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**AN INTRODUCTION TO IPHONE
HARDWARE, OPERATING SYSTEM,
APPLICATIONS AND DEVELOPMENT
OF IPHONE APPLICATIONS**



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An Introduction to iPhone hardware, Operating System, Applications and Development of iPhone Applications

The aim of this thesis work is to discuss the newly popular mobile phone device named iPhone made by Apple Inc, iPhone operating system and iPhone Applications. Apple iPhone has recently become extremely popular and just within two years of its launch it has captured millions of customers around the world. Thousands of developers have been developing all kinds of mobile phone applications for iPhone and a new era of mobile phone applications development has started. Augmented reality applications on iPhone have really changed the ways that a mobile phone device can be used. This thesis work will find out that what kind of applications can be developed for Finnish iPhone users and for this purpose an iPhone application is developed that shows the timetable of Turku city buses.

KEYWORDS:

Apple iPhone, iPhone Operating System, App Store, iPhone Applications, Augmented Reality Applications, Objective-C, iPhone SDK



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TABLE OF CONTENTS

1 INTRODUCTION	1
1.1 Product Information	1
1.2 Background	2
1.3 Research Questions and Methodologies	3
2 IPHONE, IPHONE HARDWARE AND OPERATING SYSTEM	5
2.1 iPhone	5
2.2 iPhone Hardware	6
2.3 iPhone Operating System	9
3 IPHONE APPLICATIONS	12
3.1 iPhone App Store	12
3.2 Ideas for Developing iPhone Applications for Finnish Users	32
3.3 Augmented Reality Applications	39
4 DEVELOPMENT OF IPHONE APPLICATIONS	41
4.1 iPhone Developer Program	41
4.2 iPhone SDK	41
4.3 A Sample iPhone Application	42
6 CONCLUSIONS	45
7 REFERENCES	46

FIGURES

Figure 2.1: iPhone front view	8
Figure 2.2: iPhone back view	8
Figure 3.1: SimCity game being played on an iPhone device	13
Figure 3.2: An image of the 1 June 2009 issue of The New Yorker	14
Figure 3.3: The main window of the Measurements iPhone application	15
Figure 3.4: News Feed window of the Facebook iPhone application	16
Figure 3.5: The Shazam application menu window of the iPhone	17
Figure 3.6: AirSharing iPhone window showing files of a computer	18
Figure 3.7: The main window of the eBay application on the iPhone	19
Figure 3.8: The Google iPhone application is searching on the Internet using a voice command	20
Figure 3.9: Trip Journal showing information about Eiffel Tower, Paris	21
Figure 3.10: FIFA Worldcup 2010 iPhone application showing teams in groups	22
Figure 3.11: An image of Tom Tom iPhone application giving directions	23
Figure 3.12: The Sleep Cycle iPhone application shows statistics of a user's sleep	24
Figure 3.13: Front page of BBC News application for iPhone	25
Figure 3.14: An image being edited on Adobe Photoshop iPhone application.	26
Figure 3.15: CNBC application customizes the stock of a user on an iPhone	27
Figure 3.16: Folders, showing the idisk of a user on an iPhone	28
Figure 3.17: NASA showing its missions on their iPhone application	29
Figure 3.18: The Weather Channel iPhone application shows weather conditions	30
Figure 3.19: A book is being read on Amazon Kindle for iPhone	31
Figure 3.20: Eye Test application testing the eyesight of iPhone user	32
Figure 3.21: New York Nearest Subway using the iPhone camera to guide the user	40

Figure 4.1: The iPhone Developer Program	41
Figure 4.2: The main view showing the line numbers of Turku buses	43
Figure 4.3: The window showing the timetable of Line 1	44

1. Introduction

1.1 Product Information

The iPhone was introduced to the public on January 9, 2007 in a keynote address given by Apple Inc.'s CEO Steve Jobs. Before the introduction of iPhone, there had been huge speculation that Apple had been developing a mobile phone device since Apple was required by the law to apply for several patents and permits and such filings are usually made available to the public. The iPhone went on sale in June 2007 and it was initially available to the customers in the U.S.A. only. Later on the first generation of iPhone model also known as iPhone 2G (since it lacks 3G capability) was released in UK, France, Germany, Ireland, and Austria. The first-generation iPhone did not initially have many applications; it had quite a few applications other than making phone calls and sending text messages. But iPhone became a huge success due to the fact that it was a first ever finger sensitive touch screen mobile phone and it introduced some applications that were not present in any other mobile phone device at that time. It mostly received positive reviews from its customers and critics. [1]

Initially, the iPhone was locked to its GSM Operator AT&T in the U.S.A. and one had to obtain the connection of AT&T to activate the iPhone. But soon after its release, hackers found ways to unlock the iPhone so that it could be used with any wireless carrier anywhere in the world. The developers from all around the world started working on the iPhone operating system and found ways to develop applications for iPhone 2G. This was quite interesting since there was never such an enthusiasm from the developers to develop applications for any other mobile phone operating system before. Just after a few months of iPhone release, developers had developed hundreds of iPhone applications including iPhone games, entertainment applications, utilities and plenty more. But to install these applications, one had to modify the operating system of iPhone, which Apple did not support. However, a number of iPhone owners chose to modify their iPhone operating system and started to use these applications on their iPhones.

On 11 July 2008, Apple released a new version of iPhone known as 'iPhone 3G' since it supported the 3G network and it was released in twenty-two countries, mostly European and North American countries. Apple also released a newer operating system of iPhone, with the release of iPhone 3G. The real change in the iPhone

operating system was the introduction of 'App Store'. App Store is an iPhone operating system application that allows iPhone users to buy and download applications directly on their iPhones. App Store was also integrated in Apple iTunes software for Mac and PC from which users can buy and download iPhone applications on their computers just like they buy and download music from iTunes. [2]

1.2 Background

Apple introduced iPhone SDK (Software Development Kit) to develop applications for the iPhone operating system and started the iPhone Developer Program in July 2008. The iPhone Developer Program works in such a way that a developer can register with Apple by paying a one-time registration fee of \$99 and after that the developer can develop applications for iPhone and submit these applications to Apple. Apple then reviews these applications and if approved, they are listed in App Store. The developer can choose to either distribute an application for free, or set a sale price of his/her choice. The developer will receive 70% of revenue share of their applications sale and Apple will keep 30% of the revenue share. Just within two years of the introduction of the iPhone SDK and iPhone Developer Program, there are more than 225,000 applications for sale in the iPhone App Store and more than 5,000,000,000 applications have been downloaded from the App Store [3]. It is estimated that more than 10,000,000 applications are downloaded from App Store every day.

The individuals and companies across the world have developed a great number of interesting and useful applications for iPhone. This has helped both developers and users of the iPhone. The developers can earn quite a lot of money by just working from home and developing iPhone applications and iPhone users can acquire lots of these interesting and useful applications on their iPhones. iPhone users can access such functions on their iPhones that were not possible without a computer a couple of years ago. For example, these iPhone users can keep themselves updated with latest news on their iPhones and they do not really need a computer to send and receive emails. The App Store contains applications for just about everything.

The applications on the App Store are divided into different categories depending on the nature of that application, i.e., a game application will be included in Games section of the App Store and, similarly, music related app would be included in Music section of the App Store. Apple has country-based App Stores meaning that Sweden would have

a different App Store, Finland would have a different App Store and similarly other countries would have their own App Stores. There is not a huge difference between these different App Stores but an App Store of a particular country has some applications that are country or region-specific. For example, a news application of Helsingin Sanomat is only available in the Finnish App Store as this newspaper probably has no readers in other parts of the world. iPhone users in countries like the U.S.A., U.K. or Canada have access to plenty more country or region-based applications than iPhone users in Finland have. There is a huge opportunity to develop such country-based applications for Finland and sell these applications on the Finnish App Store. This would help both Finnish developers to earn money and Finnish iPhone users to maximize the use of their iPhones.

Finnish people are very keen in procuring Apple devices and using these products in their daily life. There is no exact figure on iPhone users in Finland available but it is a quite an overwhelming number. But there are not many applications that are particularly designed for iPhone users in Finland. For example, there are not many lifestyle applications and this is a very popular category of applications in the App Store. One of main purposes of this thesis work is to discuss the applications that can be quite handy for Finnish iPhone users and are in fact needed in the Finnish market. This thesis aims to discuss those applications that are missing from the Finnish App Store and are available to users in other parts of the world.

Apple has sold more than 50 million iPhones within three years of the iPhone launch. It has also sold millions of iPod Touch and iPad devices that use the iPhone operating system. [4] These sale numbers continue increasing every day. Developers from around the world have developed hundreds of thousands of iPhone applications that are available for sale on the App Store. These numbers may indeed define the importance of this thesis work. [2]

1.3 Research Questions and Methodologies

This study discusses four main questions and gives answers to these questions using different methodologies as mentioned below:

- What is an iPhone, its hardware and operating system? To give answer to this question, a practical experience was needed and an iPhone has been used to thoroughly examine the device hardware and its operating system.

- What is iPhone AppStore and what kind of applications are available in this App Store? The study of iPhone applications and how these applications are categorized in App Store was needed. It was done by practically using iPhone App Store and popular iPhone applications. A reading of iPhone applications reviews on different fora was also very helpful.
- What kind of applications could be developed for iPhone users in Finland? To give answer to this question, a study of iPhone applications including augmented reality applications for iPhone that are being used in other parts of the world has been carried out. This study was conducted through reading reviews and articles on iPhone applications available on different websites, magazines and by contacting friends who are using iPhone in other countries.
- How can one develop a simple iPhone application using Xcode? Mostly, developers had not been keen on developing applications for Apple products until recently. It was due to the market share of Apple products. But this situation has been changing recently after the release of iPhone and its operating system. The iPhone operating system is a simplified version of Apple's Mac OS X. The applications are written in Xcode that is based on Objective-C. [5] A brief study of Xcode was carried out by reading different books on the topic, going through tutorials available on the Internet and by watching Xcode tutorial videos available on YouTube.

2. iPhone, iPhone Hardware and Operating System

2.1 iPhone

The **iPhone** is a smart phone manufactured by Apple Inc., which has capabilities of multimedia and Internet. Its basic functions include a phone dialer, text messaging, a camera and it can be used as a portable media player equivalent to an iPod Touch. It has wi-fi, an email client and a web browser. It has a multi-touch screen and a virtual keyboard in lieu of physical keyboard.

First-Generation iPhone (iPhone 2G): The first-generation iPhone was quad-band GSM that supported EDGE networks but lacked support for 3G networks. It featured a two-megapixel camera and it had a metal silver back. The original iPhone came in 4GB, 8GB and 16GB memory versions.

Second-Generation iPhone (iPhone 3G): In the second-generation iPhone, also known as iPhone 3G, Apple added 3G-network support that enables 7.2Mbps Internet downloading speed. Apple added GPS in this model of iPhone. The outer look of iPhone was totally changed. Instead of a silver metal back, it came in two different models one with a black color back plate and other with a white color back plate. The iPhone 3G display was slightly warmer than the previous generation iPhone. iPhone 3G was available in two memory capacities, 8 GB and 16GB.

Third-Generation iPhone (iPhone 3GS): The third generation of iPhone, also known as iPhone 3GS, has a similar look to that of the previous generation iPhone. But there are several improvements in its hardware. It features a video camera of 3 megapixels. It has a faster processor, so it works much faster than the previous generation iPhone and its 'S' in 3GS stands for speed. Apple added a compass in this new model of iPhone. This iPhone can also be controlled with voice and this new feature is called voice control. It features a scratchproof touch screen. iPhone 3GS is available in 16GB and 32GB capacities. [2]

The further discussion in this thesis concerns iPhone 3GS but it is simply named as iPhone for convenience.

2.2 iPhone Hardware

The iPhone touch screen is a 9cm (3.5in) liquid crystal display with a resolution of 320x480 pixels. Its touch screen is designed for a bare finger, or multiple fingers for multi-touch sensing. The iPhone touch screen is scratchproof and features a fingerprint-resistant oleophobic coating. There is a home button under the touch screen of the iPhone that can be pressed to exit an application on the iPhone and return back to home screen. There is also a sleep/wake button on top right of the iPhone that would put the iPhone in wake/sleep mode and it can also be used to restart the iPhone.

The iPhone has four kinds of sensors.

1. A proximity sensor blanks the touch screen display when the iPhone is brought near the face during a call. This saves battery power.
2. An ambient light sensor adjusts the display brightness and display becomes brighter when it is brought to light and becomes darker when it is brought in dark.
3. The moisture sensors indicate whether water damage has affected a device.
4. An accelerometer sensor that is the most useful sensor of the iPhone detects the orientation of the iPhone. It is very useful in several applications like in web browser. It changes the web browser from portable to landscape view when the iPhone is held in landscape.

The iPhone features two speakers, one is located above the screen as an earpiece, and the other is located on the left side of the bottom, opposite to a microphone on the bottom-right. Volume controls are located on the left side of the iPhone. Speakers are used both for hands-free operations and media playback. The headphones jack is located on the top left corner of the iPhone. There is a button to put the iPhone in silent mode that is located above the voice controls on left side of the iPhone. The built-in Bluetooth supports wireless earpieces and headphones. Composite video and stereo audio can be output from the dock connector using an adapter made by Apple.

The iPhone includes a GPS chip that is used in many navigation and map applications of the iPhone. It features a compass that is used to display the directions on the iPhone. The compass is also used in many iPhone applications.

The iPhone features an internal rechargeable battery just like an iPod but unlike most other mobile phones, the battery is not user-replaceable. The iPhone can be charged when connected to a computer with a USB cable. Alternatively, a USB to AC adapter may be connected to the cable to charge directly from an AC outlet.

The iPhone has a 3 megapixel camera, featuring auto focus, auto white balance, and auto macro. It is also capable of capturing 640x480 resolution video at 30 frames per second. The video can then be uploaded to services like YouTube.

The SIM card sits in a tray, which is inserted into a slot at the top of the device. The SIM tray can be ejected with a paperclip, or the "SIM eject tool" (a simple piece of die-cut sheet metal) included with the iPhone. The iPhone comes in two internal storage capacities of 16GB and 32GB. It does not feature any memory card slot unlike other mobile phones. A USB/sync cable is provided that is used to synchronize and charge the iPhone. A pair of earphones with a remote control and a microphone is included. The remote control is used to control iPhone functions and the microphone is used as an audio input device. An AC adapter is included that can be used together with the USB cable to charge the iPhone. A small paper pin like tool is included to eject the SIM tray of iPhone. A quick start guide is included that helps users to quick start with the iPhone.

Unlike other smartphones, iPhone cannot be operated out of box. It needs to be connected to computer first using the included USB cable. The computer should have iTunes installed on it that can be downloaded for free from the Apple website. iTunes will recognize the iPhone automatically and it will connect with the iTunes server on the Internet and then the iTunes server will activate the iPhone so that it can be used as a phone. [2]

The complete illustration of the iPhone external hardware is shown in Figure 2.1 and Figure 2.2.



Figure 2.1: iPhone front view [6]



Figure 2.2: iPhone back view [6]

2.3 iPhone Operating System

The iPhone OS is a mobile operating system developed by Apple Inc. Since the introduction of the iPhone and the iPod Touch, it has been included as the default operating system of the devices, and has been announced as the default operating system for the upcoming Apple tablet named iPad. This operating system is derived from Mac OS X, a Unix-like operating system. The operating system uses less than 500MB of the device's memory.

iPhone OS features a dialer application that presents a virtual dial pad to dial any number on the iPhone and is also used to store contacts on the iPhone and maintains a history of the call log. It features visual voicemail, too but that is not supported by all GSM carriers. The iPhone OS includes a mail client named as Mail. It is used to send and receive email directly on the users' iPhone. Users need to configure their email server in the iPhone settings for this purpose. It requires the Internet connection to update emails on the iPhone but it keeps the emails stored once updated on the iPhone. An iPhone version of the popular Internet browser Safari is included in the iPhone OS. It can open several web pages simultaneously on the device. A messaging application is used for messaging. It can be used to send and receive text, photo and video messages. The virtual keyboard on screen is used for text input. The users can also copy and paste text from other iPhone applications to this application and send it as text message.

The iPhone operating system features a full iPod in an application called iPod. This application converts iPhone into a portable media player. It stores songs and videos on the iPhone. It is synced by the iTunes music library from a computer. An iPhone version of YouTube is part of its operating system. It requires Internet connection to play YouTube videos on the iPhone. Users can search the database of YouTube videos and play them on the iPhone.

The Camera application of OS is used to operate camera of the iPhone. This application lets the users take pictures and record videos and then save them in Photos. Photos is a separate application which stores photos and videos taken by the iPhone camera. It can also store the photos copied from the iPhone web browser.

Maps uses Google maps to display maps on iPhone. One can search for any street address and receive directions between two places using the Maps application. One can also obtain street views of certain places around the world. The Maps application uses the Internet and GPS of the iPhone. A Compass application is also part of the iPhone OS and is used to show directions. It uses the built-in hardware of the compass for the purpose.

The other applications included in iPhone operating system are: Weather, Stocks, Voice Memos, Notes, Calculator and Calendar. The Weather application displays the weather conditions of selected cities. Users can choose any cities in this application and the iPhone will display the weather conditions in those cities. This application also requires Internet connection.

The Stock application shows the stock charts of selected stocks and users can customize this application by choosing stocks of their choice. The Voice Memos lets users record voice and may be used to record a class lecture, for example. It uses a microphone as input device. One can make notes of anything in the Notes application by using a virtual keyboard. It is quite a simple and useful application. The Calculator application features two types of calculators. One is a simple calculator and when the iPhone is placed in landscape mode, it will turn that simple calculator into a scientific calculator. A Calendar application is included to display the date and can be used to keep track of the events on a particular date.

The Settings application is used to configure all the settings of iPhone. It may configure both built-in OS applications and third party applications downloaded from iTunes. It can also be used to turn on/off several features, like Wi-fi, 3G etc. Users may even choose to change wallpaper, set local keyboard settings or any other iPhone setting they may wish to change using this application.

The iPhone OS comes with two stores, the iTunes Store and the App Store. The iTunes Store is the iPhone version of Apple iTunes. Users can directly download music from the iTunes store on their iPhone using this application or may just choose to listen to a sample of any song available on the iTunes store. This application also requires the Internet service to work. The App Store is a store from which one can buy and download applications mostly made by third party developers for iPhone. These applications are categorized in different categories. Most of these applications come

with a price tag but some of them can be downloaded free of cost. This application also requires Internet service.

An interesting feature of iPhone OS is Voice Control. It lets users to play music and make phone calls by giving voice commands to the iPhone. It uses the microphone as an input audio device. This feature supports more than twenty languages. [7]

3.0 iPhone Applications

3.1 iPhone App Store

The App Store is a service for iPhone, which allows users to browse and download third party applications on their iPhones. These applications are developed by individuals and companies around the world and then submitted to Apple. Before submitting these applications, one has to register with Apple through iPhone Developer Program. Apple then reviews these applications thoroughly for which they have several merits and if the application is approved by Apple, it is then listed on the App Store for sale. The developers can set their desired price for their application, or they can also offer their applications for free download on the iPhone. The App Store is also available on the iPod Touch and the iPad. These devices use the same operating system as of the iPhone except for some minor differences.

It can be argued that instead of making separate applications, developers may develop web-based applications independent of any platform so that these web-based applications may function on any mobile phone. However, the mobile phones available today are not similar. They are manufactured by different companies and use several kinds of operating systems. Their size of display, input and operating methods vary from one another. So, this idea of universal web-based applications is not very practical in today's time. For instance, ebay.com has a customized website for mobile phone devices and it also has an eBay application for iPhone. Using the eBay application on the iPhone is far more convenient and well-organized than browsing the eBay customized mobile phone website on iPhone.

The App Store itself is the most popular application of the iPhone and an estimated number of more than 250,000 applications are available to download on an iPhone [3]. The world's largest companies and organizations have developed customized applications of their services for the iPhone just like world's largest companies designed their websites to introduce their services on the Internet a few decades ago. Users can find applications of almost anything on their iPhone App Store. Google, Facebook, eBay, NYTimes, MLB.com and all such big names have their applications in the iPhone App Store. Some developers have claimed that they have earned more money in just a few months by developing iPhone applications than they used to earn

in years by developing computer applications. This all reflects the success and popularity of the iPhone App Store.

Some of the App Store applications can be downloaded for free from the App Store. Users may also find some paid applications for free for a limited time as a special offer from their developers. Other applications are paid applications and users need to pay to download these applications. It is also possible to make In-App purchases. For example, the Amazon Kindle application for the iPhone can be downloaded for free from the App Store but users need to pay to download books in this application, such purchase is known as In-App Purchase.

The iPhone App Store provides the following categories of applications:

Games: This section contains games applications. Users can find a variety of games in this section. Some of these games are quite simple games, like a game of 'tic tac' that has been developed by an individual developer and some of the games in this section have been developed by the world's largest games companies, such as Electronic Arts Inc and they are very advanced games. Users may find their favorite games such as SimCity, Street Fighter, Need for Speed and so on. In this section as in recent years, the world's largest game companies have developed iPhone versions of their famous games. Apple has especially advertised 'iPod Touch' as a gaming device as iPod Touch is extremely popular with teenagers who download and play several iPhone games.

Electronics Arts (EA) has developed a number of iPhone games including one popular iPhone game, SimCity. Figure 3.1 shows SimCity being played on an iPhone.



Figure 3.1: SimCity game being played on an iPhone device.

Entertainment: This section contains entertainment-related applications for iPhone. Users may find radio and TV applications in this section and may listen or even watch live streaming of their favorite radio or TV programs. This section also contains some very simple and interesting applications, such as iBeer, IMDB app, 1500 Ringtones and many more.

One of the most popular entertainment applications is Brushes that is a painting application of the iPhone. It has become so popular that the cover of 1 June 2009 issue of The New Yorker was designed by using this application on iPhone as it is shown below in Figure 3.2 [8].

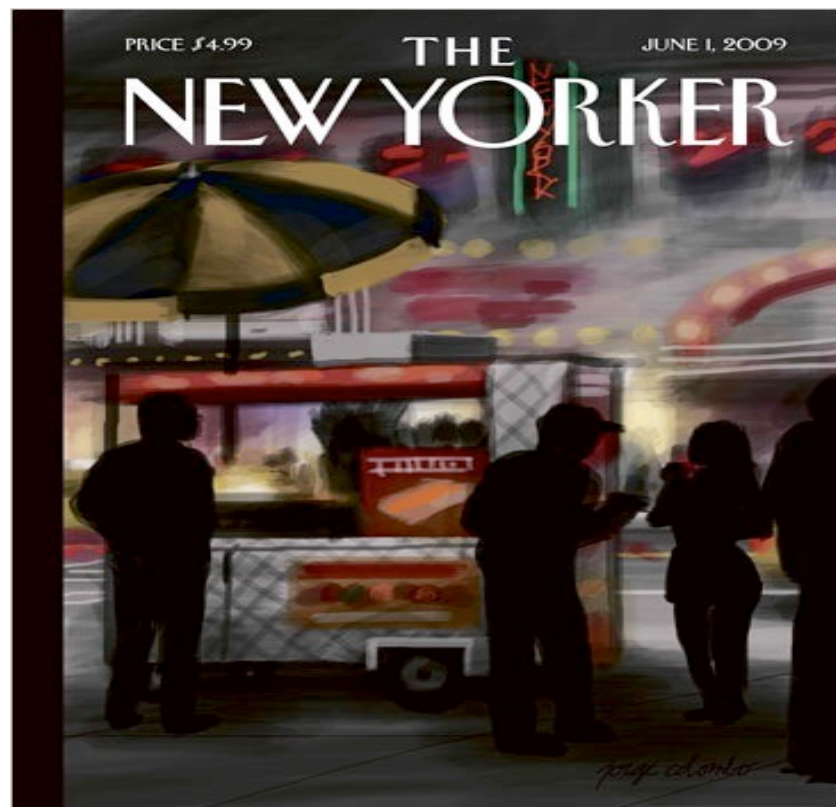


Figure 3.2: An image of the 1 June 2009 issue of The New Yorker [9].

Utilities: The most useful applications of iPhone can be found in this section. This section contains a wide range of applications. Users may find conversion applications that can convert currency and units and so on. There are applications that would show

the Internet speed of the iPhone. Some utilities can even enhance the capabilities of certain iPhone hardware.

Measurements is a quite popular iPhone utility application for different kinds of measurements. The main window of Measurements is shown in Figure 3.3.

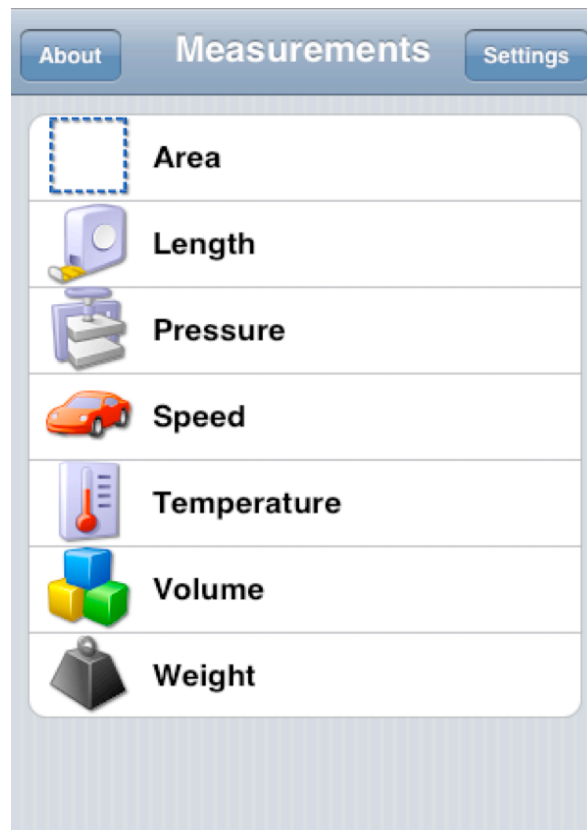


Figure 3.3: The main window of the Measurements iPhone application.

Social Networking: It is probably the most popular section as it contains some of the most popular iPhone applications. It contains applications like Facebook and Skype. There are applications that would allow users to make VoIP (Voice over Internet Protocol) calls on an iPhone. For instance, users can make VoIP calls by using the iPhone version of Skype. This section also contains other interesting social networking and dating applications such as MySpace and SpeedDate. There are plenty of applications in this section that would allow users to send free text messages on any mobile phone around the world.

The iPhone version of Facebook is one of the most popular iPhone applications. The users can more or less do anything that they can do on their desktop computers using this iPhone application. They can receive news feeds, notifications, requests etc., on their facebook application as shown in Figure 3.4 below:



Figure 3.4: News Feed window of the Facebook iPhone application.

Music: This section contains music-related applications. Users can download radio applications that would play music 24 hours 7 days a week. There are plenty of applications that would turn the iPhone into any music-playing instrument, such as piano, guitar, and drums. One of the most popular applications in this section is Shazam. This application can detect any song playing around the user and show the song title, artist name and gives the the link to buy that song directly from the iTunes on his/her iPhone. The Shazam application menu window of the iPhone is shown in Figure 3.5.

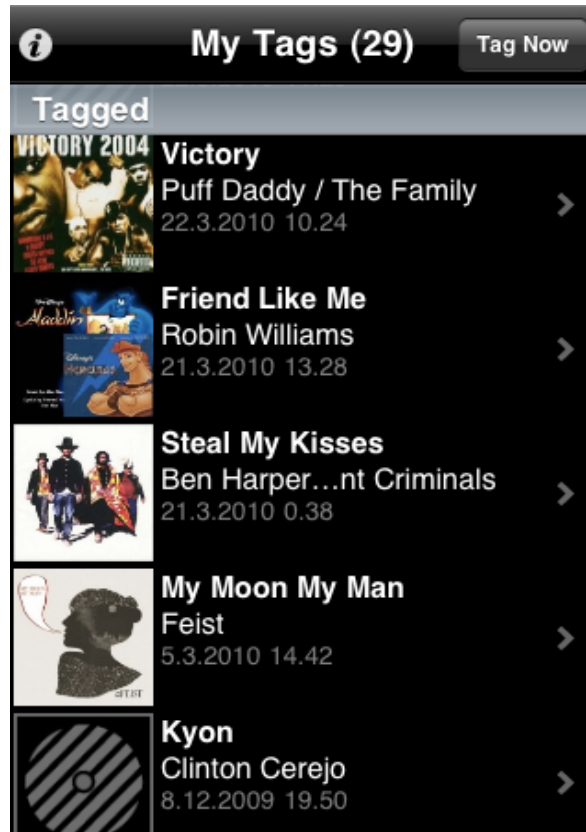


Figure 3.5: The Shazam application menu window of the iPhone.

Productivity: This section also contains some very useful applications. These applications increase the productivity of the iPhone. It has applications that would let users to remote access their computers using the iPhone. There are virtual keyboard applications that would make it easier to type on the iPhone using some interesting techniques. It contains applications to sync the iPhone with the computer without using a cable. There are some simple applications that would help users to make a list of tasks they would like to do in a day. It also has some very useful language translation applications.

One very useful application in productivity section is AirSharing. It lets users to mount iPhone on any Mac, Windows, or Linux computer and drag-drop files between computer and iPhone. It also lets the users to view documents in many common formats of computer and iPhone. In Figure 3.6, the Airsharing window on iPhone is showing the files of a computer.

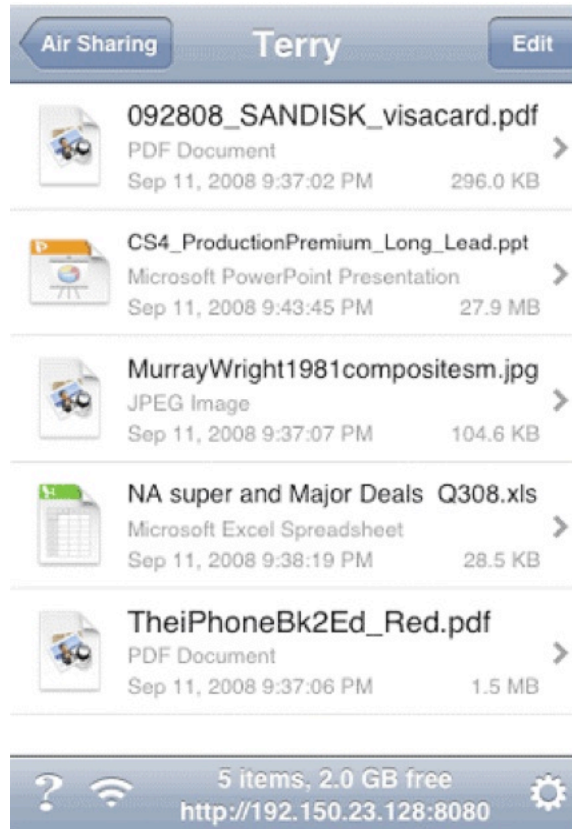


Figure 3.6: AirSharing iPhone window showing files of a computer [10].

Lifestyle: This section contains several interesting iPhone applications. There are applications that would show the nearest restaurants or bars. Users can find applications that have recipes of food, cocktails and many other exciting applications that contain some very useful information on almost every topic related to life and style. eBay and Amazon have their applications in this section that let users to buy products from their websites.

The iPhone application version of eBay is being used by a number of people around the world. This application lets users check their buying and selling on eBay. The main window of the eBay iPhone application is shown in Figure 3.7.

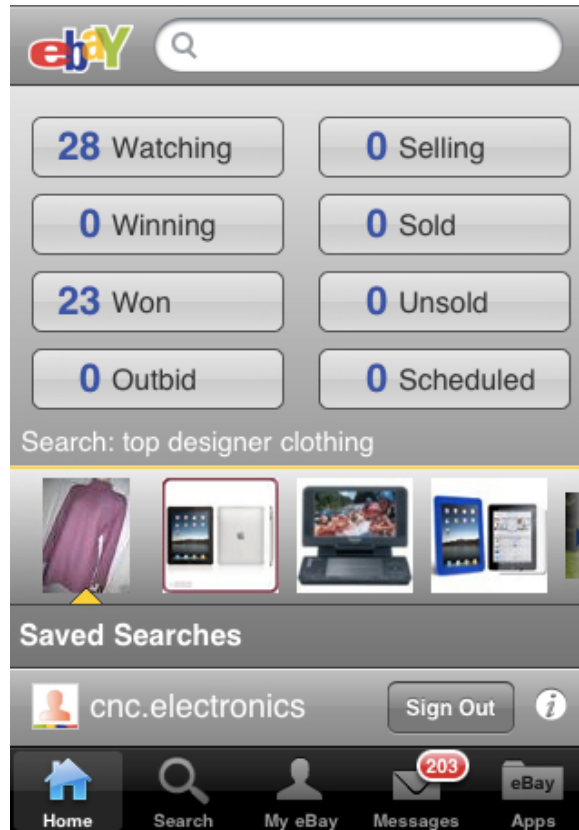


Figure 3.7: The main window of the eBay application on the iPhone.

Reference: Reference includes applications that show information from other websites like Wikipedia. These applications let users search anything on these websites. This section also contains/includes dictionaries applications, Bible applications and many other such applications.

Google Mobile App lets users search Google using voice and location. In Figure 3.8, a user has asked for an Internet search using a voice command and the Google iPhone is searching for that content on the Internet.

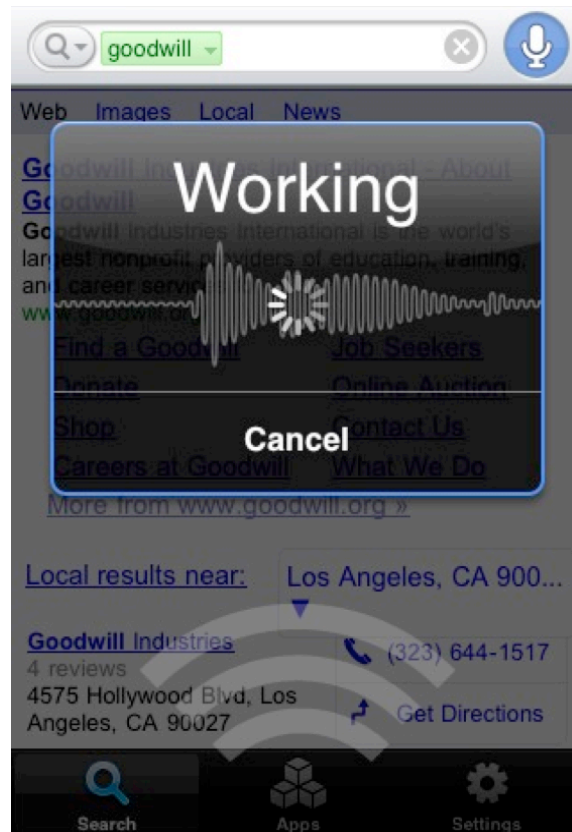


Figure 3.8: The Google iPhone application is searching on the Internet using a voice command.

Travel: Users can find all travel-related applications in this section. These applications can be really handy when traveling. These applications show flight status by just entering the flight number in it. There are applications that would provide information about local transport of a certain city. For example, LondonTube is an application that advises users about local traffic in London. There are several other applications that contain travel-related information.

Trip Journal is a travel application of the iPhone that is ranked as the number1 travel application of iPhone by Google. The application is showing information about Eiffer Tower, Paris in Figure 3.9.



Figure 3.9: Trip Journal showing information about Eiffel Tower, Paris.

Sports: In this category, users can find applications related to sports. These applications would show live scores of different sport games and other related information. There are applications from Formula 1, English Premier League, FIFA World Cup 2010, NHL and many more. Users can also find applications from Sport TV channels such as EuroSport. There is an application for almost every popular sport in this section.

One very popular sports application these days is FIFA World Cup 2010. It contains all the teams and tournaments information on this iPhone application. Figure 3.10 shows a window of this application that shows the teams in each group of FIFA World Cup 2010.

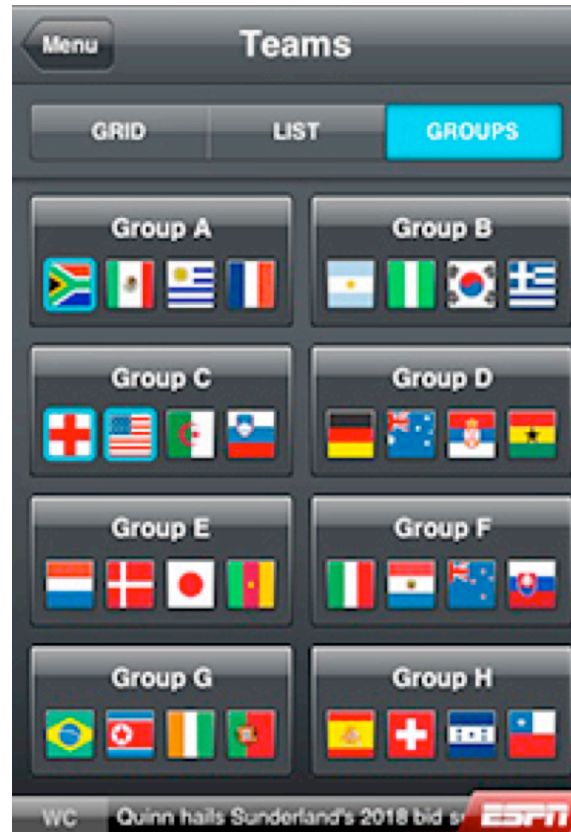


Figure 3.10: FIFA World Cup 2010 iPhone application showing teams in groups.

Navigation: Navigation applications are the highest grosser applications and many people buy them to use their iPhone as a GPS device. These navigation applications use the GPS of the iPhone and developers have developed a wide range of navigation applications for the iPhone. By using navigation applications, users can find the local transport routes between two points, they can locate their car in a large parking lot, they can check the speed of their bus. There are applications available that have sea and air maps to help users sailing a boat or flying a small jet. The world's largest navigation device manufacturers, such as Tom Tom and Navigon, have developed navigation applications for the iPhone.

Drivers in many parts of the world are using the Tom Tom iPhone application. It gives voice guided turn-by-turn directions while driving using the GPS of the iPhone as shown in Figure 3.11.

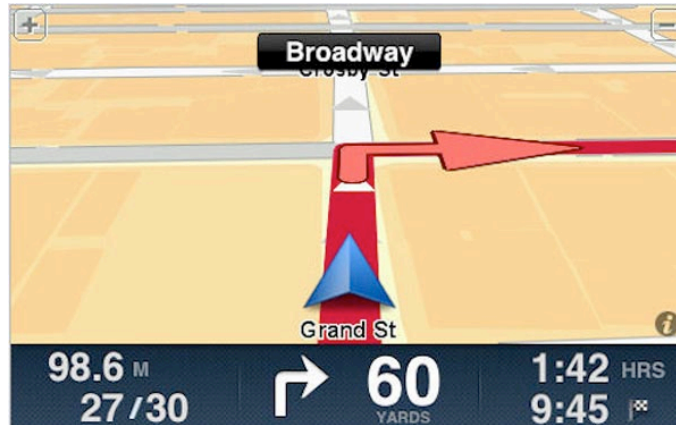


Figure 3.11: An image of Tom Tom iPhone application giving directions.

Health and Fitness: This section includes some very useful applications related to health and fitness. There are lots of applications that users can download to learn and practise different kinds of exercises to keep themselves healthy and fit. There are applications that would give massage using the iPhone vibrator, applications that would help the user to fall asleep and plenty other interesting applications related to health and fitness in this section.

There is an interesting application called Sleep Cycle Alarm Clock, this application would count sleep cycles and will wake up the user in the lightest sleep phase. It keeps statistics of the user's sleep cycle and users can even share these statistics with other sby email or on Facebook. This is illustrated in Figure 3.12.



Figure 3.12: The Sleep Cycle iPhone application shows statistics of a user's sleep.

News: Almost all of the world's most popular news organizations, such as BBC, CNN, AP News, NY Times, have their iPhone applications available in this section. Users can read news, watch news videos and update news application frequently to check the latest news. There are several RSS readers that would fetch the latest news from the configured servers. Users can even watch live streaming of news channels.

The BBC News application gives live news updates and users can read the news from around the world on their iPhone applications as shown in Figure 3.13.

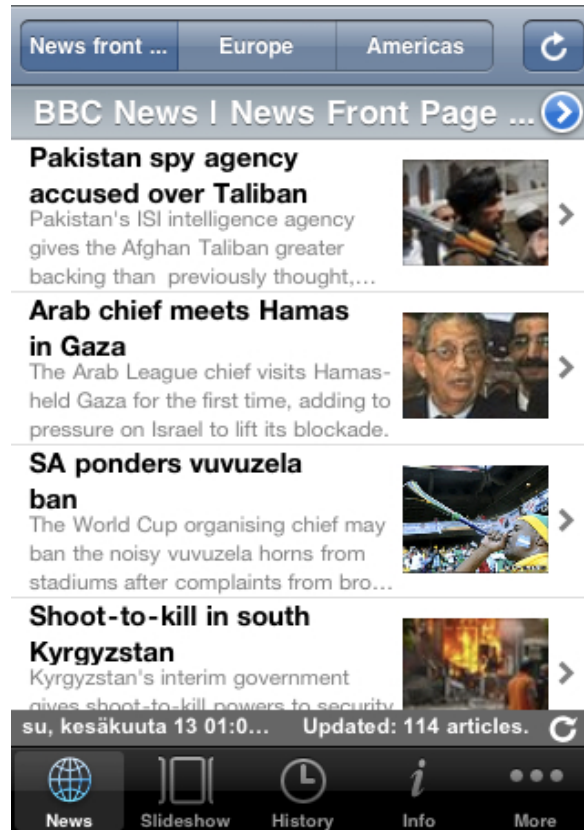


Figure 3.13: Front page of BBC News application for iPhone.

Photography: There are many interesting applications in this section to do tricks with the iPhone camera and photos. These applications can enhance the digital zoom and resolution of the iPhone camera. There are other applications that would let users to edit their photos on the iPhone.

The popular image editing software Adobe Photoshop has its own version of iPhone that helps users to make changes to their photos on the iPhone. Figure 3.14 shows the Adobe Photoshop iPhone application.



Figure 3.14: An image being edited on Adobe Photoshop iPhone application [11].

Finance: This section includes plenty of applications to help manage finances by using iPhone. It contains currency-related Forex applications, stock exchange shares applications and so on. There are some simple applications like one application called ATM Hunter that would help to find the nearest ATM machine.

CNBC has its own iPhone application that lets users to observe their customized stock in the My Stocks window of application. The CNBC application window is shown below in Figure 3.15.



Figure 3.15: CNBC application customizes the stock of a user on an iPhone.

Business: This section has some very useful business applications. These applications help to make and read business-related documents on the iPhone conveniently. Some of these applications would let users to connect to their computer to access files on the computer. Users can also find some simple but useful applications in this section, such as applications describing different kind of tie knots. Folders is an iPhone application that lets business users to transfer files from computer to iPhone via Wi-Fi. It lets users make an idisk in the application and users can store their documents in this idisk as shown in Figure 3.16.

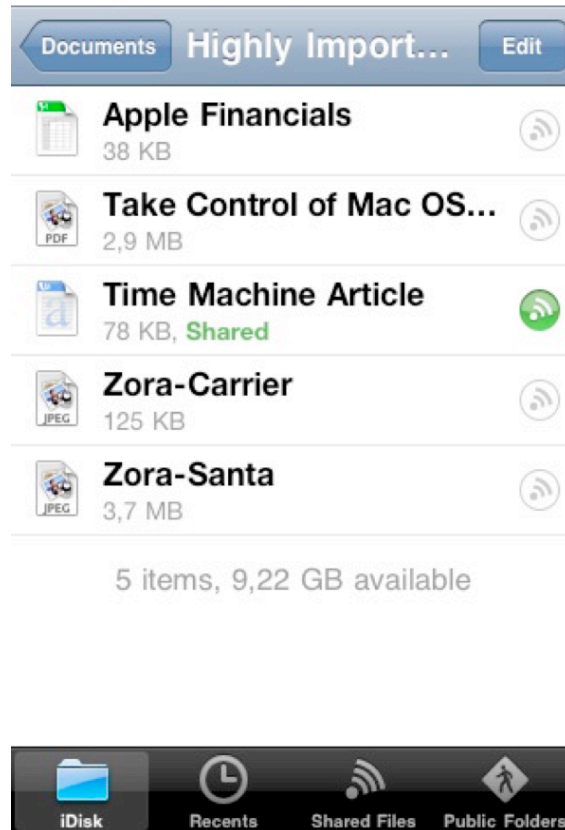


Figure 3.16: Folders, showing the idisk of a user on an iPhone.

Education: Users can educate themselves or their children on different topics from the applications in this section. One can find applications in almost every subject here in this section. Users can increase their general knowledge or learn natural sciences, mathematics, astronomy or any other subject by downloading an application on that particular subject. Some of the applications in this section can help users to teach their children.

NASA has developed an iPhone application that shows information of its missions including images, videos and updates. The Missions window of the NASA application is shown in Figure 3.17.

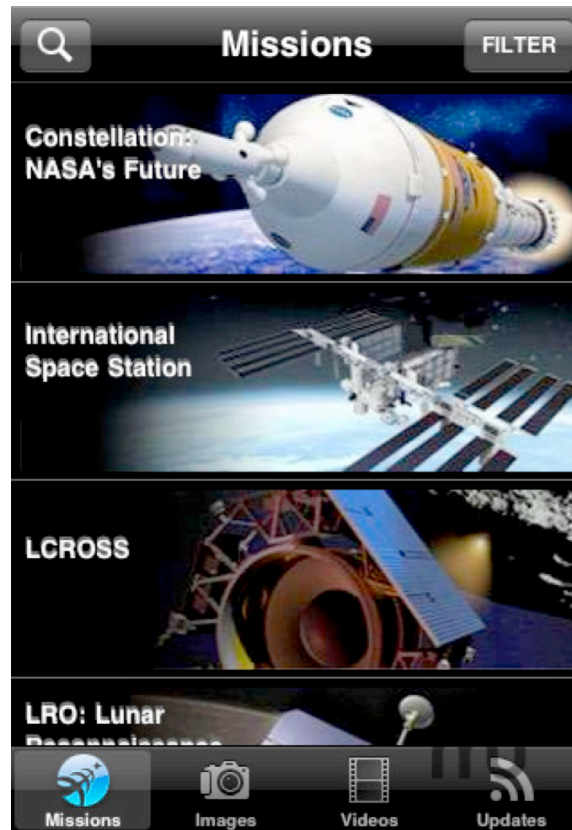


Figure 3.17: NASA showing its missions on their iPhone application.

Weather: A number of weather-related applications are available in this section. These applications would show complete weather details that are much more convenient and helpful than reading the temperature on a thermometer. These applications show the actual temperature, feel like temperature, and visibility and many more details that are really helpful.

The Weather Channel has its own iPhone application that lets users observe the weather condition of their selected places. In Figure 3.18, the Weather Channel iPhone application shows the weather conditions in Washington, PA.



Figure 3.18: The Weather Channel iPhone application shows weather conditions.

Books: Users can find books on any topic in this section. Some of the books are available in an application format and some applications are book readers that allow users to download and read books in these book readers. There are also other book-related applications available in this section, like library book search databases applications.

Amazon has introduced an iPhone version of its famous book reader Kindle. The iPhone version of Kindle is shown in Figure 3.19.

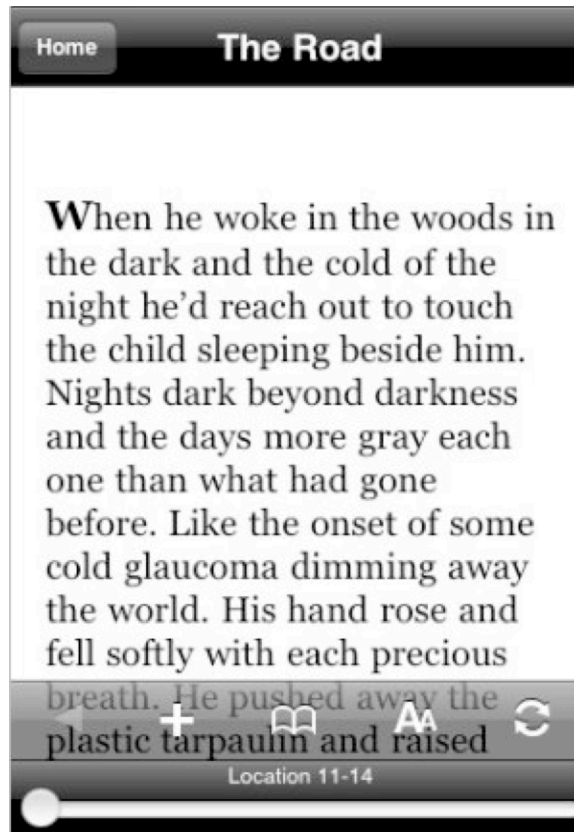


Figure 3.19: A book is being read on Amazon Kindle for iPhone.

Medical: This section contains some very useful medical-related utilities. These applications include eye test, colorblindness test and so on. There are plenty of applications that contain database of medicines and other medical-related knowledge and these applications could be very helpful for healthcare professionals, medical students, and nurses or for ordinary public. Some of the applications in this section would simply help the user relax by playing sounds of nature.

The Eyes Test application by Bokan technologies has been developed to test the eyesight of iPhone users. It tests the user's eyesight by displaying different structures as shown in Figure 3.20.

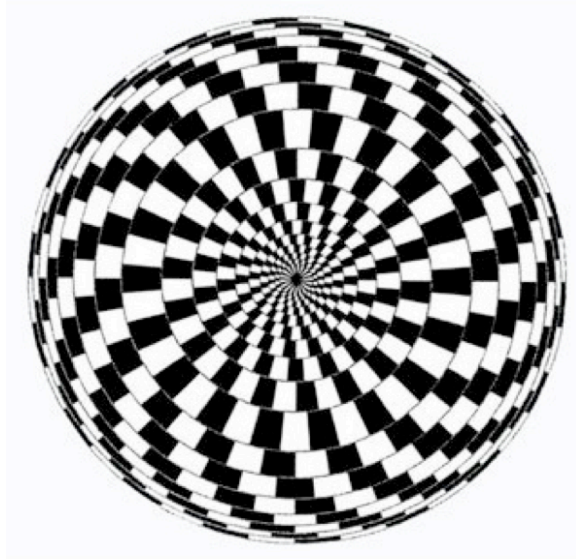


Figure 3.20: Eye Test application testing the eyesight of iPhone user. [12]

3.2 Ideas for Developing iPhone Applications for Finnish Users

One main focus of this research work is to find out that what kind of applications may be developed for Finnish users of iPhone. There are plenty of different kinds of applications that are available to iPhone users in other parts of the world but developers in Finland have not developed such applications for iPhone users in Finland. This chapter will discuss such applications and provide suggestions on developing such new applications. This will give developers ideas to develop these new applications so that they may develop these new applications and sell them on the Finnish App Store to earn more money. It will also help iPhone users in Finland who may find more useful and interesting applications in the Finnish App Store and may download these applications on their iPhones that would help them in their day-to-day affairs and they can take the maximum advantage of their iPhones.

Finland can, indeed, be a very attractive market for iPhone developers. Finnish people are very keen on using the latest technology to make their lives easier. There is a huge need of iPhone applications and developers can fulfill this need by developing these applications and selling them on the Finnish App Store.

This study may not cover all such applications but it addresses some of the most important such applications that may be developed. These applications can be divided into the following categories:

Games: Educational games in Finnish language for young children may be developed so that these games can help them to learn. Children may be taught more easily by being taught in such an attractive way.

Other simple games can be developed that would let users to practice their general knowledge of Finland. One such game called Älypää is available in the App Store but there can be more games like this.

Some advanced sport games can be developed especially winter sport games. Such games may not only attract users in Finland but they would also attract users in other countries where winter sports are very popular. There are already some winter sport games in the App Store but there is a room for more such games.

Entertainment: There is a huge room for entertainment-related applications that can be developed for iPhone users in Finland. An application that would display all the Finnish TV channels programs schedule would be really handy for iPhone users so that they can check the schedules of their favorite TV programs from this application and may even be able to set a reminder in this application that would remind them about their favorite program. An application called Telkussa is already available in the App Store but it is a very basic application that only shows the programs schedule and does not give any other options to users. An advanced such application that would give user more choices can be really useful.

An application that would display movies being played in local cinemas can also be very helpful. Such application may also give users the option to review those movies that are being played in local cinemas and this will help other users to choose a movie to watch in their local cinema.

Entertainment TV channels can also develop their own iPhone applications. These applications may have schedule, highlights, reviews, and other related contents of

programs that are being aired on these TV channels. These TV channels may even offer live video streaming or recorder programs in these applications that users may subscribe to watch.

An iPhone application for the website www.lippu.fi that sells tickets of most of the entertainment events happening in Finland can be developed for the users to use the service of this website on their iPhones. It would let users to buy tickets of the event they are planning to attend directly on their iPhones.

Some simple applications can also be developed, like applications that would display entertainment-related happenings in local areas. These applications may contain information of live music events or stand-up comedy events or any festival happenings in the local area.

Different festival or other entertainment event organizers can develop an iPhone application of their events and may attract more people to come to attend their events. For example, an application of a festival called RuisRock that happens every year in Turku can be developed and this application would contain all the information of this festival including event information, performing artists information and other related content.

Bars, clubs, restaurants and pubs can develop their own iPhone applications that would help them to advertise their business through the iPhone and help them to attract more customers.

Movie renting stores can also develop applications to let iPhone users check availability of a movie in their store and may reserve a movie by using this iPhone application.

Music: some music-related applications might also be added in the iPhone's Finnish App Store, like the applications from music radio stations of Finland. There is an application called Radio Finland and it plays most of the Finnish radio stations on the iPhone. But different radio stations could also design their separate iPhone applications that would show more information of these radio stations including program details and hosts information. One may also start a new radio channel through an iPhone application.

A Tunewiki kind of application for Finnish music can also be introduced. This application would show artist information, lyrics and other related information of Finnish music being played on an iPhone.

Finnish artists like international artists can release iPhone application versions of their new music albums that would have information on their new album and let users buy this new album from iTunes. This would help the artists to promote their music through a new channel.

A simple application that would show iPhone users the nearest record shop can also be interesting application.

Lifestyle: A lot of applications can be developed for this category as a number of applications in this section that are missing for the Finnish iPhone users, are available to users in other parts of the world. These applications can be very helpful for users and may introduce some very interesting new usages of an iPhone.

There are a few applications related to life and style in Finland available in the App Store like eat.fi, an application that displays the nearest restaurants. However, this application merely displays restaurants but no other related information. An application that would also contain more information, like menu details and other related information of these restaurants could be more attractive to iPhone users. Similarly, restaurants can also develop their personalized applications and promote their restaurants through an iPhone application.

An application that would help users to shop grocery can be very useful. This application would contain grocery prices of different super stores, let users to make a list of grocery products that they need to buy and may contain other related features. Such applications are available and being frequently used by iPhone users in USA, Canada and UK.

Different businesses can develop their iPhone applications. For example, clothing stores can introduce their iPhone applications to promote their clothing catalogues or hairdressers can introduce iPhone applications that would let their customers to reserve a time at their shops. Similarly, libraries can offer a service for library Internet users to reserve a computer using an iPhone application. Such applications can really change the way of life for people and help them to save a lot of time and money and it

would also help business owners to attract more customers and enhance their services.

An application that would offer discount coupons of different products can be very popular. It would send iPhone users discount coupons on their iPhones, for instance, Hesburger can offer discount coupons to their customers using this iPhone application.

Fast food restaurants can introduce applications for iPhone that would let their customers to buy food directly from the iPhone and then customers would just go to collect the food and save a long waiting time.

Finnish auction and classified websites can develop their iPhone applications that would let users to use their services on iPhone. Internet auction websites, such as eBay, have developed their iPhone application that is extremely popular among iPhone users. Similarly, Finnish websites, like huuto.net, tori.fi, nettiauto.com, oikotie.fi, can make their applications for iPhone.

In Sweden, tax office staff uses iPod Touch to issue a queue number to visitors. They have developed an iPhone application that let their staff to operate a number issuing machine. It is very helpful when there are many visitors visiting a certain office. Such iPhone applications can also be developed by Finnish Government Offices and Finnish banks to handle visitor queue numbers.

Several guides can be introduced on iPhone in applications format to introduce Finnish life and style. For example, an application can be developed about Finnish housing that would describe the kinds of houses in Finland and similarly such applications can be developed on other subjects of Finnish life and style.

Reference: In this category, a lot of applications can be added. Developers can develop applications related to objects in Finnish life. Applications about Finnish animals, Finnish foods, Finnish lakes, Finnish forests, Finnish telephone directories, and Finnish businesses could be very attractive for Finnish iPhone users.

To develop applications for this section could be rather easier as developers would just need to gather information from other sources and include them in their own iPhone applications by mentioning source names.

Travel: This section lacks a lot of applications that may contain information on Finnish travel. Many applications can be developed that would have information of Finnish

national parks, Finnish lakes, Finnish landscapes, Finnish cities. These applications may contain information on all such places that would attract tourists. Different travel guide applications can be developed, like a Helsinki travel guide application could really be useful for travelers visiting Helsinki.

This category can also include applications that would show the schedule of local or intercity transport. There are a couple of applications available that show the schedule of local transport of Finnish cities but these applications do not cover all the cities. So, an application can be developed that would show the schedule of local transport in every city of Finland. An application that shows the schedules of intercity transport is also missing in the Finnish App Store.

Finnair has not developed an iPhone application but many other airlines have their iPhone applications available in App Store. Finnair may also develop its own iPhone application that would be very useful for its passengers. They may be able to buy air tickets or check flight schedules using this iPhone application.

A lot of people travel by ferry from Finland to other countries like Sweden and Estonia. An iPhone application that would show the departure and arrival times of these ferries could be developed. Ferry operators may also develop their own iPhone applications that would let their customers buy a trip on their ferries and show related information about these ferries.

Simple applications such as offline maps of Finnish towns or phone number of Taxi services in Finland can be very useful for iPhone users.

Sports: Applications related to Finnish sports, like an iPhone application of ice hockey, can attract a lot of Finnish iPhone users. This application may show live scores of games, live match streaming, information of teams and players and so on.

In Finland, there are several playgrounds in cities and towns across the country. People can reserve time in these playgrounds to organize a sport event or practice their own game. An iPhone application that would show local playgrounds in an area and let users to reserve a time in a playground can be developed. Such applications may be introduced by the administrative authority of these playgrounds.

Health and Fitness: An iPhone application that would have a database of fitness centers, swimming pools, gyms etc. in Finland can be developed. This application can

also let users review these places so it may help others to decide which place to join for health and fitness.

News: Finnish newspapers and news channels can introduce their iPhone applications. There is only one Finnish newspaper Helsingin Sanomat that has its application available in the App Store. But in other countries like the U.S.A. almost all the major news organizations have developed iPhone applications of their services. Other Finnish news organizations, like YLE, Turun Sanomat etc., can also develop their iPhone applications.

An application that would detect the location of an iPhone and show the local news can also be developed.

Finance: Finnish people normally use Internet banking to pay bills and keep record of their finances. Finnish banks have very reliable Internet banking services. These banks can develop iPhone applications to offer their Internet-banking services. iPhone users can pay bills or make money transfers by using these iPhone applications of banks. Different banks around the world have already developed iPhone applications and offering Internet-banking services to iPhone users by these applications.

An application that would show the nearest bank branch or ATM can also be developed for iPhone users.

Education: Many Finnish children use iPod Touch and they are familiar with the iPhone App Store. Education-related iPhone applications for these children could really help them to learn. Children would find this method of learning more attractive than learning from books and they would learn more easily.

For higher education institutes, more advanced applications can be developed. iPhone applications that would let students to check their class schedules can be developed. These applications may also notify students about a particular class cancellation or other related information.

Applications to conduct examinations may also be developed. These applications can be a really good idea especially in an examination that contains multiple-choice questions. Such applications can be downloaded from the App Store but may only be accessed by a password. Examination supervisors may provide this password at the time of examination. So, students can access this application at the time of

examination and give their exam on an iPhone. This would also help to control cheating in such examinations.

Weather: Several very good weather-based applications are available but an application particularly designed for Finland is missing. An iPhone application that will obtain weather forecasts from the Finnish weather services can be more reliable for Finnish users.

3.3 Augmented Reality Applications

Augmented reality is a term that is used to describe a computer-generated imagery for physical real world [13]. iPhone has many applications that are based on augmented reality. These applications mainly use the GPS, Compass and Camera of the iPhone to perform their functions. An example of such an application would be if an iPhone user was walking down in a street somewhere in Amsterdam and the user turns on an augmented reality application on iPhone that is designed for that area in Amsterdam. Then, this application would display information of buildings and places on both sides of the street or any other related information about that particular area. This application may also include information like which houses or businesses are for sale in this street and mark such place with an arrow. Similarly an augmented reality application may guide the user to nearest underground railway station in a city like London.

Augmented reality applications can help users in many situations of daily life. They can help users gauge short distances using the iPhone camera, it can help hungry users find the nearest restaurant, or it can help a user locate his/her parked vehicle in a parking lot.

One very good example of iPhone augmented reality application is New York Nearest Subway. This augmented reality application is particularly designed for New York City and users can use this application to find the nearest subway. This application uses the camera and creates displays information of the streets that are being viewed in the camera and guides users towards the nearest subway using this display to the nearest subway. A screenshot of this application is shown in Figure 3.21.

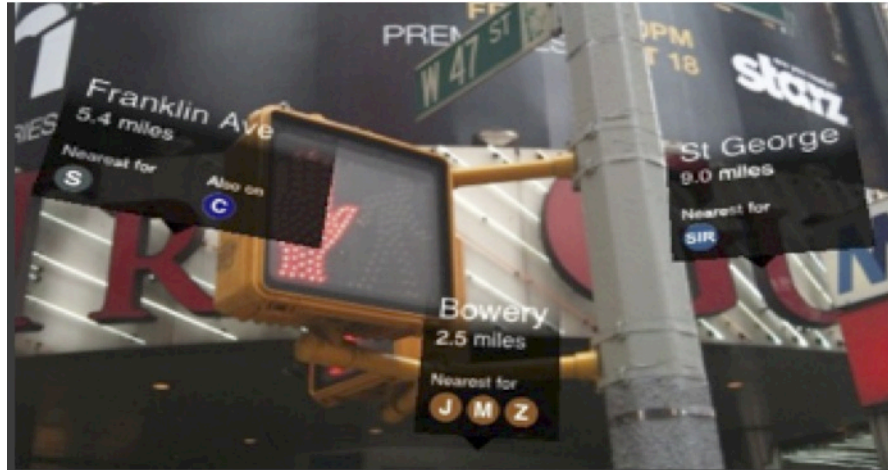


Figure 3.21: New York Nearest Subway using the iPhone camera to guide the user

[14].

Recently, there have been many developments in the field of augmented reality applications. However, there is hardly any application that has been developed for Finnish iPhone users. A variety of augmented reality applications can be developed for places in Finland that would attract a lot of iPhone users. Developing such applications would require advanced knowledge of iPhone programming and perhaps more resources, such as teams of developers commissioned to develop these applications. But ideas to develop such applications are easily available. For example, an application like New York Nearest Subway can be developed for the city of Helsinki. [15]

4.0 Development of iPhone Applications

4.1 iPhone Developer Program

The iPhone Developer Program is illustrated by the following Figure 4.1. [16]

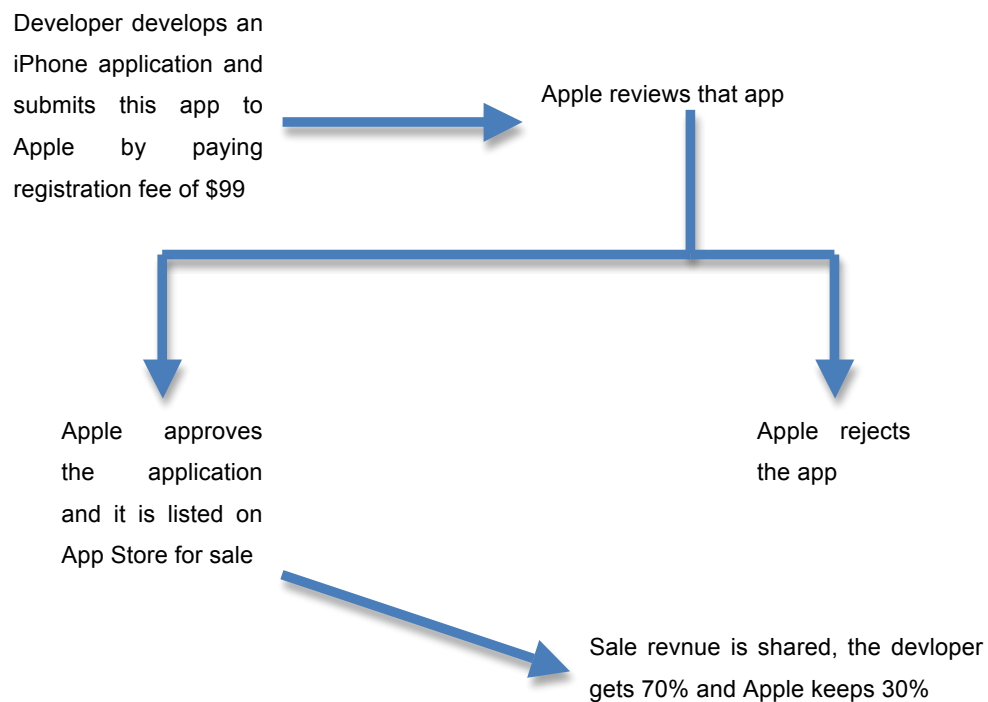


Figure 4.1: The iPhone Developer Program

4.2 iPhone SDK

The iPhone SDK was released a few months after the release of first generation iPhone. It can be downloaded for free from the Apple website. It has three main components: Xcode, interface builder, and iPhone Simulator.

Xcode is the development environment for the iPhone SDK. Applications are written in Xcode using the Objective-C language, a language that is also used to write Mac OS and iPhone OS.

Interface Builder is a tool for building complex user interfaces for the Mac and iPhone platform. It is, however, a non-intuitive program. A developer will need both of these components of SDK to develop their application. The Xcode would be used for writing the code and interface builder for designing the interface for that application.

iPhone Simulator is another important component that would allow users to test their application on a simulator. It allows developers to make applications for the iPhone, iPad and iPod Touch. However, loading an application onto the devices is only possible after paying an iPhone Developer Program fee. [17]

4.3 A Sample iPhone Application

The following is a sample application that has been developed for this thesis work and it shows the timetable of buses in Turku. This application has been developed in Xcode and required some basic programming skills of Xcode.



Figure 4.1: The main view showing the line numbers of Turku buses.

Figure 4.1 shows the main view of this application that displays all the bus lines operating in Turku. The users are able to scroll on this window and can select any line for which they want to see the timetable by tapping on that line.

The next window shows the bus timetable of a selected line in form of an image that can be stretched using fingers to increase visibility and it will also give an option to go back to the main view so that users may check the timetable of other lines in this application as shown in Figure 4.2.

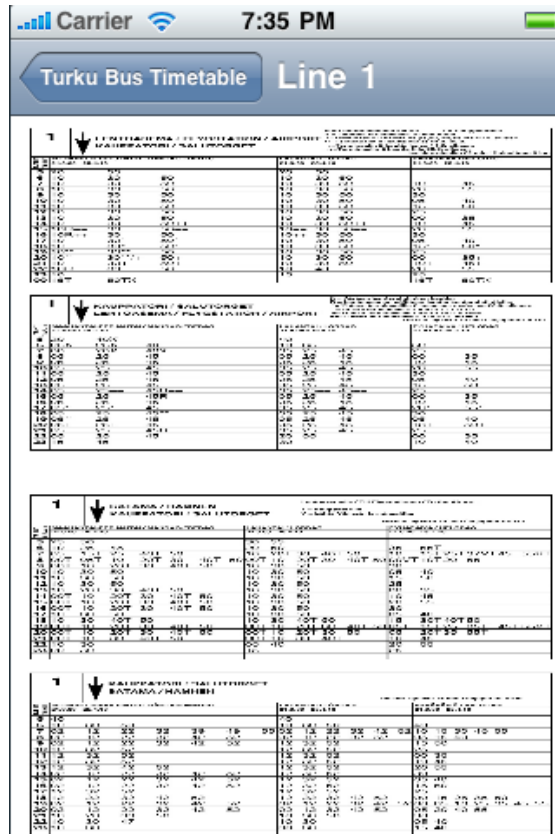


Figure 4.2: The window showing showing the timetable of Line 1.

This application has been tested on an iPhone simulator and can be submitted to Apple for sale in the App Store. This is a simple but a very useful application for commuters in Turku. It can be especially useful in situations when a user wants to find the timetable of a local bus but does not have access to the Internet.

Although this above mentioned sample iPhone application is a simple application, it can be really useful. Based on the coding of this application, many other useful applications can be developed. [18],[19]

5. Conclusions

This thesis work provides some very useful information on the future of mobile phone applications by studying the mobile phone applications development of the iPhone. The reason for choosing iPhone as an example is its huge popularity and the number of users it has already gathered in a short span of time. Its operating system contains more mobile applications than any other mobile phone device. Users around the world have downloaded billions of mobile phone applications on millions of iPhone devices.

Due to the iPhone design, its operating system and the applications that are being used on it have made the iPhone a necessity for several people and for many more it may become an essential part of their daily life in the near future. The iPhone development has also excited developers around the world to come up with numerous interesting ideas to develop applications for iPhone.

A number of iPhone applications, especially the augmented reality applications that have been developed for iPhone users in some Western European and North American countries, are just phenomenal. Many such applications can be developed for iPhone users in Finland. Augmented reality applications on mobile phone devices especially on iPhone may soon become an integral part of our everyday life.

The platform for development of iPhone applications called Xcode may be new to many developers but it is an interesting programming platform to learn and can help developers to enhance their development skills. It provides a huge opportunity for the developers to make money by developing iPhone applications. A number of developers have been able to earn more money by developing iPhone applications in months than they used to earn in years by developing applications for other platforms. The iPhone developer program is a very attractive option for the developers and opens a door to enormous opportunities.

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http://www.youtube.com/watch?v=VhSWE6_leyA&feature=related