services project is closely related to this project. It is a suite of powerful services that “VivaAir” offers to customers to benefit from its reusability[17]. They adopt the SOA methodology (SOMA) from IBM and realize its applicability in the domain of airline reservation services.

This project offers the following services:

- Customer Service: Which are used to manage customer profile.
- Flight Service: Which are used to get detailed information about flights.
- Reservation Service: Which are used to manage bookings.
- Payment Service: Which are used to acquire credit card information and deal with payment.

Though some of the services offered, in the above project, are not supported in this project, the concept, style and use of technologies are closely related.

Emirates Airline is driving online mobile innovation with a version of Emirates.com optimized for smart phones. Passengers who access Emirates.com from their smart phones are automatically redirected to the mobile website. The site is compatible with more than 3,000 devices, allowing passengers to interact with Emirates while on the move, from almost anywhere in the world[16]. The mobile site provides passengers with the flexibility to manage aspects of their journey.

The popular features found on Emirates.com, including:

- Booking a flight and checking fares
- Checking in and choosing or changing seats
- Viewing passenger itinerary, requesting a meal, and booking ground transportation
- Checking real-time flight status and viewing global timetables
- Looking for products and services available on any specific flight
- Learning about dedicated departure lounges

The services offered in Emirates.com are identical to those of this project, despite the fact that those services are only accessible from smart phones.

CHAPTER 3: SYSTEM REQUIRMENT SPECIFICATION AND ANALYSIS

This chapter presents requirement specification analyses of the proposed system. We will detail about stake holders, functional and non-functional requirements of the system. Finally we will look at the system models.

3.1. Stake holders

The project involves users, passengers and Ethiopian Airlines System which are defined as follows.

- User-any person who search for flights and looks for information provided by the services.
- Passenger- air transport users who are customers of the airline.
- Existing System- currently working Ethiopian Airlines information system.

3.2. Functional Requirements

A functional requirement defines a function of a software system or its component. The functional requirement specifies specific functionality that defines what a system is supposed to achieve. Each functional requirement has a unique reference ID which is defined as: Mobile Based Reservation System-Functional Requirement-Number.

- MBRS-FR-1 -The system shall enable users to search for flights.
- MBRS-FR-2-The system shall enable the passenger to book flights.
- MBRS-FR-3-The system shall enable the passenger to manage a booked flight.
- MBRS-FR-4-The system shall enable the passenger to check status of flights.
- MBRS-FR-5-The system shall enable the passenger to check-in online.
- MBRS-FR-6 -The system shall enable users to view information.

3.3. Scenario

The five main business scenarios which are identified are described in details as below.

Business scenario 1-SearchFlight:

- The user is permitted to search available flights based on the origin city, destination city, departure date and return date.
- The system will display any matching records based on the search criteria entered.
- The system will notify the user about the flight availability.
- If the searched flights are available, then system will display flights which are within a week. Otherwise, the system will prompt to ask the user to re-enter new searching criteria.

The business scenario 2- Book Ticket:

- The passenger is required to fill in flight search criteria then the system will prompt the passenger to select from the list of available flights.
- The passenger will select the flight which met his/her schedule then continue booking by filling personal and booking information.
- The system will generate booking confirmation number upon successful booking.

The business scenario 3-UpdateBooking:

- The passenger is required to be logged in using the booking confirmation code before he has privilege to cancel or edit his confirmed booking.
- The passenger will view details of his/her booking.
- If the passenger wants to edit the booking information he/she will select edit on the booking page then can make changes to the booking.
- The system will save the changes made by the passenger.
- If the passenger wants to delete his/her booking he/she will select delete.
- Once the booking is confirmed to be deleted then the system will delete the data off from the database.

The business scenario 4-FlightStatus:

- The passenger is required to provide the booking confirmation number and flight number of the flight before he has privilege to view status of a given flight.
- Once the passenger provided this information then the system will display the status of the flight.

The business scenario 5-Check-In:

- The passenger is required to provide the booking confirmation number and flight number of the flight in order to Check-Into a booked flight.
- The system will issue a check in confirmation code in which the passenger use it as boarding pass.

3.4. Non- functional Requirements

Non-Functional requirements describe user visible aspects of the system that are not designated to the functional behavior of the system. Each non functional requirement has a unique reference ID which is defined as: Mobile Based Reservation System-Nonfunctional Requirement-Number. The requirement includes from user interface to security issues. Non-functional requirements of the system are described as follow:

MBRS- NFR- 1- Performance

Description

The Server must respond to user requests maximum in one minute unless the connection is interrupted. The system should also respond to user click maximum in five seconds. Since the system is going to be accessed by different users with different needs, it should be capable of handling and processing their queries quickly. Since the system is an online system, it is difficult to tell exactly how many users will be using the system at a time. However, the system should handle its users concurrently.

MBRS-NFR-2-User interface

Description

Since the system runs on a mobile phone for better management of the small screen, the right type and amount of interactive user interfaces shall be used.

MBRS-NFR-3- Security

Description

The system should be developed in a way that the airlines system is exposed for its users in a secured way. The system should be developed in a way by protecting the integrity of data that is exchanged between the system and its users. The system shall also accept only a valid data.

MBRS-NFR-4-Portability

Description

As the system primarily aimed to be accessed from mobile phones, which has accesses to internet connection, it should work on mobile device which has a browser to view web contents.

3.5. System Analysis Models

3.5.1. Use Case Model

3.5.1.1. Use Case Diagram

Use case diagrams represent the functionality of the system from a user's point of view. They define the boundaries of the system. The following use cases details the Mobile Based Reservation System for Ethiopian Airlines.

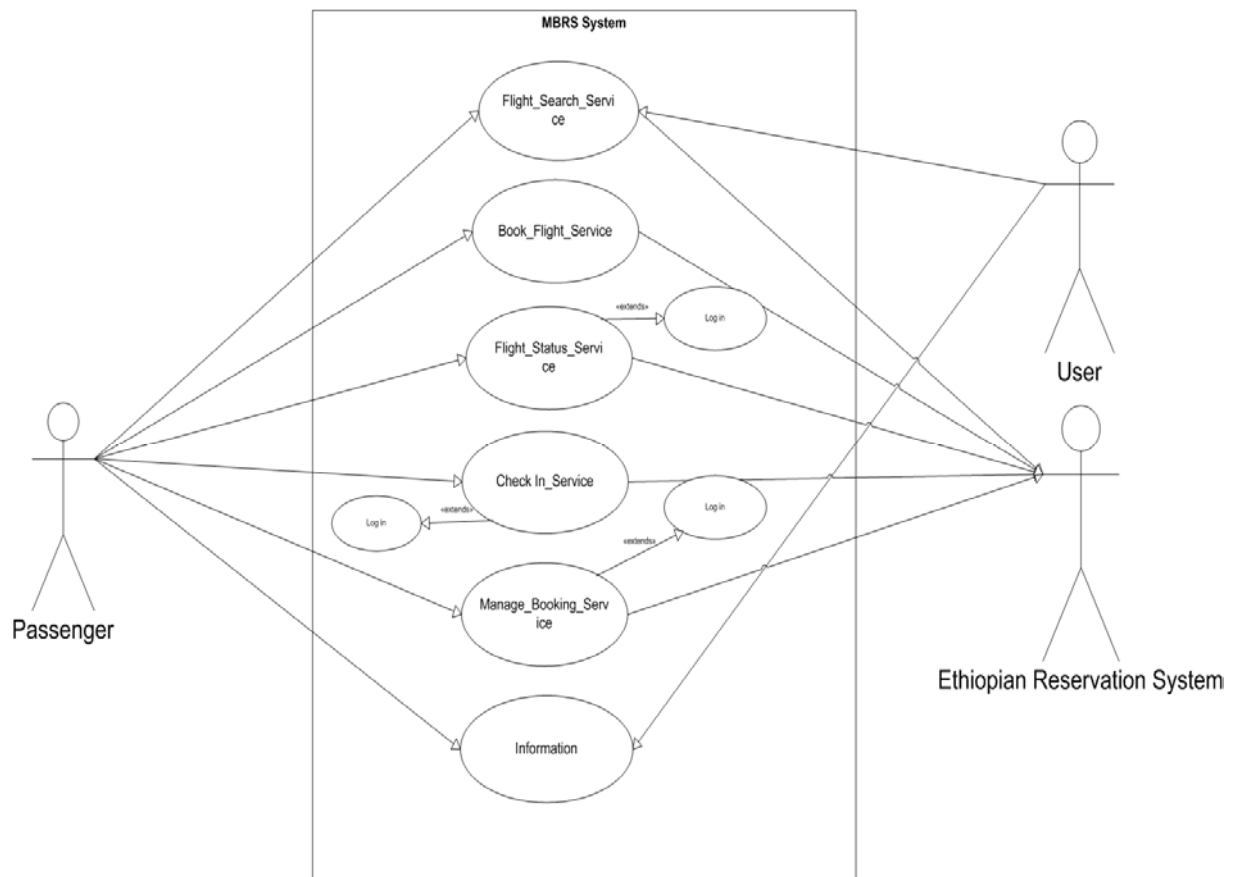


Figure 3-1 Use case diagram

3.5.1.2. Use case description

The following tables show the description for the above use case. Each use case has unique identifier UC (use case) number. The description details how the each actor interacts with the system in order to use the services implemented.

Table 3-1 Use Case Description for Search_Flight_Service

Identifier	UC 1
Use case name	Search Flight
Actor	User
Description	Allows the user to look for possible flights which met their schedule.
Entry Condition	The passenger opens browser on a mobile phone and enter the URL.
Basic course of action	<ol style="list-style-type: none"> 1. The use case begins when the user clicks on Search Flight button 2. The user should provide the origin of the flight. 3. The user should provide the destination of the flight. 4. The user should provide the departure date of the requested flight. 5. The user should press check flight button to view the available flights. 6. The information will be validated. 7. If there is a flight on the given criteria, flights on two days range will be displayed
Alternative course of action A	<p>If the user filled invalid information</p> <ol style="list-style-type: none"> 6.1. The system displays an error message, prompts the user to correct the problem. 6.2. The user will review the alert details and will be allowed to correct the information again. <p>If there is no flight based on the user's criteria.</p> <ol style="list-style-type: none"> 7.1. The system will notify the user. 7.2. The system will allow the user to search again.
Exit condition	Flights matching the criteria are displayed in list.

Table 3-2 Use Case Description for Book_Flight_Service

Identifier	UC 2
Use case name	Book flight
Actor	Passenger
Description	Allows the Passenger to Book flights which met their schedule.
Entry Condition	The passenger opens browser on a mobile phone and enter the URL.
Basic course of action	<ol style="list-style-type: none"> 1. The use case begins when the Passenger clicks on the Book flight button to book a flight. 2. The passenger should specify the trip type. 3. The passenger should provide the origin of the flight. 4. The passenger should provide the destination of the flight. 5. The passenger should provide the departure date of the requested flight. 6. The passenger shall provide the return date of the requested flight if it is round trip. 7. The passenger shall specify the number of adult, child and infant passengers. 8. The information will be validated. 9. The system will display the available flights. 10. The Passenger will select a flight. 11. The Passenger shall provide personal information. 12. The Passenger shall provide contact information. 13. The Passenger shall provide flight detail. 14. The Passenger shall provide travel document information. 15. The information will be validated. 16. The passenger clicks book. 17. The use case ends when the passenger gets a booking confirmation upon successful booking.
Alternative course of action A	If passenger enters invalid information. 10.1.The system displays an error message, prompts the user to correct the problem.
	If passenger enters invalid information. 15.1.The system displays an error message, prompts the user to correct the problem and allows the passenger to correct the information again.
Exit condition	The booking confirmation number that confirms the flight the passenger books displayed.

Table 3-3 Use Case Description for Flight_Status_Service

Identifier	UC 3
Use case name	Check status
Actor	Passenger
Description	Allows the passenger to view for the status of a flight.
Entry Condition	The passenger opens browser on a mobile phone and enter the URL.
Basic course of action	<ol style="list-style-type: none">1. The use case begins when the passenger clicks on check status.2. The passenger should provide the booking confirmation number of the flight to check the status of a flight.3. The passenger clicks check status.4. The information will be validated.5. The use case ends when the passenger gets status information of the given flight.
Alternative course of action A	If the passenger provide invalid data. 4.1. The system notifies and allows the passenger to correct the information.
Exit condition	The status of flight displayed.

Table 3-4 Use Case Description for Check In_Service

Identifier	UC 4
Use case name	Check In
Actor	Passenger
Description	Allows the passenger to check-in online for a flight booked earlier.
Entry condition	The passenger opens browser on a mobile phone and enter the URL.
Basic course of action	<ol style="list-style-type: none">1. The use case begins when the passenger clicks on check in.2. The passenger should provide the booking confirmation number.3. The information will be validated.4. The use case ends when the passenger gets a check in confirmation number.
Alternative course of action A	If the information the passenger entered is invalid. 3.1. The system notifies and allows the passenger to correct the information again.
Exit condition	A check in confirmation number is displayed.

Table 3-5 Use Case Description for Information

Identifier	UC 5
Use case name	Information
Actor	User
Description	Allows the user to view basic information.
Entry condition	The passenger opens browser on a mobile phone and enter the URL.
Basic course of action	<ol style="list-style-type: none"> 1. The user clicks on information. 2. List of information will be displayed.
Exit condition	List of information will be displayed.

Table 3-6 Use Case Description for Manage_Booking_Service

Identifier	UC 6
Use case name	Manage Booking
Actor	Passenger
Description	Allows the user to update booking information.
Entry condition	The passenger opens browser on a mobile phone and enter the URL.
Basic course of action	<ol style="list-style-type: none"> 1. The user clicks on Manage Booking. 2. The passenger should provide the booking confirmation number. 3. The information will be validated. 4. The passenger will make changes to his/her previous reservation. 5. The use case ends when changes the passenger made are saved.
Alternative Course of Action	<p>If the information the passenger entered is invalid.</p> <ol style="list-style-type: none"> 3.1. The system notifies and allows the passenger to correct the information again.
Exit condition	The use case ends when changes the passenger made are saved.

3.5.2. Sequence Diagrams

In this Section the sequence diagram of the use case identified in Sub-section 3.5.1 are depicted in the following diagrams. Sequence diagram shows how the behavior of a use case is distributed among its participating objects.

Figure 3-2 shows sequence diagram for search flight service use case in which users search for available flights.

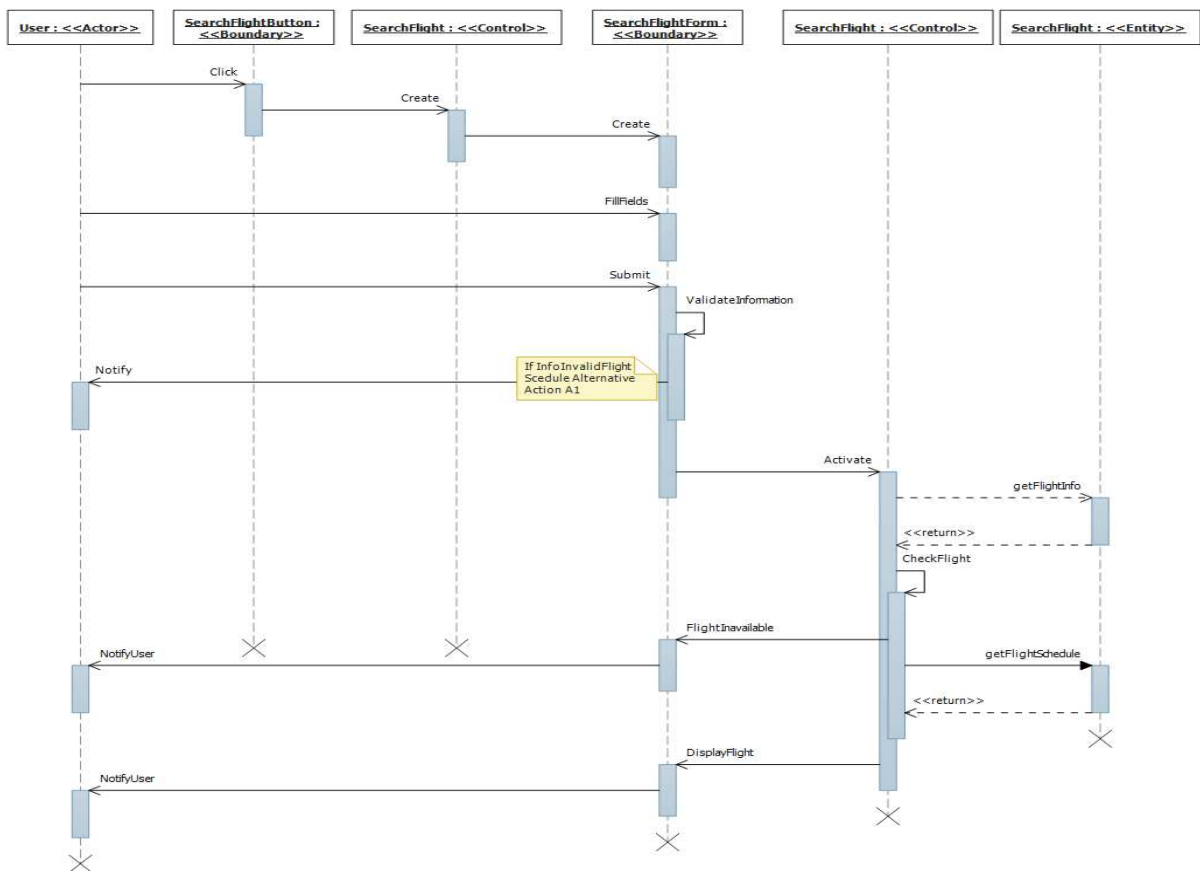


Figure 3-2 Sequence diagram for Flight _Search_Service Use case

Figure 3-3 shows sequence diagram for book flight service use case in which passengers use the service to book flights.

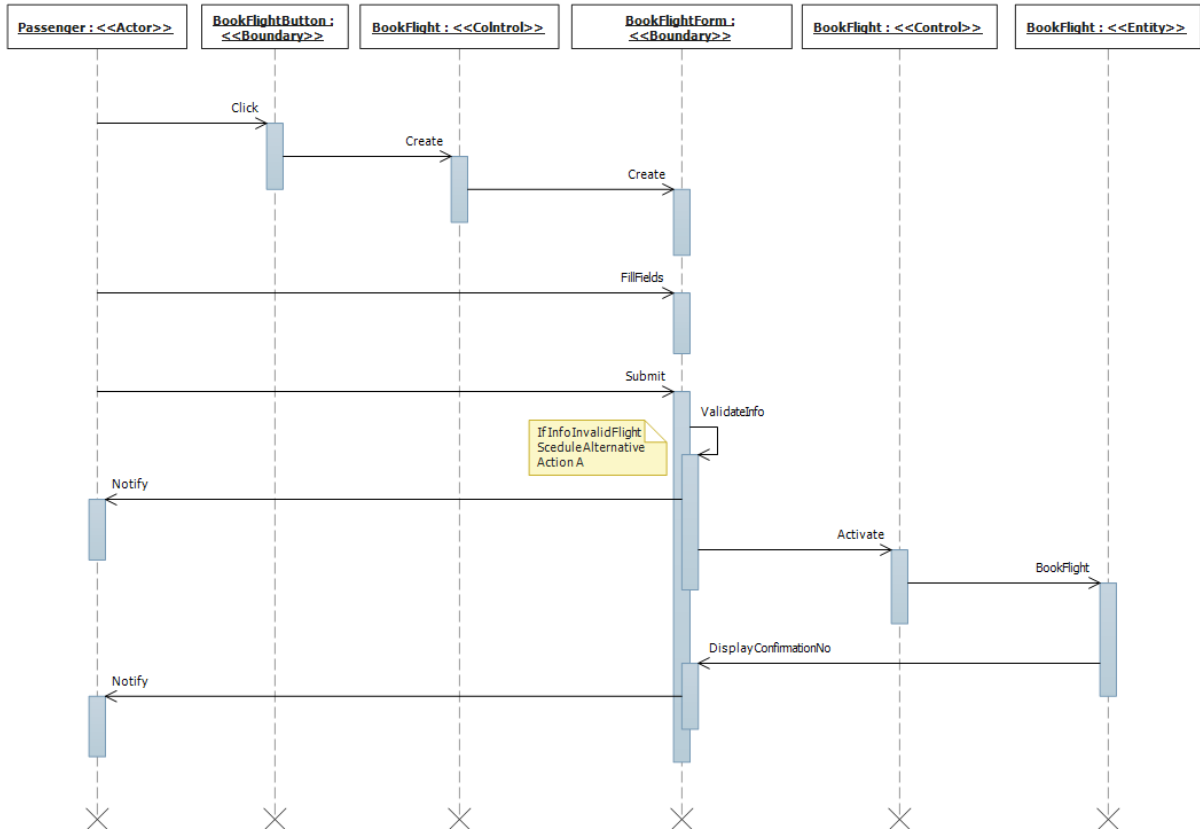


Figure 3-3 Sequence diagram for Book_Flight_Service Use case

Figure 3-4 shows sequence diagram for flight status service use case in which passengers check status of flights.

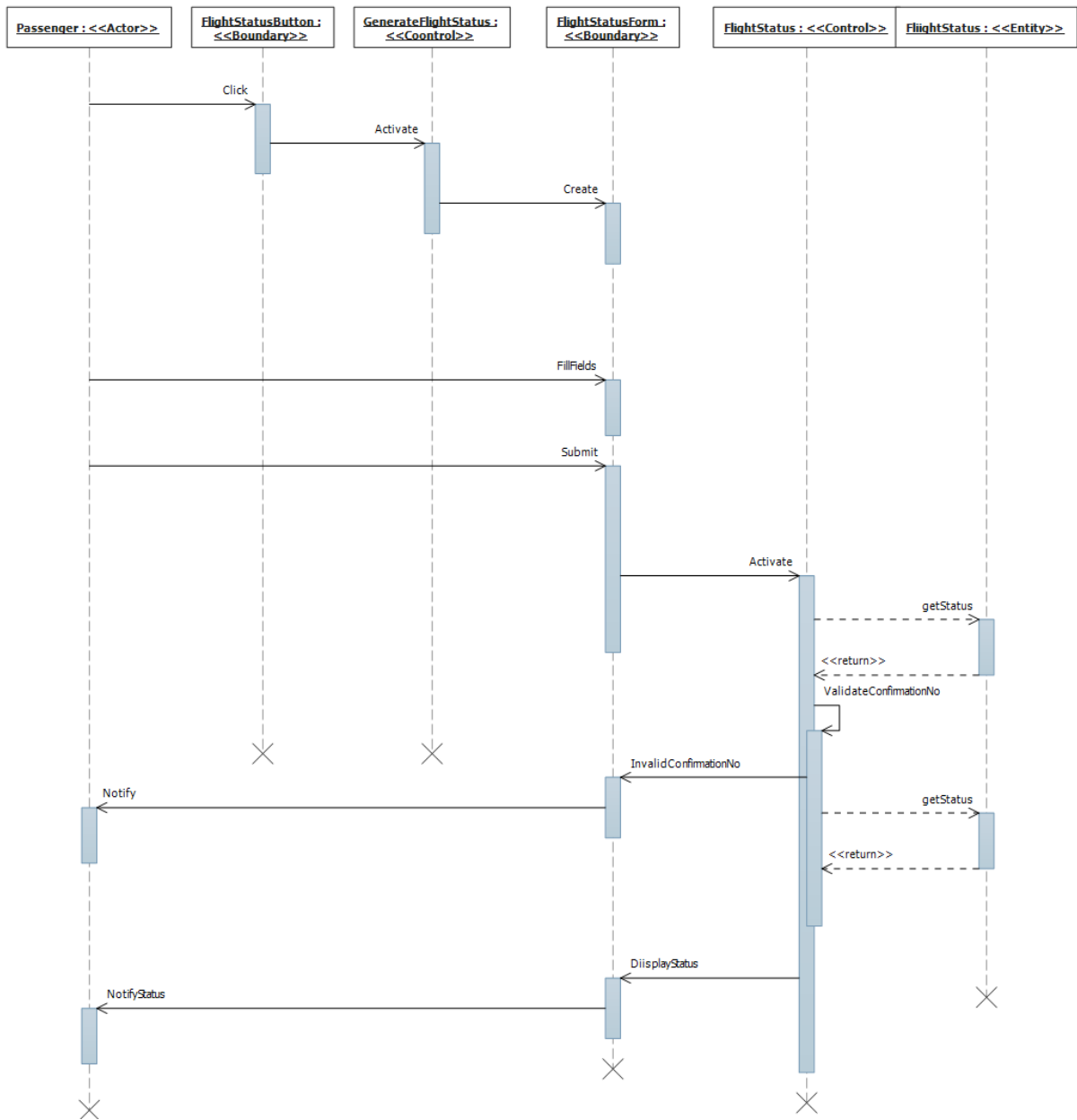


Figure 3-4 Sequence diagram for Flight_Status_Service Use case

Figure 3-5 shows sequence diagram for check in service use case in which passengers check in to their flight.

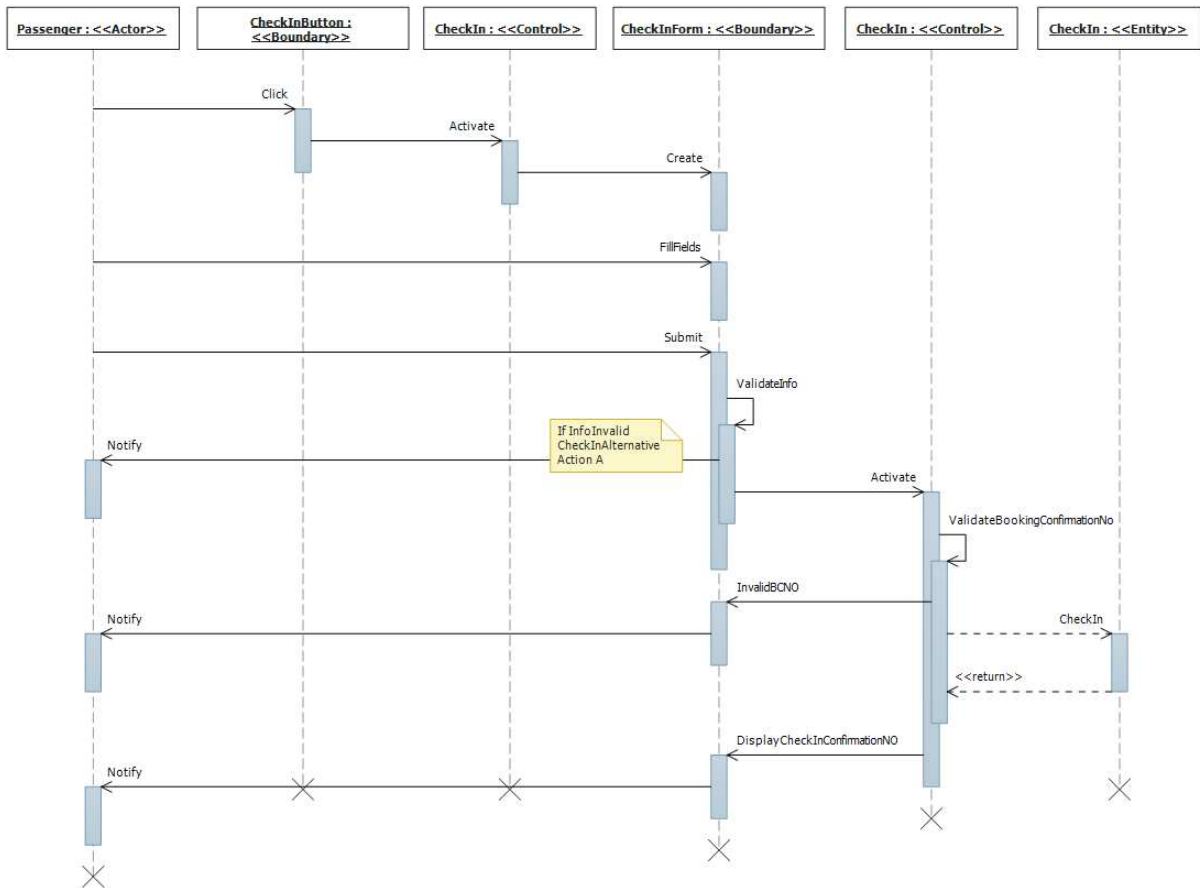


Figure 3-5 Sequence diagram for Check In_Service Use case

Figure 3-6 shows sequence diagram for manage booking service use case in which passengers update their booked flights.

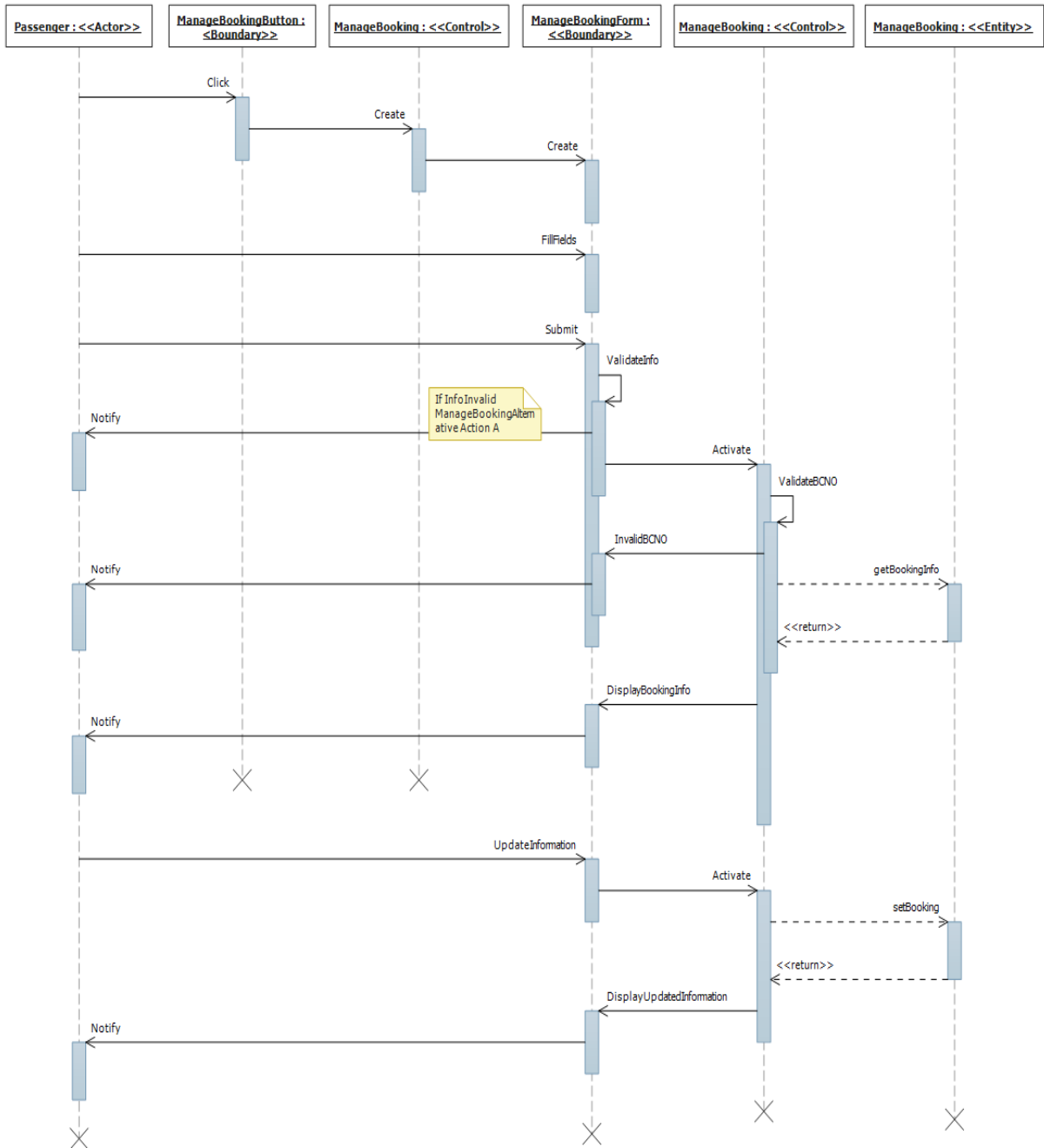


Figure 3-6 Sequence diagram for Manage_Booking_Service Use case

3.5.3. Class Diagram

A class diagram describes the structure of a system in terms of classes, their attributes, operations also called methods and the relationships among the classes. In this section, the identified classes of in the project are presented in Figure 3-7.

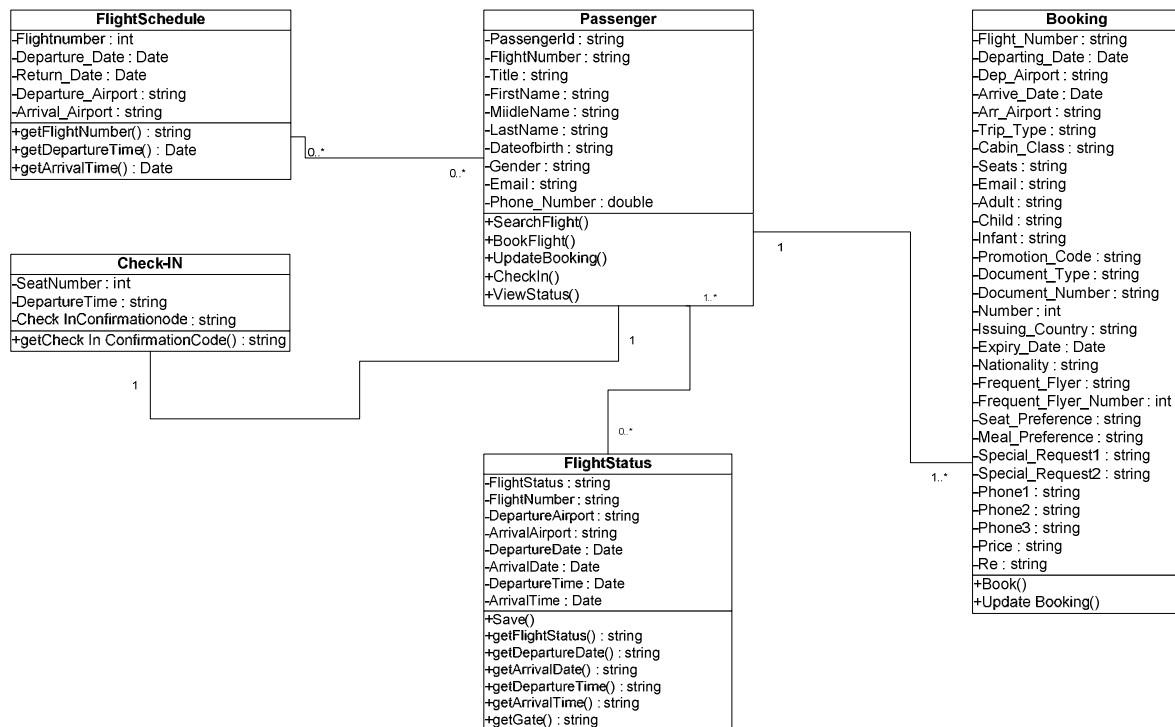


Figure 3-7 Class Diagram

3.5.4. Activity Diagram

Activity diagram is a graphical representation of work flows of stepwise activities and actions with support for choice, iteration and concurrency. In this section, activity diagram is used to describe the work flow of use cases identified in Section 3.5.2.

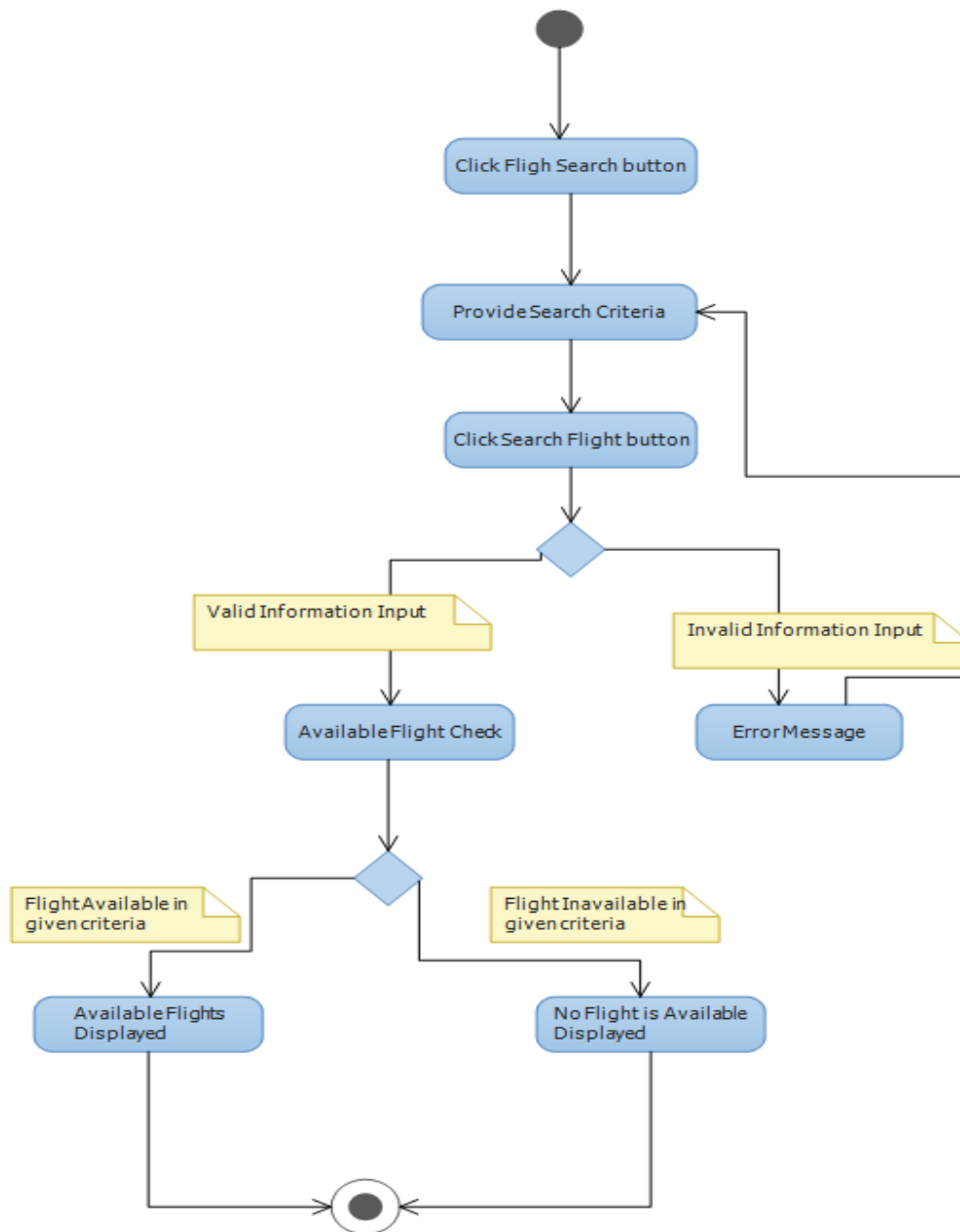


Figure 3-8 Activity diagram for Flight_Search_Service

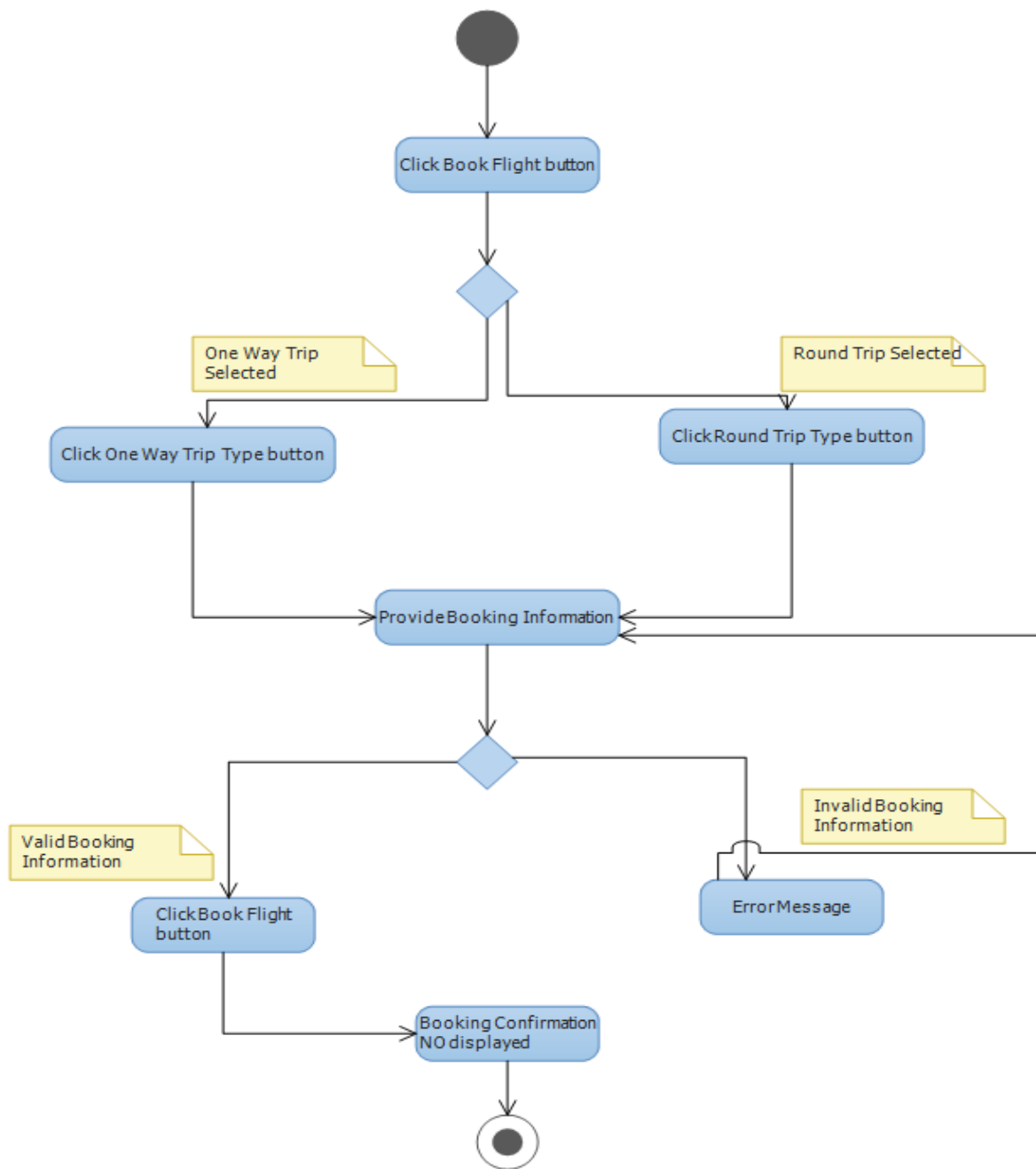


Figure 3-9 Activity Diagram for Book_Flight_Service

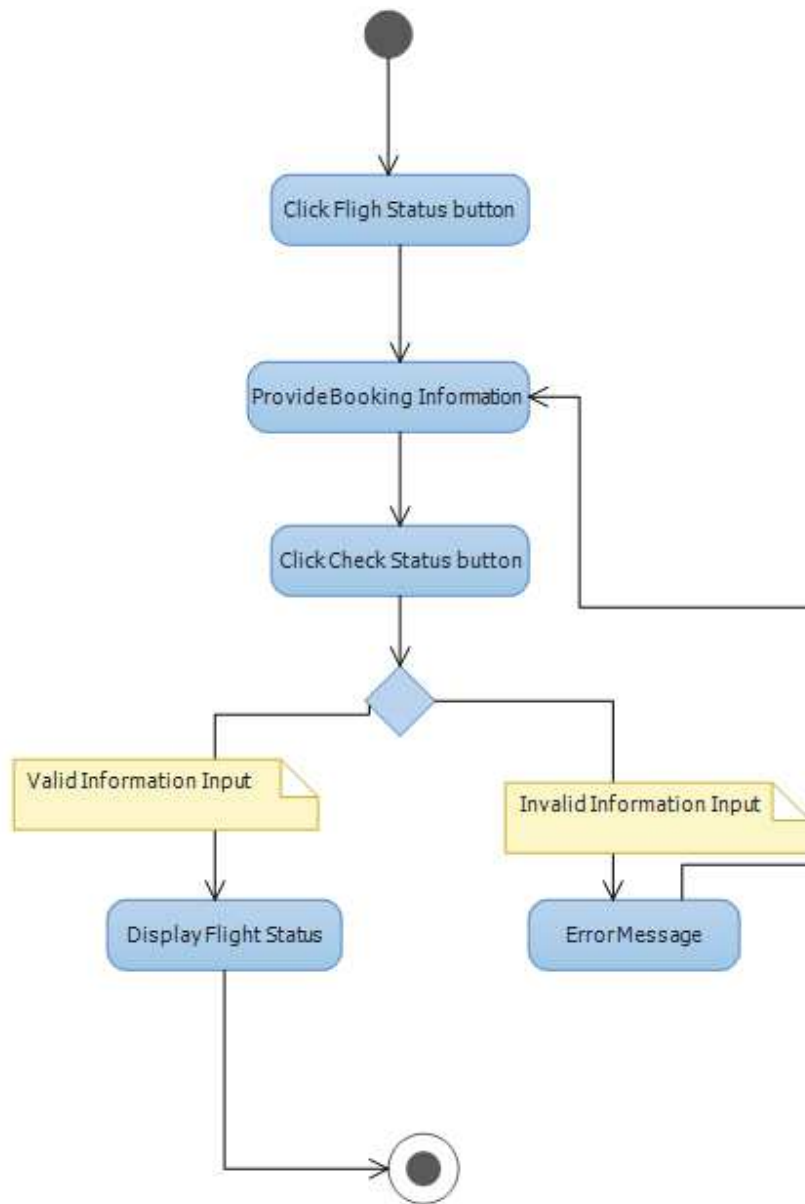


Figure 3-10 Activity Diagram for Flight_Status_Service

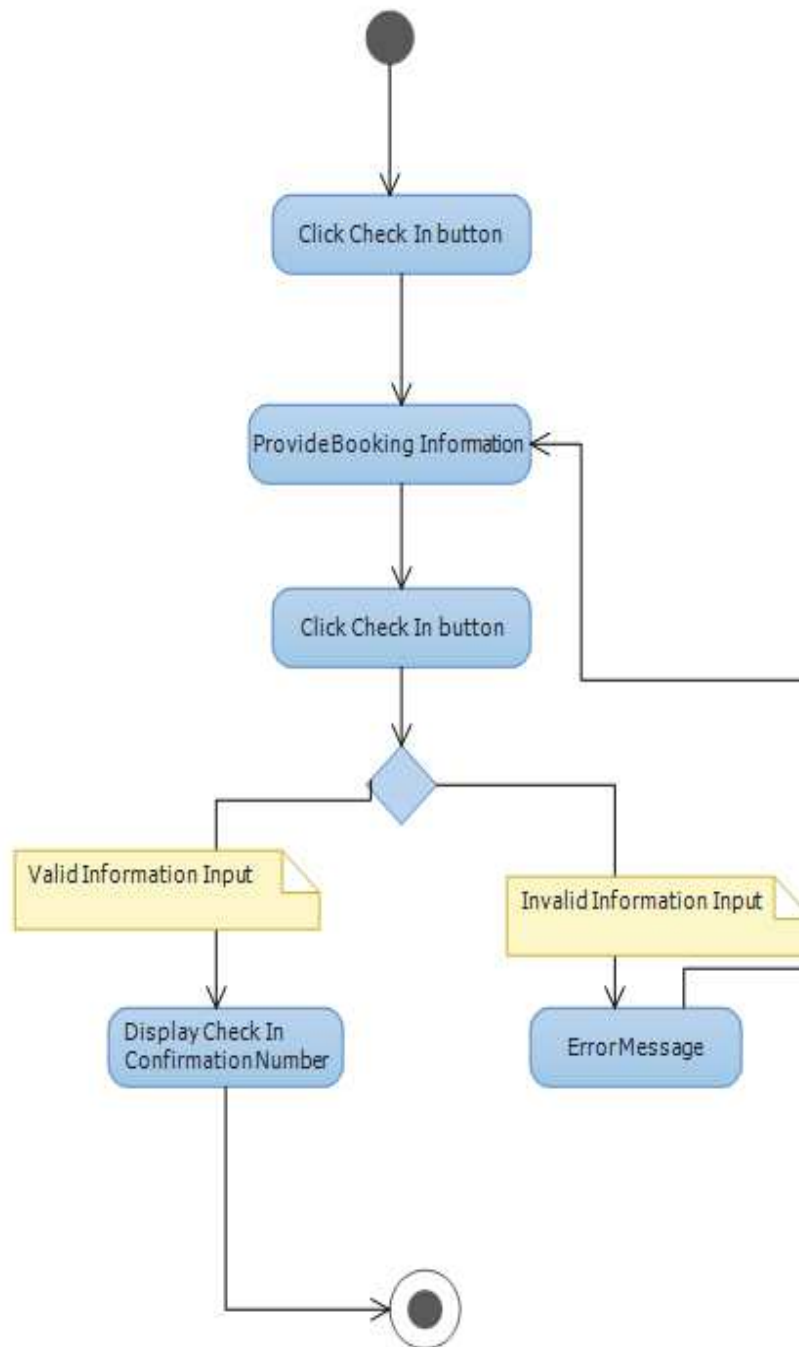


Figure 3-11 Activity Diagram for Check In_Service

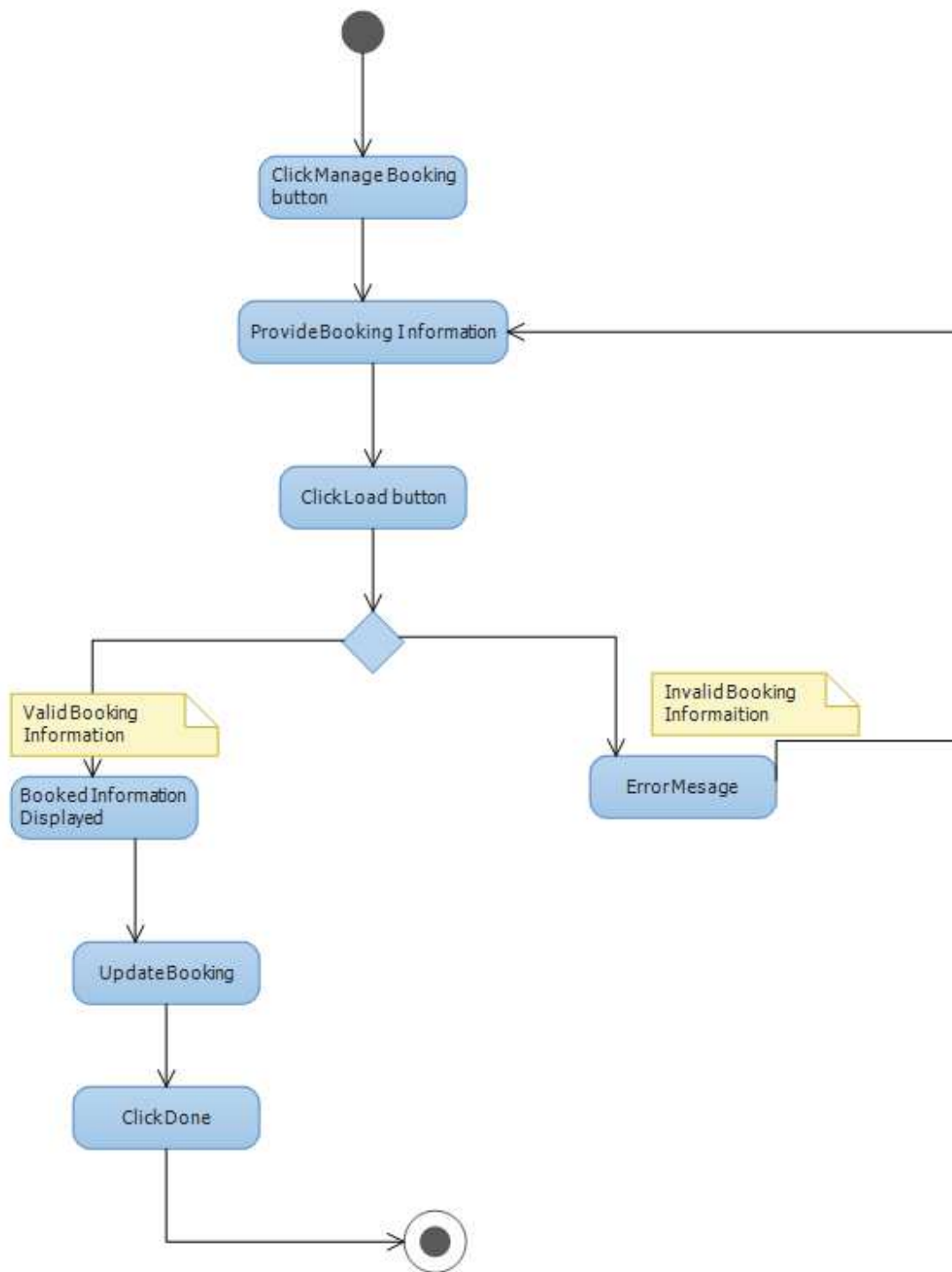


Figure 3-12 Activity Diagram for Manage_Booking_Service

CHAPTER 4: SYSTEM DESIGN

This document records the results of the system design process and describes how the system will satisfy the requirements specification. It also interprets the requirements into a description of the architecture, structure, components, and data necessary to support the building process.

4.1. Design Goals

The design goals represent desired qualities of the system and provide a consistent set of criteria that must be considered when making design decisions. The non-functional requirements identified in Chapter 3, are transformed into design goals. The following are the key goals needs to be satisfied.

- **Performance-** The system should be able to serve one thousand users which are expected to access it concurrently.
- **Security-** The system should prevent the sensitive data from unauthorized access.
- **Portability-** The system should be transported to a different platform (hardware and/or software) with minor modification. The system should be accessible from a variety of mobile phones.
- **User Interface-** The user interface of the system should be easy to use by each user of the system and no special training will be required. The interface should be adapted to the screen size of a mobile.

4.2. Proposed solution

This project aims to implement Mobile Based Airline Reservation System, MBRS. We prefer to develop and implement each user requirements as service.

As stated in [18], a service is an application or piece of software that communicates with other services or applications and performs a specific task.

Services have many advantages in software development including:-

- **Reusability:** services are loosely coupled and distributed components. This behavior enables them to be reused. The concept of reusability saves a lot of time at the development stage, because developers can take existing services and reuse them to meet new business requirements.
- **Interoperability:** in SOA context client/ consumer and service providers communicate with each other with well-defined contract agreement, procedure and the services run regardless of platforms, systems and languages.
- **Scalability:** Services can be removed or added as demand varies.
- **Flexibility:** Unlike tightly-coupled components which share semantics, states and libraries and are difficult to constantly modify, loosely-coupled services are more flexible as they can be easily updated and modified to keep up with the constantly growing market needs and requirements.
- **Cost Efficiency:** The fact that loosely-coupled services are reusable and flexible makes them less costly as avoiding developing services from scratch saves development time and resources.

4.3. Design Decision

This project is designed to extend the existing Ethiopian airlines reservation system in order to let users to get the functionalities using mobile. The proposed solution extends the reservation with web service concept, in particular WCF services are used to expose the reservation services of the Ethiopian airlines. As WCF is implemented primarily as a set of classes on top of the .NET Framework's Common Language Runtime (CLR), this enables us to build service-oriented applications in a familiar way.

WCF is made up of services and end-points that communicate with clients, regardless of the platform[18]. The existing reservation system stays intact and its functionality is not changed, rather a WCF services are designed to present the needed mobile services.

- Why WCF (Windows Communication Foundation)

Since WCF is designed, from ground up, to summarize the different distributed programming infrastructures offered by Microsoft.WCF provides much higher degree of flexibility and portability for implementation of services than earlier technologies that are used in service development. WCF provides a single unified solution that makes developing services easy by enabling developers avoid using different technologies to achieve service implementation.

As WCF is new it has an improved performance than the earlier technologies in implementation of services.WCF hosting allows services to be hosted in a handful of different environments, such as Windows NT Services, Windows Forms, and console applications, and well as IIS (Internet Information Services) and Windows Activation Services (WAS) as compared to ASP.NET web services which can be accessed only over HTTP[18].

WCF offers interoperability with applications built on other technologies irrespective of the OS, environment, or platform as WCF services operate independent of all of these. This will enable us to communicate with existing Ethiopian Airlines system without considering the underlying technology.

Security in WCF, includes confidentiality (encryption of messages to prevent eavesdropping), integrity (the means for detection of tampering with the message), authentication (the means for validation of servers and clients), and authorization (the control of access to resources). These functions are provided by either leveraging existing security mechanisms, such as TLS over HTTP (also known as HTTPS), or by implementing one or more of the various WS security specifications.

4.4. Design Models

The design models represent the system decomposition and other implementation designs necessary to achieve both the design goals and the functional requirements.

4.4.1. System Architecture Diagram

The system architecture diagram shows the layered structure of the system and the different layers involved in the designed system in which the boundary of each layer is explicitly defined.

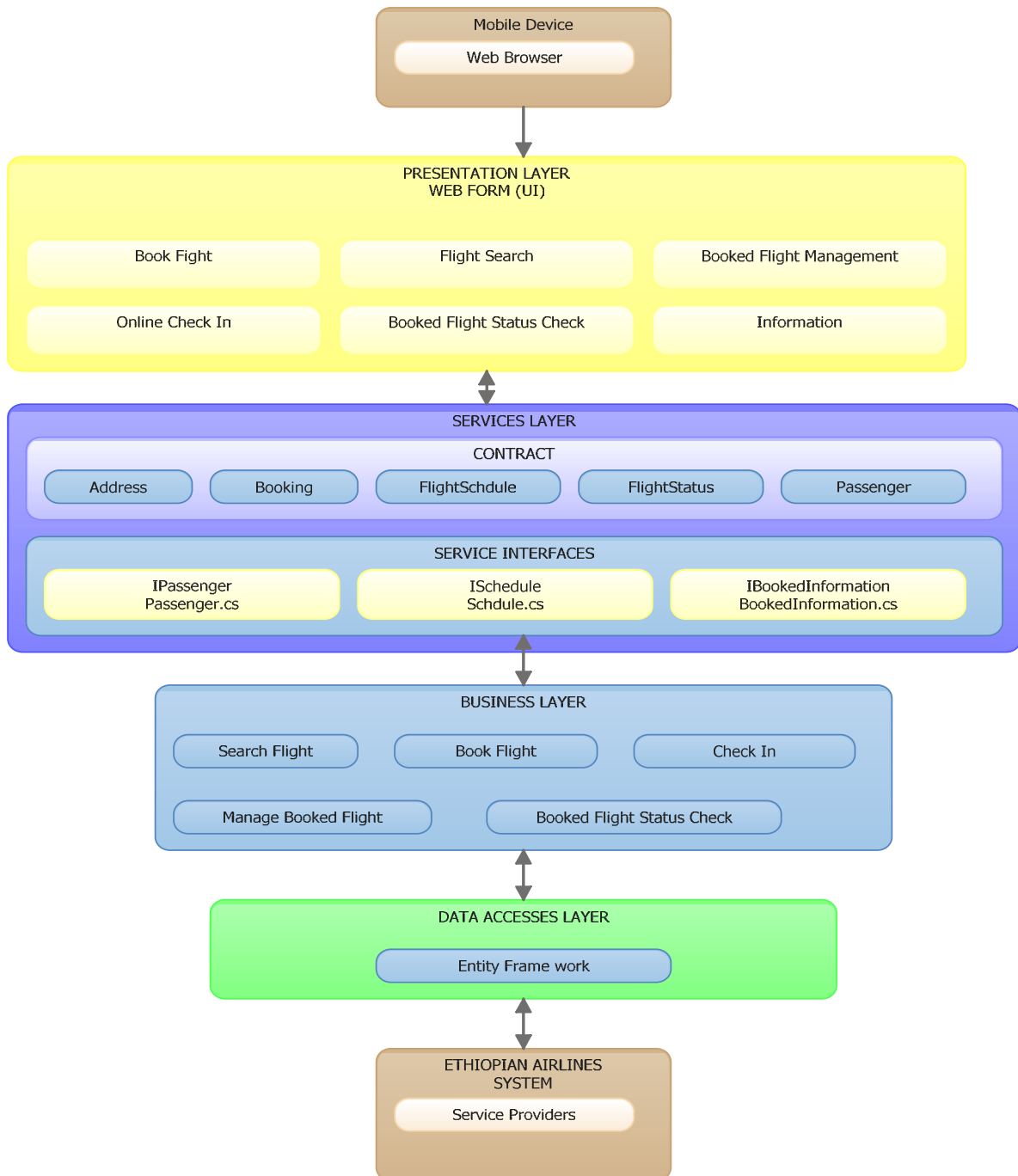


Figure 4-1 System Architecture

4.4.2. System Architecture

The proposed system architecture of MBRS is a multi-tier based Client-Server architecture which is depicted in Figure 4-2. The architecture is composed of four layers presentation, service, business and data accesses layers. Each layer is presented in detail in the sub-sections that follow. The proposed system is a thin client as opposed to a rich client that is usually more complex, and can have for instance business and data layer on the client side, since in our project there are no requirements that make it necessary to build a rich client, as the system do not require local services from the mobile phone and data to be stored on the client, all processing is performed on the application server, and the result is presented in a web browser.

4.4.2.1. Presentation Layer

The presentation layer defines user interface that facilitates the interaction between a user and the system. The user of the system interact using web browser installed in their mobile phone for the purpose of initiating reservation services and performing communication.

Web form user interface has UI components for interacting with users. This component is designed with ASP.NET architecture. Each graphical user interface is designed to handle events raised in perspective page and Active server page interface.

Most mobile phones are oriented vertically, with screens taller than they are wide. As mobile devices are known for limited screen size, the preferred and most common method of creating mobile navigation schemes is to use a simple vertical list of options[19].

In this project, the user interfaces are designed vertically using lists with reduced vertical scrolling and avoiding horizontal scrolling; keeping interfaces consistent by creating a site master which defines common features. And we avoided unnecessary functionality and limited the amount of functionality presented to the user to achieve their goal. As a result, the system is designed in such way that it is easy to understand, learn, remember and use its functions. The system shall be easy to use and no special training will be required.

4.4.2.2. Service layer

This layer is responsible to maintain service contracts, operation contracts and data contracts. The service contract defines the methods of a service, that is, what operations are available on

the end point to the client. The service and operation contracts are used to define the service interfaces that are exposed at the service boundary built on the top of Window Communication Foundation(WCF) in a dot net infrastructure. Data contracts define the data types used by the available service methods.

In this project, we have defined and implemented the following services MBRS.Passenger, MBRS.Schedule and MBRS.BookingInformation.

MBRS.Passenger service exposes Book Flight, Manage Booking and Check In functionalities: MBRS.Schedule service exposes Flight Search and MBRS.BookingInformation service exposes status of a booked flight.

Service interface defines actions the end point will take in order to implement the service. We have defined service interfaces IPassenger, ISchedule and IBookingInformation then they are implemented in the classes Passenger.cs, Schedule.cs, BookingInformation.cs respectively. Book Flight, Manage Booking, and Check In are implemented in the service interface IPassenger.

A service and its clients must use secure communication. At the very least, the transfer of messages from the clients to the service must be secured, and the clients must have a way of authenticating the service. The clients may also provide their credentials in the message so that the service can authenticate and authorize them[20].

To authenticate passengers, credentials must be supplied; these credentials are used to provide proof of identity of a passenger. To authenticate passengers who use the services to manipulate flight reservation we used a booking confirmation number. Passengers who need to update their bookings should be authenticated by their booking confirmation number and passengers who need to check in should provide their booking confirmation number. In some cases authentication is avoided since the services can interact with anonymous clients; flight search service will provide flight schedule for any user who search for a flight.

Windows Communication Foundation has system provided binding that include security schemes called WsHttpBinding which implements the WS-Security specification by default, it also supports HTTPS transport security, HTTPS transport protection with SOAP message

credential security for caller authentication and WS-Security. This project is configured to use this binding avoiding a need to insert the right attributes to secure each class and method.

In WCF, all services expose contracts. The contract is a platform-neutral and standard way of describing what the service does. The contract outlines what functionality the endpoint exposes to the client. A contract specifies what operations can be called by a client, the form of message, the type of input parameters or data required to call the operation and what type of processing or response message the client can expect. Service contracts describe which operations the client can perform on the service and data contracts define which data types are passed to and from the service.

The data contract as shown in Figure 4-2 contains service contract classes build on dot net framework which are responsible for facilitating communication between the service consumer and service provider and describe the data contract in which clients of the system needs to know in order to use the services provided by the system. Presentation layer or service consumer uses this contract to request specific service.

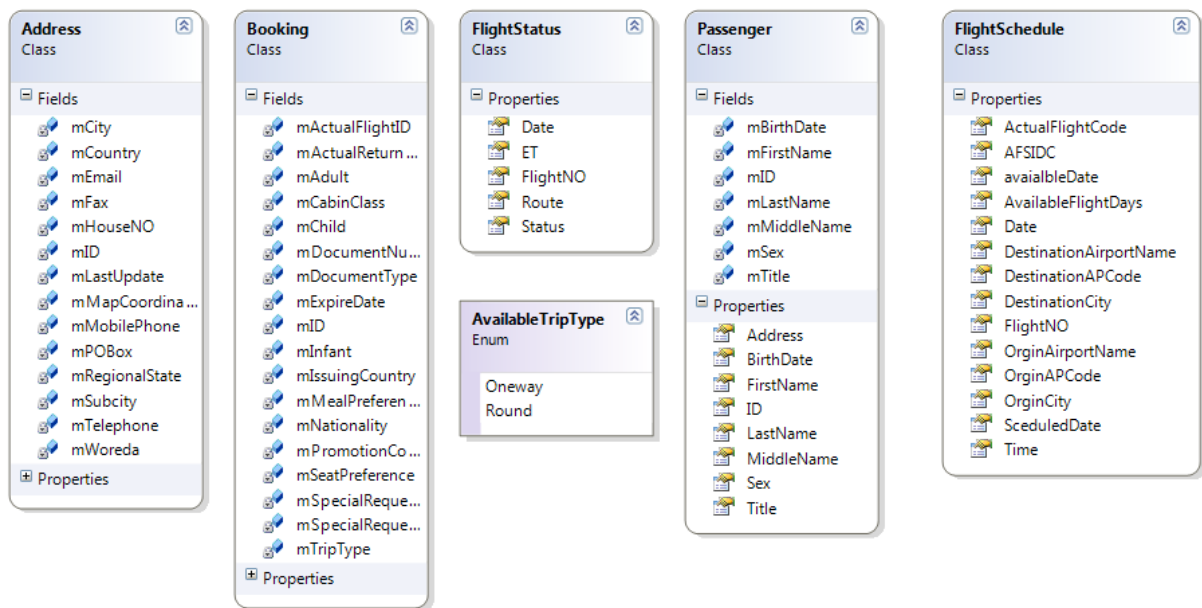


Figure 4-2 Contract Classes

4.4.2.3. Business layer

The business layer implements the business requirements and constraints. It is responsible to provide the key functionalities of the MBRS project. It takes in care of different services and access data stored permanently using the Data access layer. The business layer particularly provides Flight Searching, Flight Booking, Check In, Flight Status and Booked FlightManagement. This layer will apply the actual business logic to the service operations. It will check the preconditions of each operation, perform business activities, and return any necessary results to the caller of the service. We defined context and entities and used partial classes and partial methods to separate the business logic from the data access code. Partial classes are useful when working on large projects, spreading a class over separate files enables us to work on it at the same time.

4.4.2.4. Data access layer

The data access layer will take care of all of the tasks needed to access the underlying databases. Neither the service interface layer nor the business layer needs to worry about these things. We used entity framework a Microsoft's technology which is a conceptual design of the database. It eliminates the need for most of the data-access code that we need to write. It basically generates business objects and entities according to the database tables and provides the mechanism for performing basic CRUD (Create, Read, Update, and Delete) operations. We generated entities and classes to manage operation between the services and data source and also entity classes that represent the data. We generated EDMX file from the existing database which represents our conceptual model that encapsulates the storage model, the conceptual model, and mappings. It consists of Entities, associations & multiplicity between the entities.

4.4.3. Hardware/software mapping

The hardware/software mapping of system shows the relationship between nodes that represent the hardware components of the system and independent software components. Since the system is web-based and clients use mobile phone to access the system, client nodes should have web browser. Figure 4-3 shows the deployment diagram which includes the users' mobile device in which a web browser is installed, the web server which hosts the presentation layer, the

application server that contains the modules responsible for all processing performed and the underlying Ethiopian Airlines existing system.

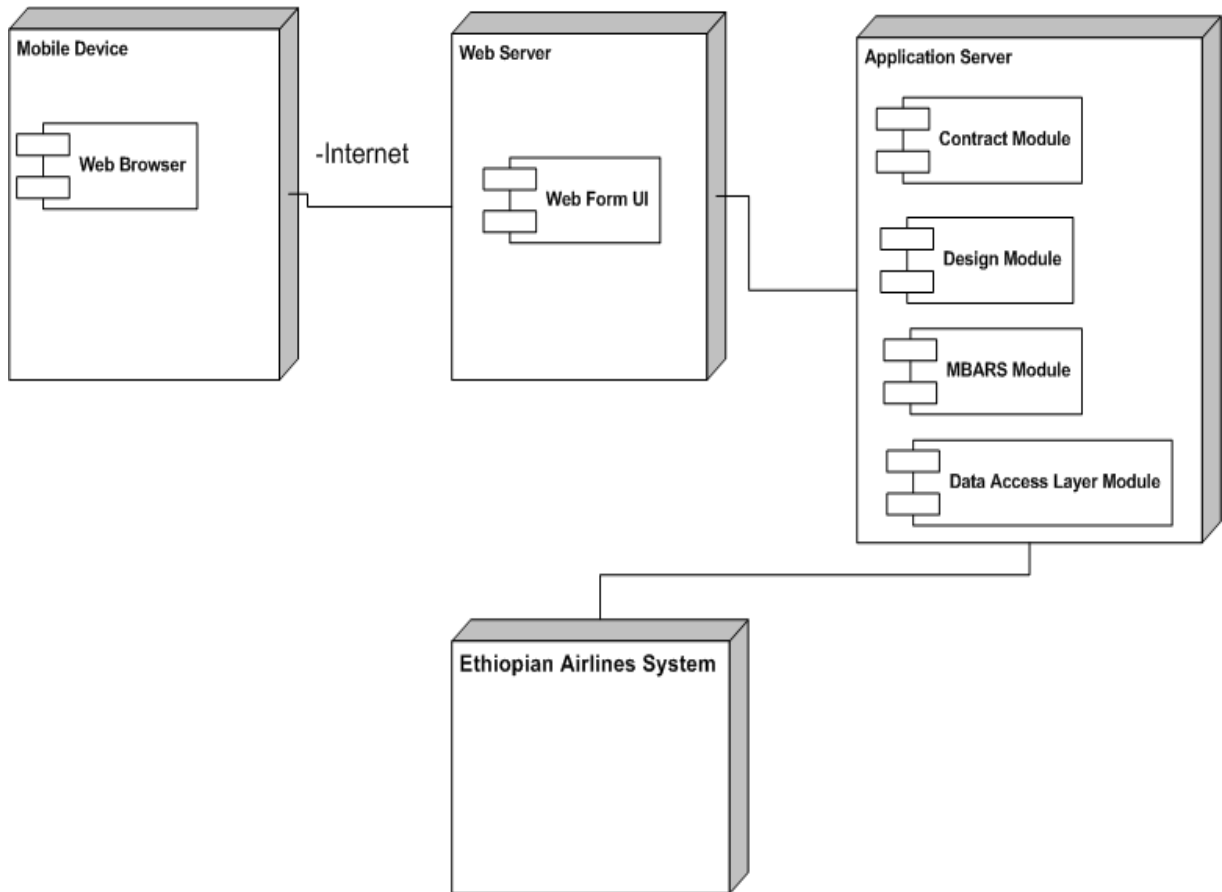


Figure 4-3 Deployment Diagram

4.4.4. Data Management

In this Section, the persistent management is presented as it is an abstract and conceptual representation of the data. Figure 4-4 represents the conceptual representation of the database the project uses. In the diagram a Crow's Foot notation has been adapted. The notation represents entities as boxes, and relationships as lines between the boxes. Different shapes at the ends of these lines represent the cardinality of the relationship (i.e. one or many). The cardinality of the relationship/ association between tables is represented with chicken feet.

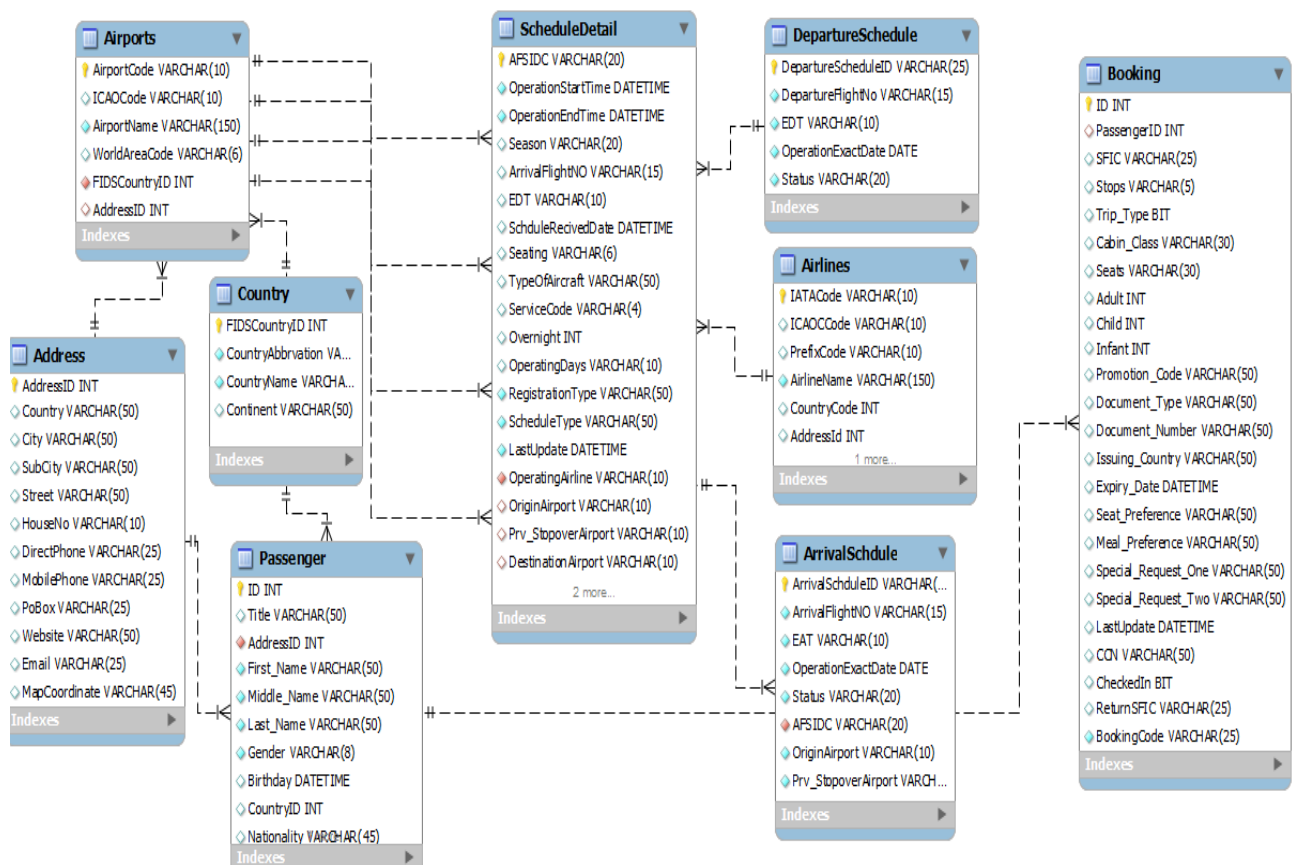


Figure 4-4: Database Diagram

CHAPTER 5: SYSTEM IMPLEMENTATION

This chapter presents the development environment used to implement the system and the implementation of the system.

5.1. Development Environment and Tools

This project is implemented using WCF services which are responsible to communicate the mobile user with Ethiopian Airlines system. The development environment and different programming tools used to develop the project are described below.

5.1.1. Development Environment

This project is developed on Hewitt-Packard HP Pavilion dv5 Note Book PC model, Intel(R) Core(TM) i3 CPU processor,4.00 GB(3.80 usable)Installed memory (RAM),64-bit Operating system with Windows 7 Ultimate and Opera Mobile Emulator which supports different types of mobile phones including Nokia, Samsung, LG, Sony and Motorola.

5.1.2. Tools

- Windows Communication Foundation (WCF)-For defining and implementation services.
- Microsoft word -Document preparation
- Visual studio Architecture builder 2010-Requirement analysis and Architecture design
- Microsoft Visio 2007 -For UML representation of requirement analysis
- Microsoft Visual studio IDE 2010 -For all development and implementation of the research project
- Microsoft C# -Underground language for both server and client implementation. It is also used in Data access layer, business logic layer and all components of the implementation.

- Microsoft Visual Studio Test Environment 2010-For testing components and functionality.
- JQUERY, AJAX-User Interface development
- Opera Mobile Emulator-For simulating the user interfaces

5.2. The System Implementation

This section discusses the implementation of the system.

The first page that the passengers will face is the home page shown on figure 5-1; the passenger will choose what to do

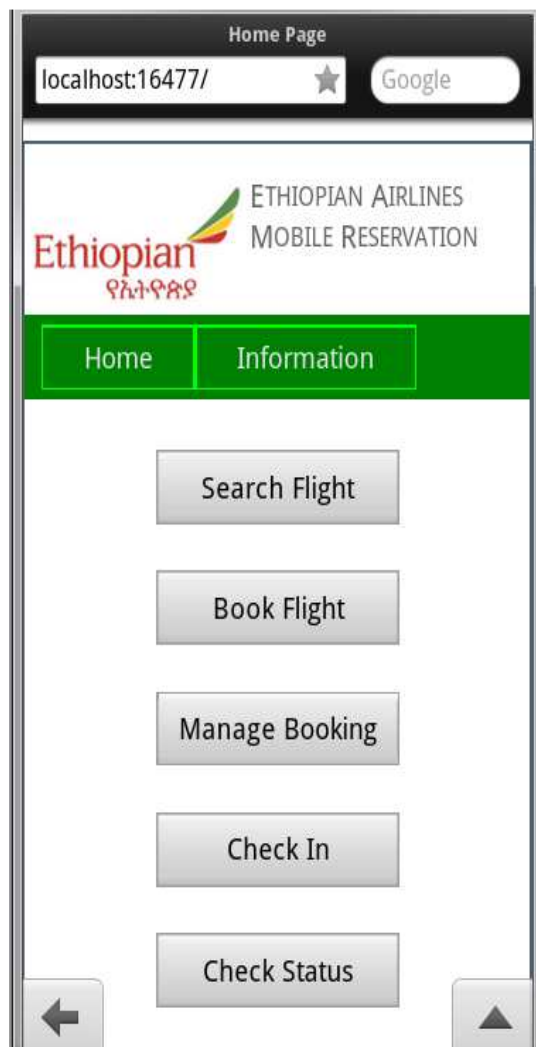


Figure 5-1 Home Page

This page will be used by the user to search flight as shown on Figure 5-2; the user will provide search criteria and click on search flight button then available flights will be displayed.

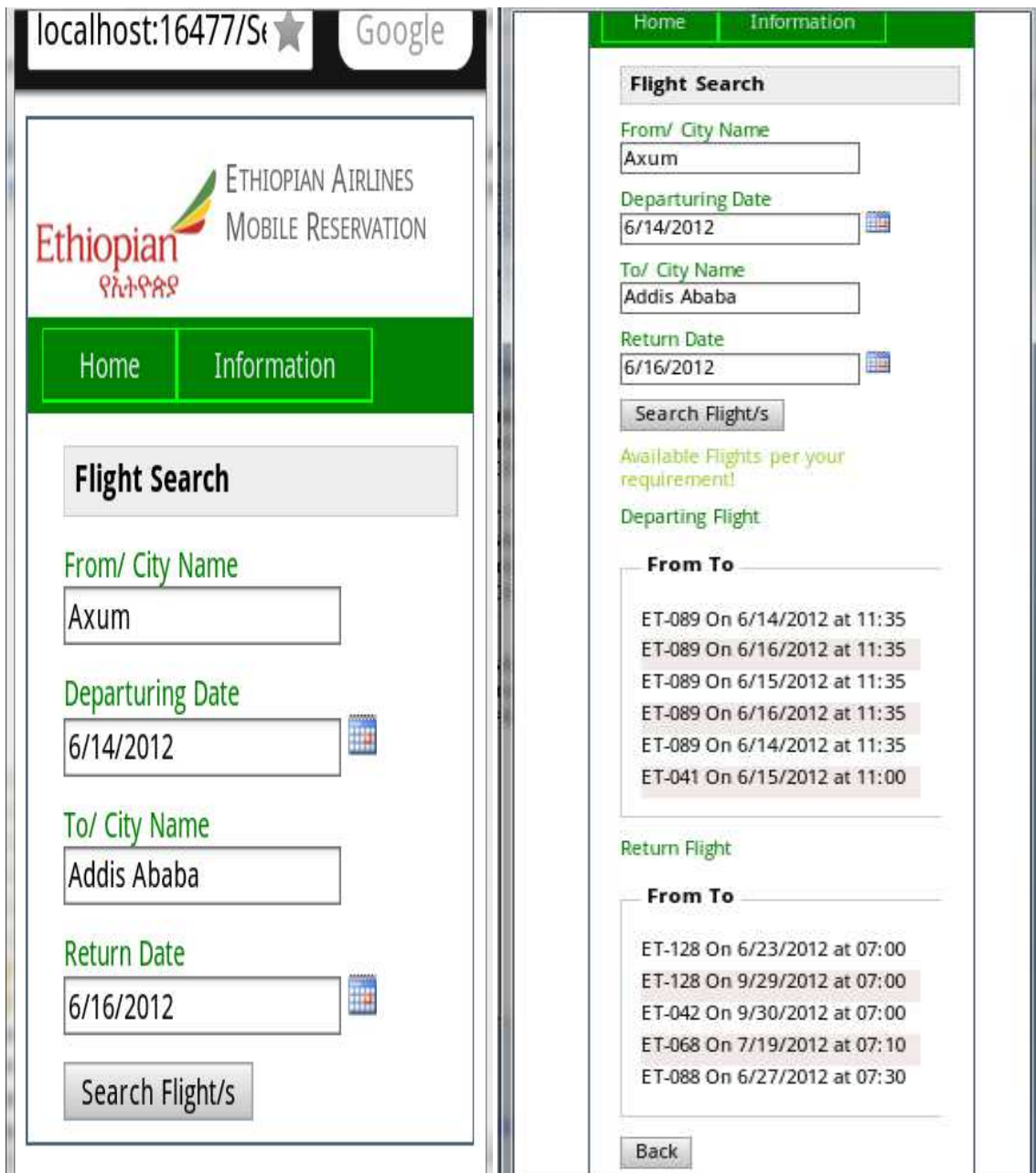


Figure 5-2 Search Flight

This page will be used by the passenger to book flight as shown on Figure 5-3; the passenger will choose the trip type.

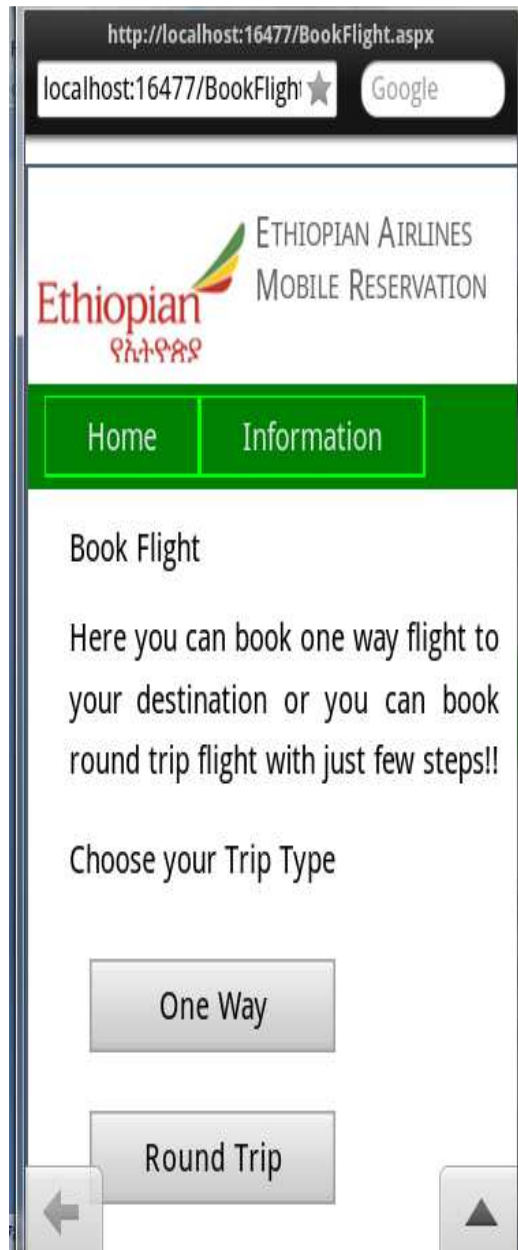


Figure 5-3 Choose Trip Type

This page will be used by the passenger to book flight as shown on Figure 5-4; the passenger will fill in flight search criteria and choose flight.

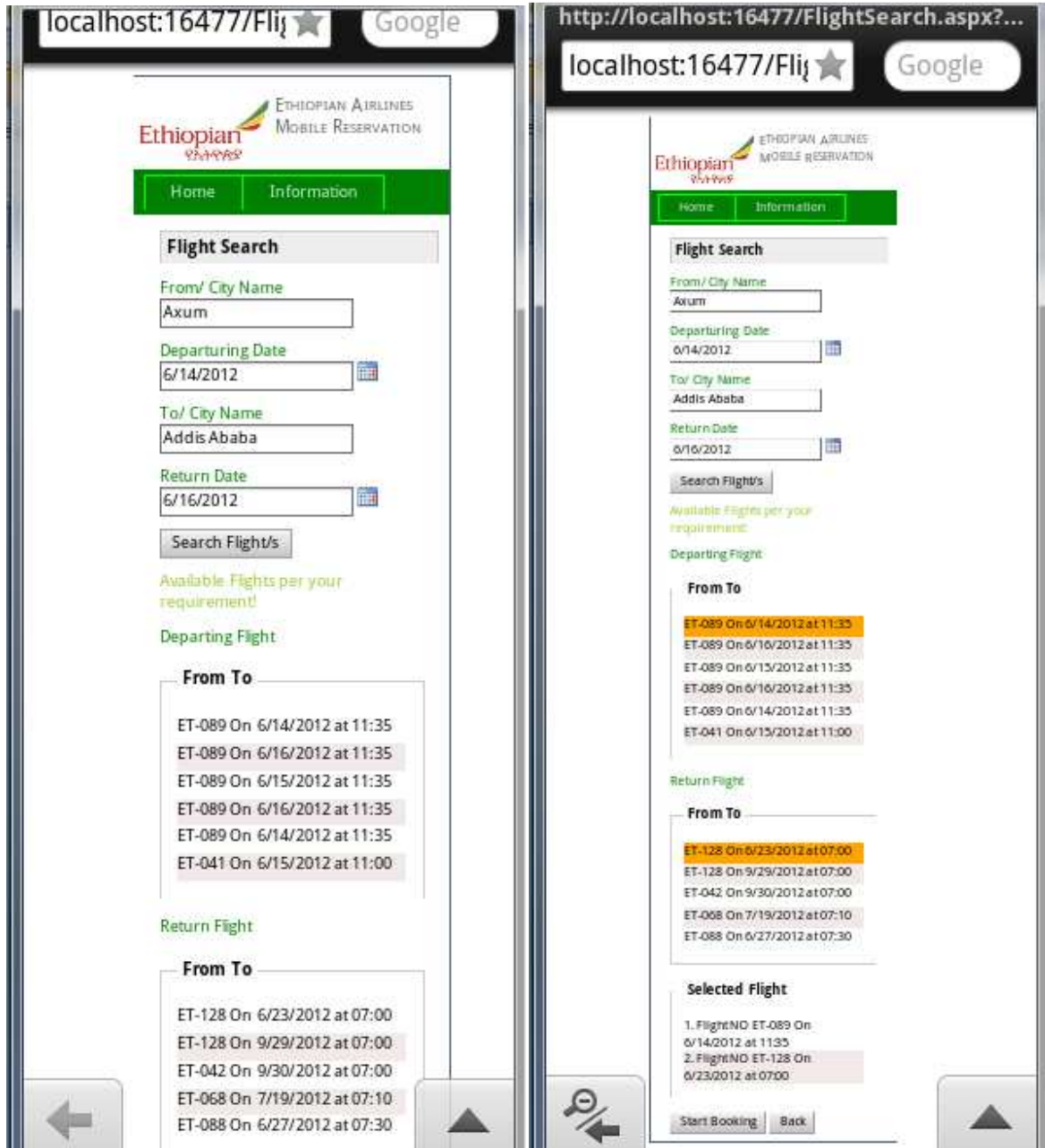


Figure 5-4 Flight Search Page

This page will be used by the passenger to book flight as shown on Figure 5-5; the passenger will fill in personal and contact information

The image displays two side-by-side screenshots of the Ethiopian Airlines mobile reservation booking page. Both screens show the Ethiopian Airlines logo and the text "ETHIOPIAN AIRLINES MOBILE RESERVATION". The left screen is titled "Personal Information" and contains the following fields: Title (Mrs.), First Name (Tsehay), Middle Name (Getahun), Last Name (W/Mariyam), Sex (Female), and Birth Date (3/4/1958). The right screen is titled "Contact Information" and contains the following fields: Mobile Number (two entries: +251913166145 and +251913053651), E-mail (tsehay@gmail.com), and Confirm E-mail (tsehay@gmail.com). Both screens feature a green navigation bar with "Home" and "Information" buttons. The left screen has a "Next" button at the bottom, while the right screen has "Previous" and "Next" buttons at the bottom.

Figure 5-5 Booking Information

This page will be used by the passenger to book flight as shown on Figure 5-6; the passenger will fill in flight detail and travel document information

The image displays two side-by-side screenshots of the Ethiopian Airlines Mobile Reservation interface. Both screenshots show the top navigation bar with 'Home' and 'Information' buttons. The left screenshot shows the 'Flight Detail' section with the following fields: Cabin Class (Economy), Seats (H6), Adults (1), Child (0), Infant (0), Seat Preference (Window/Non-smoking), Meal Preference (Low Fat Meal), Special Request 1 (Select), and Special Request 2 (Select). The right screenshot shows the 'Travel Document Information' section with the following fields: Document Type (Passport), Document Number (Et3245606), Issuing Country (Ethiopia), Expire Date (6/4/2018), and Nationality (Ethiopia). Both screenshots include a bottom navigation bar with 'Previous' and 'Next' buttons.

Figure 5-6 Flight Detail Information

This page will notify the passenger his/her book status as shown on Figure 5-7; the passenger will be given a booking confirmation number on successful booking

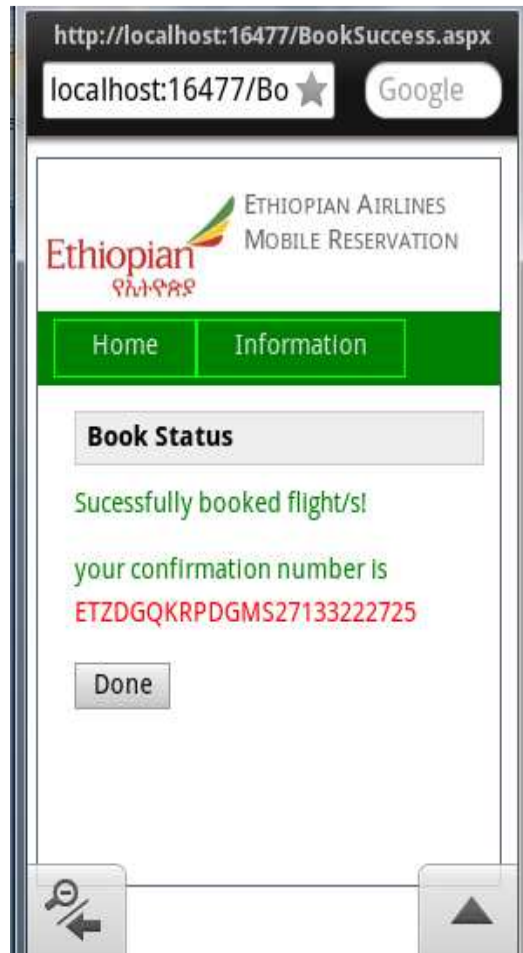


Figure 5-7 Book Status

This page will be used by the passenger to check in as shown on Figure 5-8; the passenger will be given a check in confirmation number on successful checking

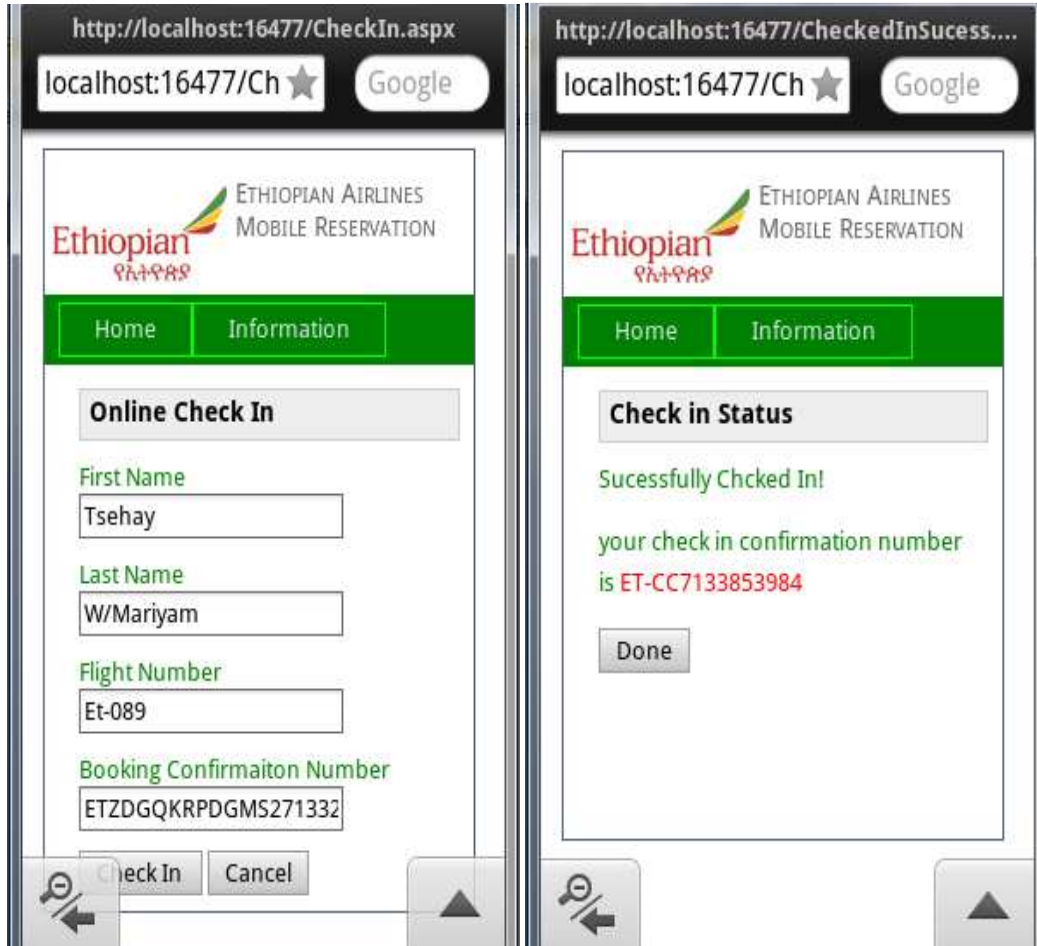


Figure 5-8 Check In

This page will be used by the passenger to check status of a flight in as shown on Figure 5-9 the passenger will provide booking information then status of the flight will be displayed.

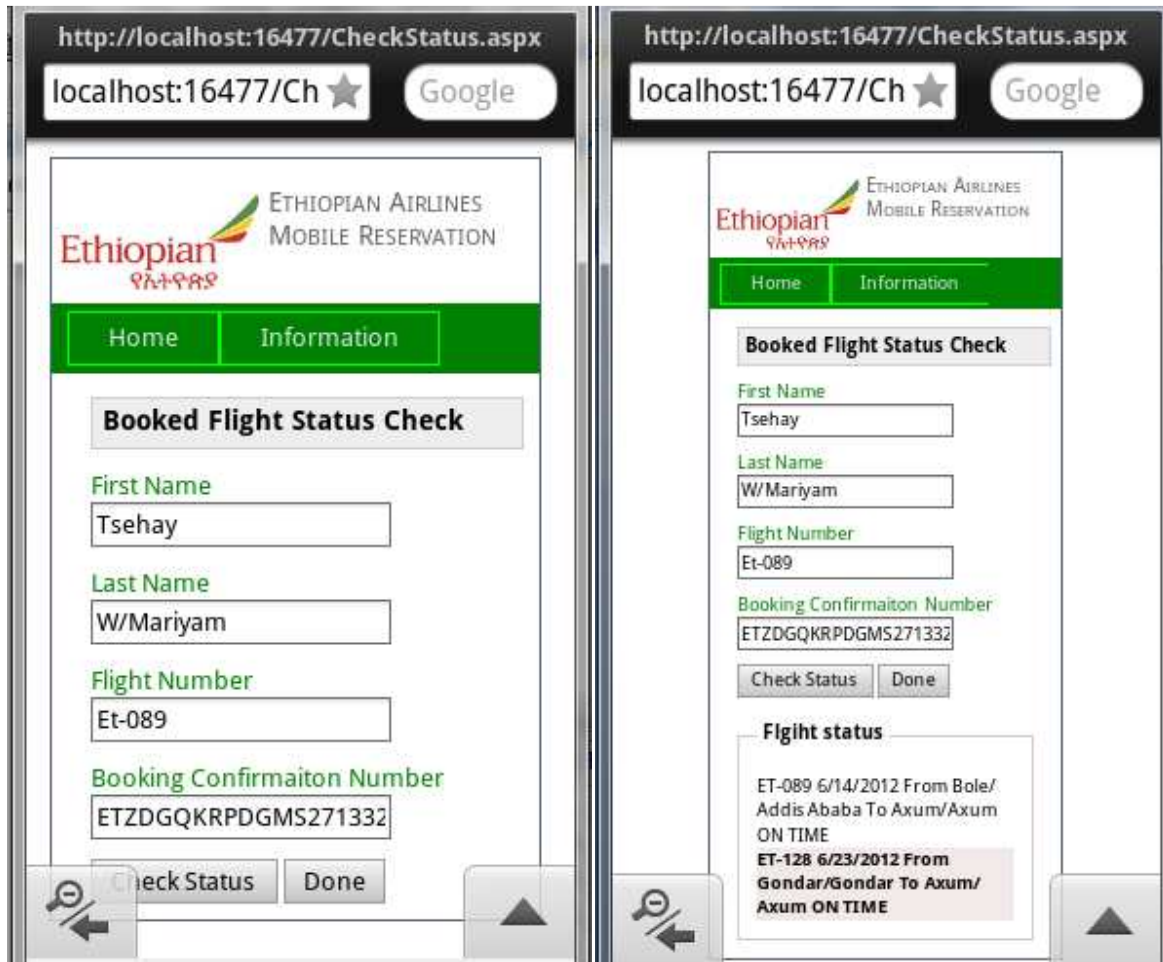


Figure 5-9 Status Check Page

This page will be used by the passenger to manage his/her booking as shown on Figure 5-10 the passenger will provide booking information then booked information will be displayed then the passenger will make changes.

The screenshot shows a mobile web application interface for Ethiopian Airlines. At the top, the browser address bar displays 'http://localhost:16477/ManageBooking.aspx'. Below the address bar is a search bar with 'localhost:16477/ManageB...' and a 'Google' button. The main header features the Ethiopian Airlines logo and the text 'ETHIOPIAN AIRLINES MOBILE RESERVATION'. A green navigation bar contains 'Home' and 'Information' buttons. The main content area is titled 'Booked Flight Management' and contains four input fields: 'First Name', 'Last Name', 'Flight Number', and 'Booking Confirmation Number'. At the bottom, there are 'Load' and 'Cancel' buttons.

Figure 5-10 Booked Flight Management

CHAPTER 6: TESTING AND RESULTS

Testing evaluates a software product to ensure that it satisfies its planned purpose. This chapter will discuss the testing process that is carried out to evaluate the successful implementation of this project. The detailed description of each test and involved matters are presented as follows.

The main purpose of this test plan documentation is to describe the testing details of the use cases of MBRS and to identify the features of the system that will be tested, to identify and define all the activities necessary to prepare for and conduct the testing process, to define the pass/fail criteria for each item that will be tested and to discuss the testing techniques being used to test the system.

6.1. Approach

This section of the test plan describes the overall approach for testing of the system. The approach followed for testing the system ensures that the major features of the project are effectively tested. The system is validated and verified to make sure that the system meets the SRS and the SDD. The approach we used for testing the system is unit testing and emulator usability testing.

6.1.1. Unit Testing

Unit testing tests each single services of the project to check for errors. This is mainly done to discover errors in the code, to isolate each part of the program and to check the correctness of the code.

6.1.1.1. Test Case Specification

The test cases specify the inputs, predicted results and execution conditions. Each test case aims to evaluate the operation of a service element of the system.

- **Test Items**

The items to be tested are all of the MBRS services.

- **Test case pass/fail criteria**

This includes criteria to identify decision rules that are used to determine whether a test case passes or fails a test.

- **Pass Criteria:** The test cases executed on the system will pass if they meet all specific requirements of the system.
- **Fail Criteria:** A test case is said to fail, if the desired functionality is not satisfied by the system.
- **Testing Environment-** An individual not involved in the project development has conducted this test on WCF test client to make sure successful operation of services.
- **Valid Data-** Data is valid only when it is consistent with the defined data types in the data contract.
- **Invalid Data-**Data which is not consistent with the one defined in the data contract to use the services operation.

Both valid and invalid data are provided in the test in order to evaluate the service's response in both cases.

Table 6-1 Test Case Specification for Search Flight

Test Case ID = TestCase1				
Tested On=WCF Test Client				
Test name = Search _Flight_Servicece_Test				
Tested Components=Flight Search				
Assumptions = Returns searched flights				
Purpose = to ensure that available flights with the given criteria are returned to the user.				
TestData=DestinationAPCode=ADD,Date, DestinationAirportName=Bole, DestinationCity=Addis Ababa, OriginAirportCode=AXU, OriginAirportName=Axum, Origin City=Axum, Date=06/29/2012.				
Steps Executed	Expected Results	Data	Actual Results Obtained	Pass/Fail
Insert a valid value for each test data and Click “Invoke” button	Available flights will be displayed	valid data for all fields	Available flights are displayed	Pass
Insert any invalid value and Click “Invoke” button	“Failed to invoke the service”	Any invalid data	“Failed to invoke the service”	Fail

Table 6-2: Test Case Specification for Book Flight

Test Case ID = TestCase2				
Tested On=WCF Test Client				
Test name = Book_Flight_Service_Test				
Tested component=Book Flight				
Assumptions = Returns booking confirmation number				
Purpose = to ensure that passengers get a booked flight.				
TestData=FirstName=Hana,MiddleName=Abebe,LastName=Kebede,Title=Miss,Sex=Female,Adult=1,CabinClass=Economy,City=Addis Ababa, MobilePhone=+251911463545				
Steps Executed	Expected Results	Data	Actual Results Obtained	Pass/Fail
Insert a valid value for each test data and Click "Invoke" button	Booking confirmation number will be displayed	valid data for all fields	Booking confirmation number	Pass
Insert any invalid value and Click "Invoke" button	"Failed to invoke the service"	Any invalid data	"Failed to invoke the service"	Fail

Table 6-3: Test Case Specification for Check_Status_Service

Test Case ID = TestCase3				
Tested On=WCF Test Client				
Test name = Check_Status_Service_Test				
Tested Component=Flight Status				
Assumptions = Returns status of a flight				
Purpose = to ensure that passengers get a status of a flight.				
Test Data=BookingConfirmationCode= ETMMXBBZBRTMKKI307528926				
Steps Executed	Expected Results	Data	Actual Results Obtained	Pass/Fail
Insert a valid BookingConfirmationCode value and Click “Invoke” button	Status of a flight will be displayed	valid BookingConfirmationCode	Status of a flight will be displayed	Pass
Insert invalid value and Click “Invoke” button	“Failed to invoke the service”	Invalid BookingConfirmationCode	“Failed to invoke the service”	Fail

Table 6-4: Test Case Specification for Check In_Service

Test Case ID = TestCase4				
Tested On=WCF Test Client				
Test name = Check In_Service_Test				
Tested Component=Check In				
Assumptions = Returns a CheckinConfirmationNumber(CCN)				
Purpose = to ensure that passengers get CheckinConfirmationNumber to check in to flights.				
Test Data=BookingConfirmationCode= ETMMXBBZBRTMKKI307528926				
Steps Executed	Expected Results	Data	Actual Results Obtained	Pass/Fail
Insert a valid BookingConfirmationCode value and Click "Invoke" button	CCN will be displayed	valid BookingConfirmationCode	CCN will be displayed	Pass
Insert invalid value and Click "Invoke" button	"Failed to invoke the service"	Invalid BookingConfirmationCode	"Failed to invoke the service"	Fail

Table 6-5: Test Case Specification for Manage_Booking_Service

Test Case ID = TestCase5				
Tested On=WCF Test Client				
Test name = Manage_Booking_Service				
Tested Component=Manage Booking				
Assumptions = Enables Passenger update a booked flight information				
Purpose = to ensure that passengers update flights.				
Test Data=BookingConfirmationCode= ETMMXBBZBRTMKKI307528926,CabinClass=Business				
Steps Executed	Expected Results	Data	Actual Results Obtained	Pass/Fail
Insert a valid value for each test data and Click “Invoke” button	Booking information will be updated	valid data for all fields	Booking information will be updated	Pass
Insert invalid value and Click “Invoke” button	“Failed to invoke the service”	Any Invalid data	“Failed to invoke the service”	Fail

6.1.2. Usability testing

Usability testing attempts to answer questions like *how good is the application?* Usability tests can be performed in a laboratory, using either an emulator or an actual device[19].

In this project, usability testing is performed using opera mobile emulator[21]. The emulator simulate a working mobile phone - Nokia 5530 Xpress, LG Optimus One, Samsung Galaxy S and Nokia 5800 Xpress music. The developed prototype is deployed in application and web server. The application server contains the developed WCF web services and the web server contains the web pages.

Test subjects access the web pages using the emulator and the following figures show how the home page renders on four mobile phones with different vendors and different resolution.

Figure 6-1 shows the home page displayed on Nokia 5530 Xpress Music, resolution 240x361.

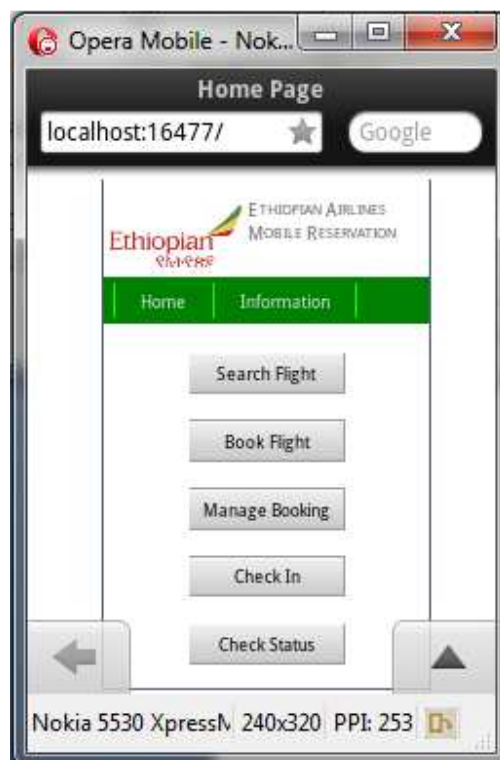


Figure 6-1 Home page on Nokia 5530 Xpress Music

Figure 6-2 shows the home page displayed on LG Optimus One, resolution 320x480.

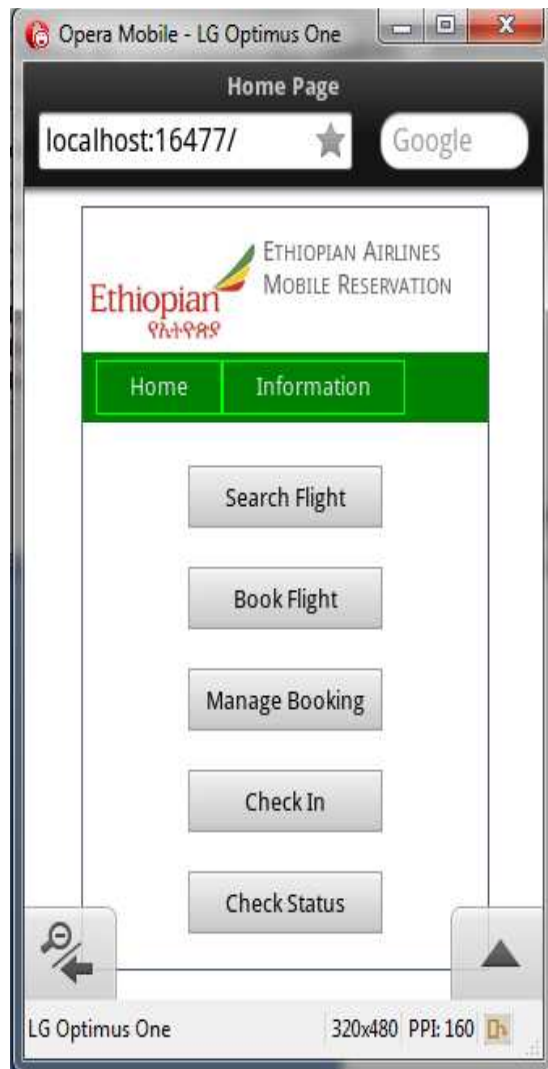


Figure 6-2 Home page on LG Optimus One

Figure 6-2 shows the home page displayed on Samsung Galaxy S, resolution 480x640.

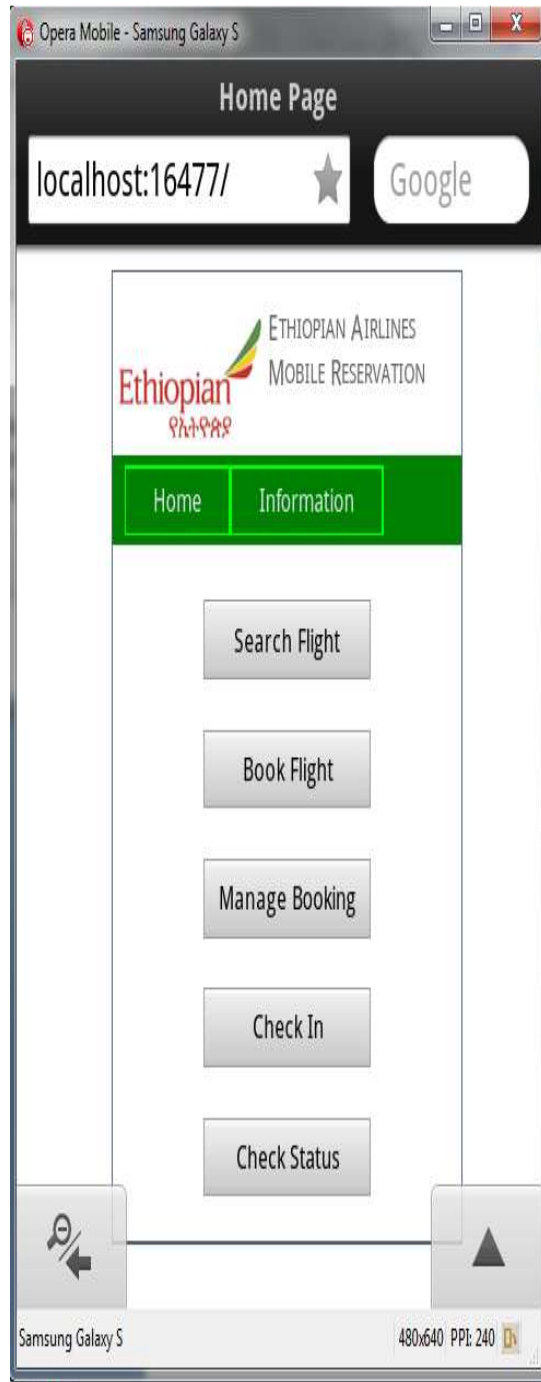


Figure 6-3 Home page on Samsung Galaxy S

Figure 6-4 shows the home page displayed on Nokia 5800XpressMusic, resolution 360x640.

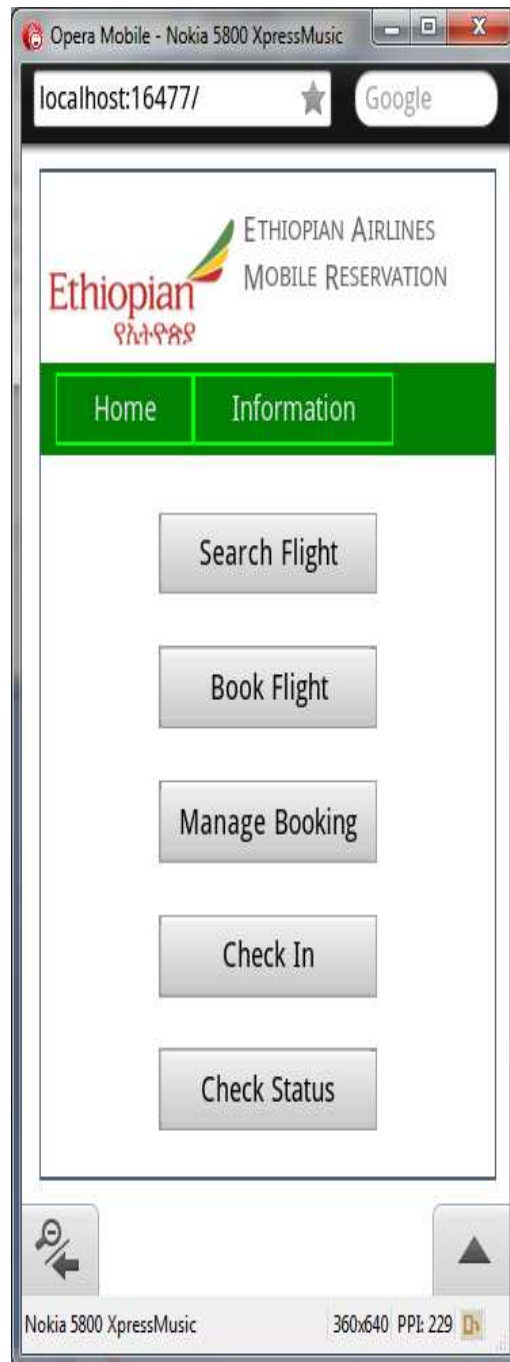
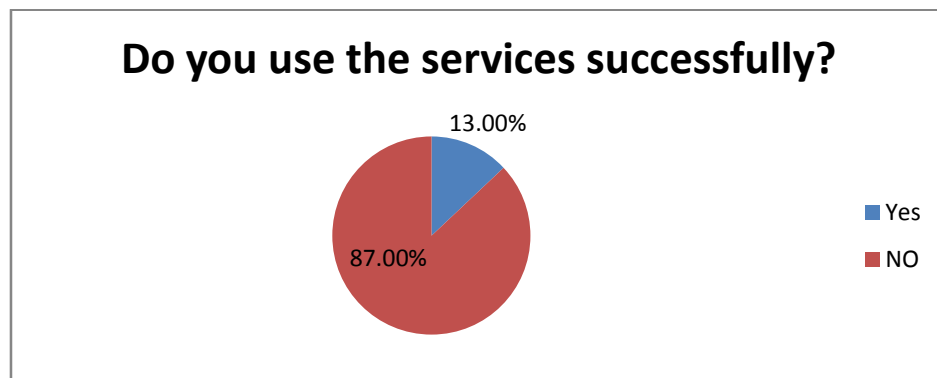


Figure 6-4 Home Page on Nokia 5800 XpressMusic

6.2. Discussion

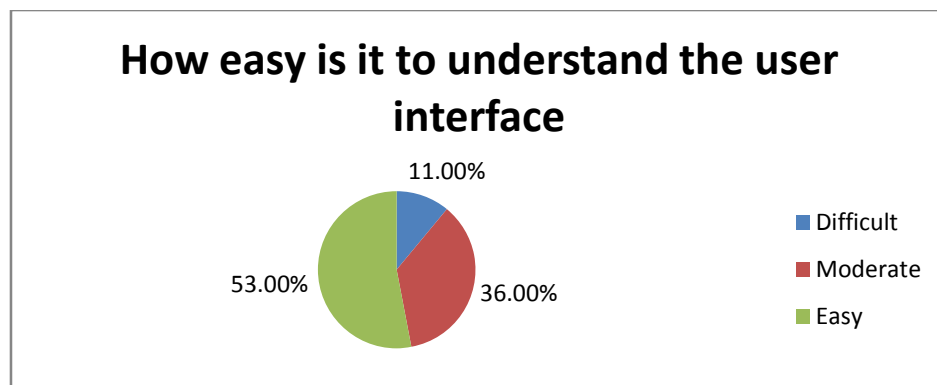
A questionnaire is used in order to do the system usability testing. The questionnaire focuses on how the system is easy to use for potential users of the airlines' flight reservation services. We tested it with twelve test subjects who are computer literate and have access to internet and own mobile phone that is emulated by Opera mobile emulator.

1. Do you use the services successfully? Yes, No



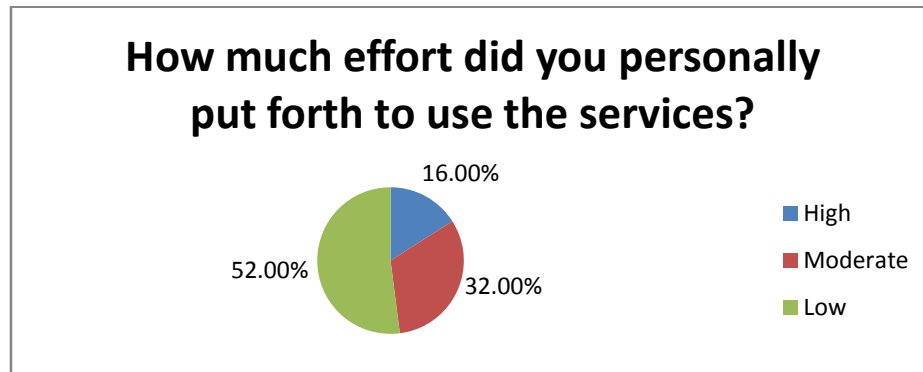
As shown in the above pie chart more than 80% of users have successfully manipulated the services.

2. How easy is it to understand the user interface? Difficult ,Moderate ,Easy



The above pie chart shows more than half of users understood the user interfaces easily.

3. How much effort did you personally put forth to use the services? High, Moderate, Low



The pie chart above shows that more than half of the people involved in this did not have to put in much effort to perform tasks to use the services. One of the reasons for this is that the UI is simple and easy to use.

Usability testing on emulator is conducted to evaluate the overall functionality of the services provided in this project. The test result shows the implemented services operate successfully in fulfilling the requirement of the project. And also users face no difficulty using the services as the user interfaces are simple and easy to use.

CHAPTER 7: CONCLUSION AND FUTURE WORK

Ethiopian Airlines is a leader in African airline industry transporting more than 2 million passengers annually. In such competitive industry increasing availability and reaching out to customers is key to succeed.

Due to the increasing number of mobile phones and their pervasiveness nature, we proposed a system which is mobile based. In this project, we have analyzed the requirements of passengers which should be included in the mobile flight reservation. In designing the system, due attention is given to how data has to be communicated between mobile based clients and the airlines existing system; and how the implementation of the project will best fit with the workflow of the current system of the airlines. The design of the system is based on the software as a service approach focusing on exposing a service in the server client environment. As a result we have used services whose concept best fit our proposed solution to develop the project for the requirements identified. Particularly the project is developed using WCF which is easier and advanced in implementing services, in which mobile based clients from different platforms can access Ethiopian Airlines flight reservation without concerning about the underlying technologies. WCF, accomplishes this by embracing interoperability and loosely coupling that ensures accessibility from different platforms and reusability as well as easy maintenance whenever needed.

After implementing the project we have conducted testing and evaluated the success of the developed solution in accomplishing the requirements. Unit testing is carried out to uncover errors and gaps in accomplishing the required functionalities, and also usability testing to evaluate the project's success from user's perspective.

Services are the best way in software development as they eliminate many overheads that hinder flexibility in developing software. As a result large scale service usage should be considered in

developing software. Future work of this project is implementing the system at Ethiopian Airlines to enable mobile based users communicate with the services provided.

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DECLARATION

I, the undersigned, hereby declare that this project is my original work performed under the supervision of Dr. Fekade Getahun, has not been presented as a project for a degree program in any other university and all sources of materials used for the project are duly acknowledged.

Name: Zebib Getachew Tefera

Signature: _____

Place: Addis Ababa

Date of submission: December, 2013

This project has been submitted for examination with my approval as a university advisor.

Advisor's Name: Dr. Fekade Getahun

Signature: _____