PPU College of Engineering and Technology
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Electrical and Computer Engineering Department

Communication Engineering Program

Bachelor Thesis

Introduction/Graduation Project

Marketing Using Mobile Via Wi-Fi

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Hebron – Palestine
June,2012

ACKNOWLEDGMENT

We acknowledge Palestine Polytechnic University for giving us the possibility to show some of what we have learned from it.

And we acknowledge all the instructors in the electrical and computer department for their great impact in our education, especially the supervisor of this project eng. Ayman Nabawaz, and everybody who effected our education.

Finally we can't forget to acknowledge our great parents who scarified themselves for educating us and facilate our life, and for all their coffee and tolerance.

Project team

Abstract

We have completed this project in order to work on providing application which makes shopping easier and smoother , by using a Wi-Fi localization system, where the location is determined by the network infrastructure .The location is based on the received signal strength(RSS) measured at Access Point(AP), RSS values are stores in database in the server. Server accepts requests from clients, determine the location by matching the values in the database with new values due to the current location of the client, then it will send back the suitable map which help the shoppers reaching the services they need.

We have built the network and distributed the access points in appropriate areas and then we measured the signal strength and stored it in a database , while the database for the application we used the (Android) to build it .Finally , we will link parts of the project with each other using the Java language.

ملخص

خدمات تحديد المواقع أصبحت مهمة في وقتنا الحالي وتزايدت بتزايد احتياجات الناس لمواكبة التطور في الشبكات اللاسلكية كما أنها أصبحت محط أنظار شركات تطوير التطبيقات باستخدام الجوالات لزيادة أرباحها وخدمة عدد اكبر من المشتركين. كما انه يجب توخي الدقة في تحديد المواقع خاصة في الأماكن المغلقة .

قمنا بإتمام هذا المشروع من اجل العمل على توفير تطبيق يجعل التسوق اكثر سهولة ويسر , حددنا الموقع باستخدام البنية التحتية للشبكة اللاسلكية (Wi-Fi) من خلال قياس قوة الإشارات المستقبلة RSS خزنا قيم الإشارات المرسلة في قاعدة بيانات موجودة في الخادم الرئيسي , بحيث يقوم الخادم باستقبال طلبات تحديد المواقع من قبل المستخدمين ومن خلال مقارنة قوة الإشارة القادمة من المستخدم مع القيم المخزنة مسبقا بقاعدة البيانات يقوم بتحديد الموقع الخاص بالمستخدم وإرسال خارطة إليه تساعده بالوصول إلى الخدمة التي يريد.

لقد قمنا ببناء الشبكة وتوزيع نقاط الوصول في مناطق مناسبة ثم قمنا بقياس قوة الإشارات وتخزينها في قاعدة بيانات. أما بالنسبة للتطبيق فقد قمنا ببنائه باستخدام (Android), ربطنا أجزاء المشروع مع بعضها البعض باستخدام لغة جافا.

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Chapter One
Introduction

Chapter contents:

1.1 Overview

Recent rise of wireless technology combined with the need for portability has led to the development and installation of Wireless Local Area Networks (WLANs) and wireless devices.

The use of wireless networks mainly, and Wi-Fi (802.11) in particular, raised a point on how it would be possible to extend the use of that network, so that they could provide the most services possible.

The Wi-Fi is a mechanism to link electronic devices wirelessly to a brand originally licensed by the Wi-Fi Alliance to describe the technology behind the WLAN based on the specifications of Institute of Electrical and Electronics Engineers (IEEE) 802.11. That uses radio waves to provide wireless high-speed Internet and network connections and to transfer and receive data at high speed [1],[2],[3].

Positioning techniques used in Wi-Fi can be network-based or client-based. Network-based techniques need a mobile device, APs, Reference Points (RPs) and a positioning server.

1.2 Problem Statement

Mobile marketing is necessary for reaching shoppers as well as away to provide a richer shopping experience over all. This application will make the connection between the customer and the shoppers easier; it is also helping guests when they are visiting our markets if their mobiles support Wi-Fi technique.

1.3 Project Objectives

The project based on several objectives:

- Reduce the time and effort for shoppers.
- Help shoppers and Gusts reach the services they need.
- Enhance the shopping experience, which finally will benefit the owners.
- Allow the sellers promoting their goods more quickly through messages that appear to customers during their shopping.

1.4 Tools

In our project, we will use:

- Mobile device support Android.
- Access points.
- Laptop/ Personal Computer (PC)
- Switch/Router.

1.5 Methodology

In marketing system, the localization can be determined through several steps. The area of a market is divided to zones, and then placed an access points to measure RSS. The value of RSS store in a server to determine the user location.

1.6 Block Diagram

The main block diagram of the whole system was described on this figure. it contains all components which we will use in this project and how these component will communicate to each other to achieve the object of the project:

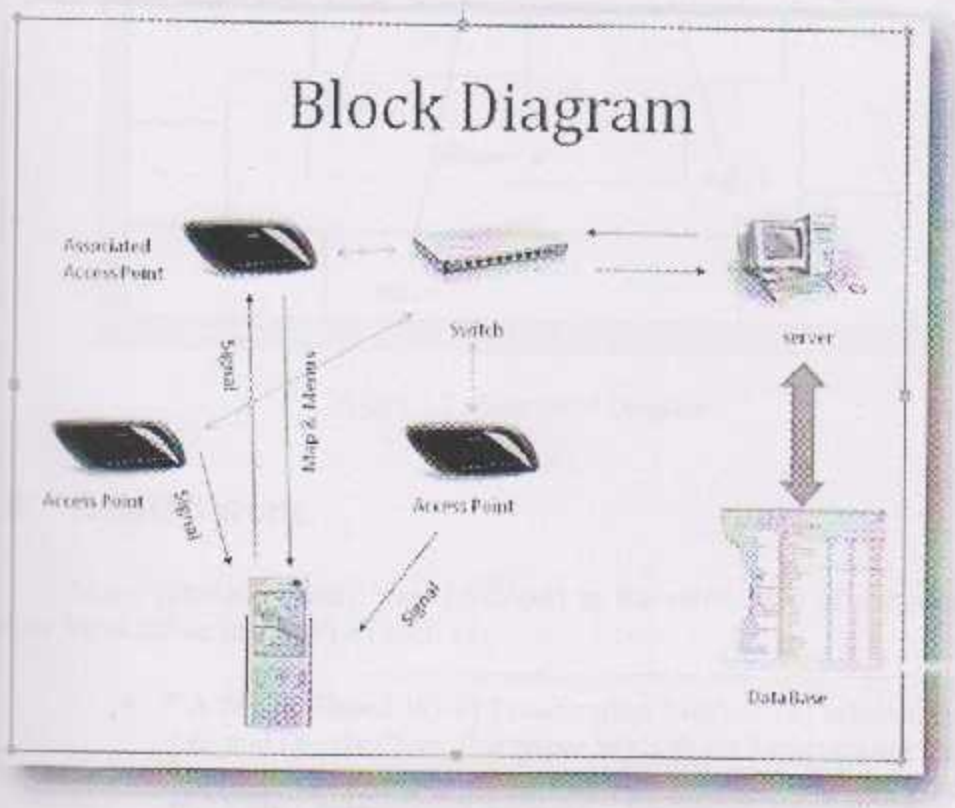

Figure 1.1: Block Diagram

1.7 Schematic Diagram

In figure 1.2, we explain the schematic diagram, through floors, zones, access points, switches, server and database.

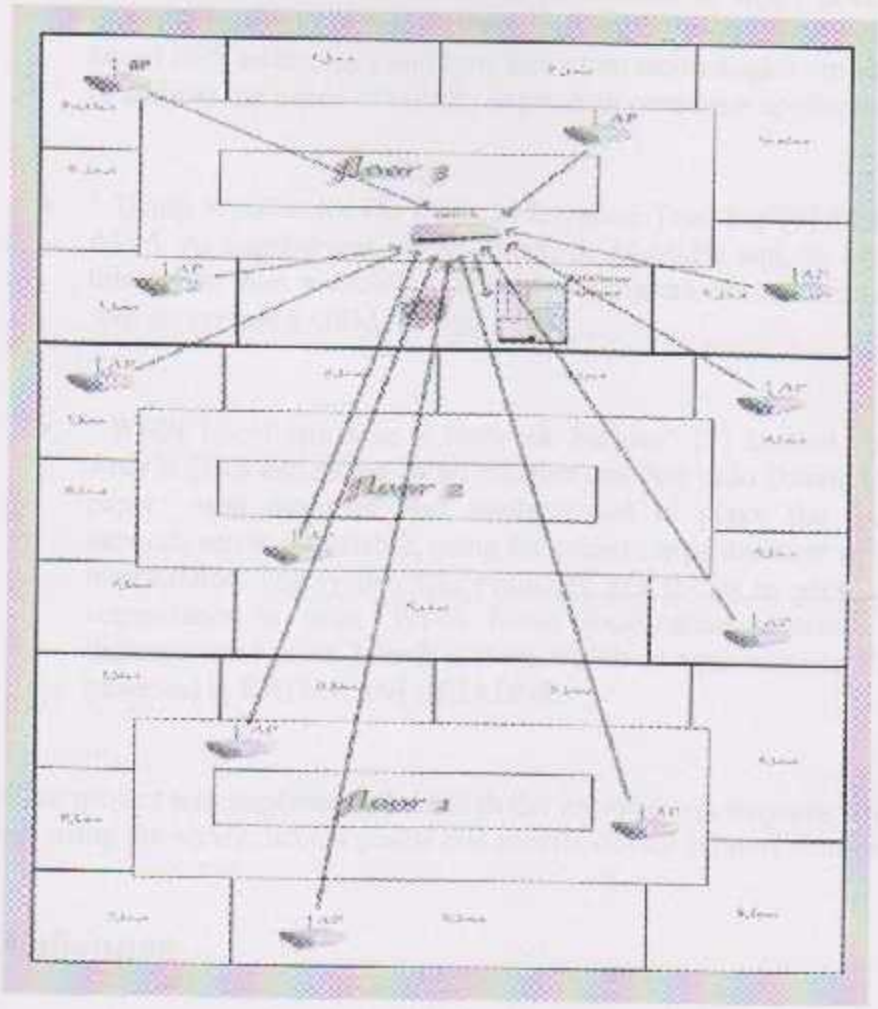

Figure 1.2 : Schematic Diagram .

1.8 Related work

Many previous papers was developed in the same field of our project about indoor localization using Wi-Fi such as :

- " A Model-Based Wi-Fi Localization Method"[4] created by Dik Lun Lee and Qiuxia Chen, this paper talk's about backtracking technique to improve the accuracy of localization results, based on Knowing the floor model, Continual tracking of the user locations, Backtracking from the current location to previous locations to resolve localization ambiguities.

mainly includes four models: Tracking, Smoothing, Partitioning and Determining the zone.

- " Taking Position Indoor (Wi-Fi Localization and GNSS)" [5] this article describe the evolution of the Wi-Fi localization technology with particular emphasis on its recent application in smart devices. They describe how this technology evolved out of time- of- arrival (TOA)-based GPS technology and how these two technologies are intertwined to address the needs of rapidly expanding consumer applications.

- " Using Mobiles for On Campus Location Tracking"[6] created by F. Aloul, A. Sagahyroon, A. Al-Shami ,I. Al-Midfa and, R. Moutassem, this paper uses a mobile application program communicates with a web server and a GSM modem.

- " Wi-Fi Localization as a Network Service" [7] created by Jo˜ao Andr´e Silva and Maria Jo˜ao Nicolau and Ant´onio Duarte Costa, this paper was designed and implemented to make the localization network service available, using the present infrastructure without user interference. The system was evaluated and shows an accuracy that is comparable to other Wi-Fi based localization systems. Average distance error is in 2 to 3 meters, which is equivalent to the values observed in RADAR and ARIADNE.

Of our project was implemented through the use of Wi-Fi network within the closed areas using the server, access points and mobile device support Android.

1.9 Challenges

In our project, we expect many of the challenges that lie ahead, including:

- How to navigate between floors in the market.
- Knowledge of the necessary programming of the mobile phone.
- How to place the access points on floors.
- Surveying and power level measurement.
- Errors and interference between zones.

2

Chapter two
Theoretical Background

Chapter contents:

2.1 Introduction

Wi-Fi is the abbreviation for Wireless Fidelity, and its works with no physical wired connection between sender and receiver by using radio frequency (RF) technology, and its refers to any system that uses the wireless local area networks, or WLAN (as opposed to LAN, or computers that are networked together with wires) based on the 802.11 standard, which was developed by the IEEE and released in 1997. [8],[9],[10].

The radios used for Wi-Fi communication are very similar to the radios used for cell phones but they transmit at frequencies of 2.4 GHz or 5 GHz and this frequency is considerably higher than the frequencies used for cell phones, and other devices and the higher frequency allows the signal to carry more data. They can transmit and receive radio waves, and they can convert 1s and 0s into radio waves and convert the radio waves back into 1s and 0s , when an RF current is supplied to an antenna, an electromagnetic field is created that then is able to propagate through space. The cornerstone of any wireless network is an AP. The primary job of an access point is to broadcast a wireless signal that computers can detect.

Wi-Fi is supported by many applications and devices including video game consoles, home networks, Personal Digital Assistant (PDAs), mobile phones, major operating systems, and other types of consumer electronics.

2.2 Advantage & disadvantage of Wi-Fi Technology

2.2.1 Wi-Fi Advantage

1. Wire-Free : One of the most advantages of Wi-Fi wireless LAN technologies because it is easier to provide connection in areas where it is difficult to lay cable.

2. Low cost : There is no cost of cables and installation since the initial investment required for WLAN hardware can be similar to the cost of wired LAN hardware, installation expenses can be significantly lower.

3. Ability for 802.11b and 802.11g to frequency hop. This process allows the 802.11b and 802.11g cards to transmit themselves on any of three bands, or splitting the radio bandwidth into channels and 'hop' between them.[11],[12],[13],[14].

2.2.2 Wi-Fi Disadvantage

1. Interference from microwaves or cordless phones which use the same frequency that 802.11g and 802.11b use: 2.4 GHz (in general).

2. Security system: To solve this problem we can use the Wired Equivalent Privacy (WEP) is the common wireless encryption standard which is easily broken even when configured accurately.[11],[12],[13],[14].

2.3 Wi-Fi Standards

All 802.11 and 802.11x refers to a family of specifications developed by the IEEE for Wi-Fi technology. There are the standards:

1) 802.11 — applies to wireless LANs and provides 1 or 2 Mbps transmission in the 2.4 GHz band using either Frequency Hopping Spread Spectrum (FHSS) or Direct Sequence Spread Spectrum (DSSS).

2) 802.11a — an extension to 802.11 that applies to wireless LANs and provides up to 54-Mbps in the 5GHz band. 802.11a uses an orthogonal frequency division multiplexing encoding scheme rather than FHSS or DSSS.

3) 802.11b (also referred to as 802.11 High Rate or Wi-Fi) — an extension to 802.11 that applies to wireless LANS and provides 11 Mbps transmission (with a fallback to 5.5, 2 and 1-Mbps) in the 2.4 GHz band. 802.11b uses only DSSS. 802.11b was 1999 ratification to the original 802.11 standard, allowing wireless functionality comparable to Ethernet.

4) 802.11e — a wireless draft standard that defines the Quality Of Service (QOS) support for LANs, and is an enhancement to the 802.11a and 802.11b WLAN specifications. 802.11e adds QOS features and multimedia support to the existing IEEE 802.11b and IEEE 802.11a wireless standards, while maintaining full backward compatibility with these standards.

5) 802.11g — applies to wireless LANs and is used for transmission over short distances at up to 54-Mbps in the 2.4 GHz bands.

6) 802.11n — 802.11n builds upon previous 802.11 standards by adding multiple-input multiple-output (MIMO). The additional transmitter and receiver antennas allow for increased data throughput through spatial multiplexing and increased range by exploiting the spatial diversity through coding schemes like Alamouti coding. The real speed would be 100 Mbit/s (even 250 Mbit/s in PHY level), and so up to 4-5 times faster than 802.11g.

7) 802.11r— 802.11r, also called Fast Basic Service Set (BSS) Transition, supports Wi-Fi handoff between access points to enable VoIP roaming on a Wi-Fi network with 802.1X authentication.

8) 802.1X - Not to be confused with 802.11x (which is the term used to describe the family of 802.11 standards) 802.1X is an IEEE standard for port-based Network Access Control that allows network administrators to restricted use of IEEE 802 LAN service access points to secure communication between authenticated and authorized devices. [15]

802.11n: 802.11n is an upcoming industry standard for high-speed Wi-Fi networking. it is designed to replace the 802.11a, 802.11b and 802.11g Wi-Fi standards for local area networking.802.11n an IEEE 802.11 wireless network standard that increases transmission speeds to 300 Mbps and beyond and it is works in both the 2.4 GHz and 5 GHz frequency bands.[16],[17].

802.11n will work by utilizing multiple wireless antennas in tandem to transmit and receive data. The associated term MIMO (Multiple Input, Multiple Output) refers to the ability of 802.11n and similar technologies to coordinate multiple simultaneous radio signals. MIMO increases both the range and throughput of a wireless network.

The 802.11n standard defines data rates in both 20 and 40MHz channels. In addition to these rates, there are several other optional rates. One optional feature is to use a reduced guard interval of 400 ns instead of 800 ns, which increases the maximum data rate for 2 spatial streams in a 40MHz channel to 300 Mbps. Other optional rates use 3 or even 4 spatial streams. The highest optional data rate defined by 802.11n is 600 Mbps, which is achieved by using 4 spatial streams in a 40MHz channel with a 400 ns guard interval.[18]

An additional technique employed by 802.11n involves increasing the channel bandwidth. As in 802.11a/b/g networking, each device uses a preset Wi-Fi channel on which to transmit. Each 802.11n channel will use a larger frequency range than these earlier standards, also increasing data throughput.

Once finalized, 802.11n will support bandwidth greater than 100 Mbps and perhaps even greater than 200 Mbps. Some manufacturers offer pre-N wireless equipment based on preliminary drafts of the standard. However, this equipment may not be fully compatible with 802.11n equipment that will meet the final standard.[19]

802.11n over 802.11//b/g :

1) It is faster. 802.11n technology delivers up to 300 Mbps of link speed for Wi-Fi radios compared to 54 Mbps with legacy 802.11a/b/g. This means increased bandwidth for end user and enterprise business applications.

2) It is supports more users. 802.11n lets users get the job done faster and at increased speeds. As a result, IT can support increased densities of enterprise wireless users with smart phones and tablets without worrying about network capacity.

3) It is more reliable. 802.11n uses multiple antennas to transmit and receive signals, while the old 802.11a/b/g uses only one to transmit and one antenna to receive. 802.11n boosts the signal quality and reliability on both ends of the Wi-Fi connection, which accelerates the performance of enterprise business applications.[20]

802.11g: In July 1999, the 802.11g subcommittee was tasked to extend the 2.4-GHz unlicensed spectrum to data rates faster than 20 Mbps. The resulting 802.11g standard was ratified in June 2003. The 802.11g standard provides optional data rates of up to 54 Mbps, and requires backward compatibility with 802.11b devices to protect the substantial investments in today's WLAN installations. The 802.11g standard includes mandatory and optional components. It specifies Orthogonal Frequency Division Multiplexing (OFDM) (the same technology used in 802.11a) .

Networks employing 802.11g operate at radio frequencies between 2.400 GHz and 2.4835 GHz, the same band as 802.11b. But the 802.11g specification employs OFDM, the modulation scheme used in 802.11a, to obtain higher data speed. Computers or terminals set up for 802.11g can fall back to speeds of 11 Mbps. This feature makes 802.11b and 802.11g devices compatible within a single network. Modification of an 802.11b access point to 802.11g compliance usually involves only a firmware upgrade.[21]

The 802.11 standard technologies all support multiple data rates to allow clients to communicate at the best possible speed. Data rate selection is a tradeoff between obtaining the highest possible data rate while trying to minimize the number of communication errors. Whenever there is an error in the data, the systems must spend time to retransmit the data until it is error free. Each 802.11 client performs a procedure to select the best data rate. The 802.11g clients can select from the widest possible range of both OFDM data rates of 54, 48, 36, 24, 18, 12, 9, and 6 Mbps, and the CCK rates of 11, 5.5, 2, and 1 Mbps.

The following figure illustrates the expected data rate of each technology at different ranges.

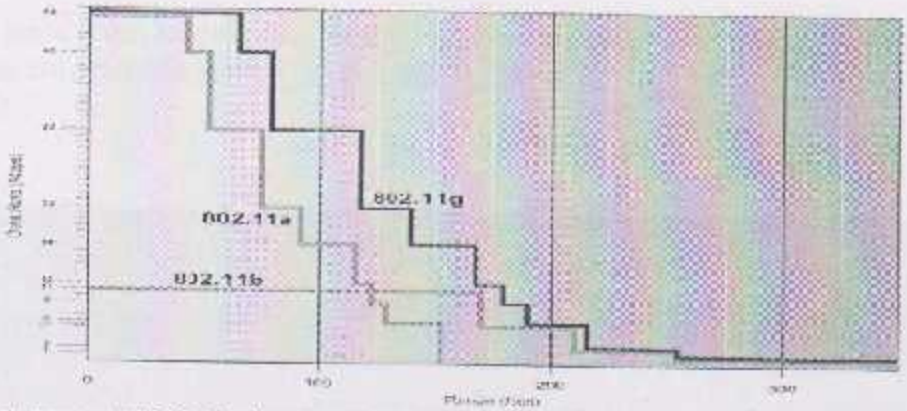

Figure 2.1: Expected 802.11a, b,g Data Rates at Varying Distance from Access Point.

Typically, 2.4-GHz 802.11g networks have the same coverage as 2.4-GHz 802.11b networks. The 802.11b standard uses Complementary Code Keying (CCK) modulation, whereas 802.11g uses both CCK modulation for backward compatibility and OFDM modulation to achieve better throughput at a given distance. The 802.11a standard also uses OFDM modulation, but there is more signal loss as it travels through objects because it uses a higher frequency.

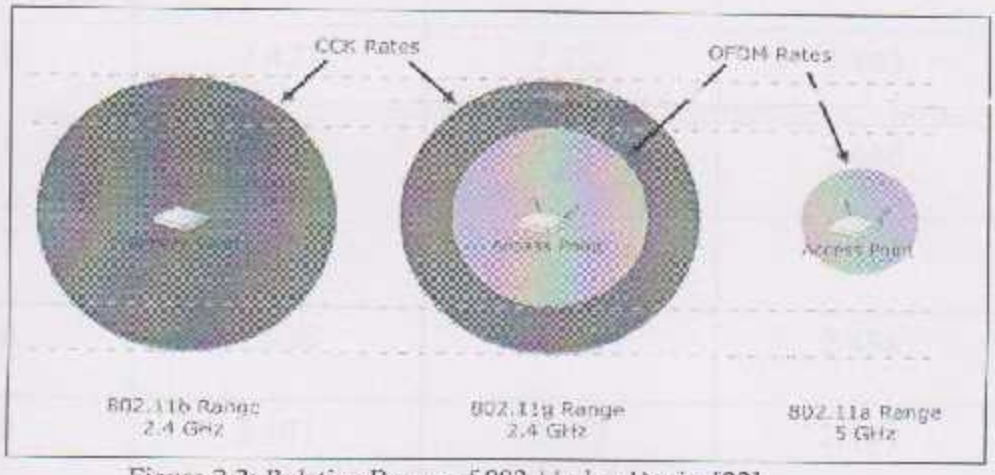

Figure 2.2: Relative Range of 802.11a,b,g Device[22].

2.4 Wi-Fi channel frequencies

There is a total of fourteen channels defined for use by Wi-Fi 802.11 for the 2.4 GHz ISM band. Not all of the channels are allowed in all countries: 11 are used in what is often termed the North American domain, and 13 are allowed in Europe. The Wi-Fi channels are spaced 5 MHz apart (with the exception of a 12 MHz spacing between the last two channels).

The 802.11 Wi-Fi standards specify a bandwidth of 22 MHz and a 25 MHz channel separation, although nominal figures for the bandwidth of 20 MHz are often given. The 20 / 22 MHz bandwidth and channel separation of 5 MHz means that adjacent channels overlap and signals on adjacent channels will interfere with each other.

The table given below provides the frequencies for the total of fourteen Wi-Fi channels that are available around the globe:[23],[24]

CHANNEL NUMBER	LOWER FREQUENCY MHZ	CENTER FREQUENCY MHZ	UPPER FREQUENCY MHZ
1	2 401	2 412	2 423
2	2 404	2 417	2 428
3	2 411	2 422	2 433
4	2 416	2 427	2 438
5	2 421	2 432	2 443
6	2 426	2 437	2 448
7	2 431	2 442	2 453
8	2 436	2 447	2 458
9	2 441	2 452	2 463

CHANNEL NUMBER	LOWER FREQUENCY MHZ	CENTER FREQUENCY MHZ	UPPER FREQUENCY MHZ
10	2 451	2 457	2 468
11	2 451	2 462	2 473
12	2 456	2 467	2 478
13	2 461	2 472	2 483
14	2 473	2 484	2 495

Table 2.1: Wi-Fi frequencies

2.5 Wi-Fi Localization

Many location based applications rely on our ability to accurately locate a mobile device in an indoor environment. There are many applications of location estimation, including activity recognition, robotics etc. Localization through Wi-Fi signals is a major technique in indoor localization. It is a client / server application that can be integrated by service providers and telecommunication operators, or even directly used by corporate customers. Due to the decreasing cost and the ease of installation of access points, indoor localization using Wi-Fi signal strengths are becoming more and more popular. To enable localization, we can collect the RSS values and their corresponding locations as the training data and build a localization model in an offline mode, and then apply the model on newly received data for estimation in an online
mode.

- A Model-Based Wi-Fi Localization Method
- Transferring Localization Models Across Space.

2.6 Receive Signal Strength

The wireless signal strength in each direction determines the total amount of network bandwidth available along that connection. It is one of the most important factors that has to be considered. If the signal strength is to low it can happen that the connection cannot be established at all or that it will fail while being connected. This can lead to all kinds of problems such as data loss or that the user has to enter data again because of the interrupted connection.[25]

In wireless environment, the received signal strength can be attenuates with increasing distance between the transmitter and receiver. Also, obstructions, by large objects such as buildings or hills, cause the signal strength to decay in a random fashion. Moreover, reflections and scattering from various objects typically cause several copies of the transmitted signal to reach the receiver via multiple paths. This leads to large variations in received signal strength over small time scales. In a multipath fading environment , the relative motion between the transmitter and receiver may also cause broadening of the power spectrum.[26]

2.6.1 Properties of the received signal strength

Indoor radio propagation is difficult to predict because of the dense multipath environment and propagation effects such as reflection, diffraction, and scattering. Multipath fading causes the received signal to fluctuate around a mean value at particular location. The received signal is usually modeled by the combined effects of large-scale fading and small-scale fading . The large-scale-fading component (of interest here) describes the signal attenuation as the signal travels over a distance and is absorbed by material such as walls and floors along the way to the receiver. This component predicts the mean of the RSS and usually has a log-normal distribution. Small-scale fading explains the dramatic fluctuation of the signal due to multipath fading. If there is no line of- sight (NLOS) component, the small-scale fading is often modeled with a Rayleigh distribution. If there is a line-of-sight (LOS) component, the small-scale fading is modeled with a Rician distribution. However, these models are focused on understanding the impact of radio propagation on receiver design and signal coverage rather than from the perspective of indoor positioning systems.

2.6.2 Signal Quality

This is a measurement of the Bit Error Rate (BER) of the received signal from the APs. All communication signals are superposed by noise, which makes a perfect instantaneous phase measurement hardly possible. The stronger the noise the stronger the uncertainty of the phase measurement or – vice versa – the stronger the signal the better the phase measurement.

The strength of the received signal relies on the following parameters:

- Signal strength of transmitter
- Attenuation in transmitter hardware
- Gain of transmission antenna (in direction to the receiver)
- free space loss due to distance of transmitter and receiver
- Attenuation by the atmosphere
- Deflection and superposition of the direct signal by reflected indirect signals (Multipath)
- Gain of receiver antenna
- Attenuation in receiver hardware
- Signal tracking technique [27].

2.8 Access Points

Access Points (also called base stations) provide wireless access to a wired Ethernet network. An access point plugs into a hub, switch, or wired router and sends out wireless signals. This enables computers and devices to connect to a wired network wirelessly. Access points act a lot like cellular phone towers: you can move from one location to another and continue to have wireless access to a network. When you connect to the Internet wirelessly using a public wireless network in an airport, coffee shop, or hotel, you are usually connecting through an access point. If you want to connect your computers wirelessly and you have a router that provides wireless capability, you don't need an access point. Access points don't have built-in technology for sharing Internet connections. To share an Internet connection, you must plug an access point into a router or a modem with a built-in router.[28]

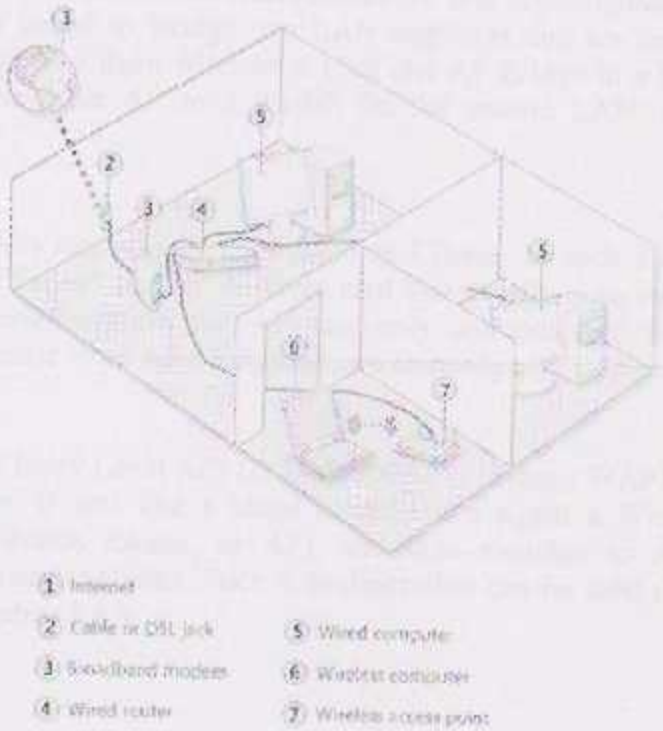

Figure 2.3: Access Point in Home

Access points used in home or small business networks are generally small, dedicated hardware devices featuring a built-in network adapter, antenna, and radio transmitter. Access points support Wi-Fi wireless communication standards.

Access points centralize all Wi-Fi clients on a local network in so-called" infrastructure" mode. An access point in turn may connect to another access point, or to a wired Ethernet router. Each access point typically supports up to 255 client computers. By connecting access points to each other, local networks having thousands of access points can be created. Client computers may move or "roam" between each of these access points as needed. Access Points available with support for 802.11a, 802.11b, 802.11g or combinations.

2.8.1 Access point configurations

1- Gateway: This is the most prevalent mode of all Entry Level Cable/DSL Routers, and Access Points. In this mode the hardware acts as a Wireless Hub connecting to Wireless Clients that are installed on network computers (Wireless Personal Computer Memory Card International Association (PCMCIA), Wireless Universal Serial Bus (USB), Wireless PCI, etc.).[29]

2- Bridge: Most APs can also be configured as a Bridge. In such Configuration the AP can only communicate with another AP that is configured as a Bridge. This mode is useful to Bridge two LAN segments that are apart, and it is preferred to connect them wirelessly. Plug one AP Bridge to a Switch on the first LAN, the other AP to a Switch on the second LAN, and they are connected.

3- Client: Few APs can also be configured as Clients. In such a configuration they act as a "Fancy" regular Wireless card that usually goes on a computer. Under such configuration the AP can only communicate with Wireless Cable/DSL Router or an AP configured as a Gateway.

4- Repeater: Few Entry Level APs (D-Link 900AP+, Linksys WAP11) can work as a Repeaters. It acts like a client to receive a signal a Wireless source (regular Wireless Router, or AP), and then switches to AP mode to broadcasts to regular clients. Such a configuration can be used to extend the range of a Wireless LAN.

2.8.2 Cisco Linksys E3000

In this project, we use the Cisco Linksys E3000; the Linksys E3000 is the first advanced router that's also easy to use for novices.

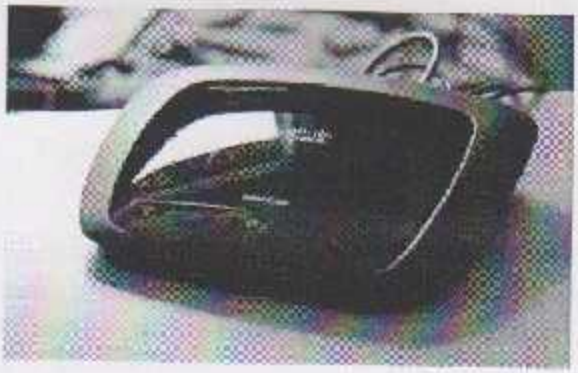

Figure 2.4: The Linksys E3000

Advantage of the Linksys E3000 [30] :

1) The Linksys High Performance Wireless-N Router E3000 delivers most of what you'd expect from a high-end router, including true dual-band, Gigabit Ethernet, fast throughput, a long range, NAS functionality, a nice set of networking features, and a good Web interface.

2) It also has an aesthetically pleasing compact design and an intuitive software application to help home users set up and manage a home wireless network with ease.

Disadvantage of the Linksys E3000 :

1) The Linksys E3000's built-in network storage function lacks speed, and its Guest networking feature is limited.

2) It doesn't support USB printers, and its Media Server doesn't work well with large video files.

3) The included desktop application can't be used with the router's Web interface. The Linksys E3000 is a true dual-band router, meaning it has two separate access points, one for the ever-popular 2.4GHz band and the other for the 5GHz band, that can work simultaneously.

Linksys E3000 specification and back panel ports :

Figure 2.5: Linksys E3000 back panel ports

The router comes with 4 LAN ports and one WAN port on the back. All are Gigabit capable, meaning they support throughput up to 1,000Mbps. Also on the back you'll find a power switch and a USB 2.0 port that can host a USB external storage device for the router's NAS function.

- Router: Linksys Wireless-N E3000
- WAN port 1
- LAN port 4 (1000 Mbit)
- USB port 1
- Wireless N (300 Mbit) both 2.4 GHz and 5 GHz frequency
- 6 Internal Antennas.

Specifications :

Model:	**Linksys E3000**
Technology:	**Wireless-N**
Bands:	**Simultaneous 2.4 GHz and 5 GHz**
Transmit / receive:	**2 x 3**
Antennas:	**6 Internal**
Ethernet ports x speed:	**4 x Gigabit**
USB port:	**Yes**
Software setup:	**CD Install**
Cisco Connect software:	**Yes**
Support :	**24/7 Award-winning Online Support Resources**

	90 days Complimentary Assisted Support
OS Compatibility:	**Windows, Mac**
Minimum System Requirements:	**Internet Browser: Internet Explorer 6, Safari 3 or Firefox 2 for optional browser-based configuration** **PC: Wireless network enabled PC with CD or DVD drive, running Windows XP SP3, Windows Vista SP1 or Windows 7** **Mac: Wireless network enabled Mac with CD or DVD drive, running OS X Tiger 10.4.11, Leopard 10.5.8 or Snow Leopard10.6.1**

Table 2.2: Specifications of Linksys E3000

2.8.3 Associated access point

Once authentication has completed, stations can associate with an access point (or re - associate with a new access point) to gain full access to the network. Association is a recordkeeping procedure that allows the distribution system to track the location of each mobile station, so frames destined for the mobile station can be forwarded to the correct access point. After association completes, an access point must register the mobile station on the network so frames for the mobile station are delivered to the access point. One method of registering is to send a gratuitous Address Resolution Protocol (ARP) so the station's Media Access Control (MAC) address is associated with the switch port connected to the access point.

Association is restricted to infrastructure networks and is logically equivalent to plugging into a wired network. Once the procedure is complete, a wireless station can use the distribution system to reach out to the world, and the world can respond through the distribution system. 802.11 explicitly forbid associating with more than one access point.

-Association Procedure:

The basic association procedure is shown in figure 2.6:

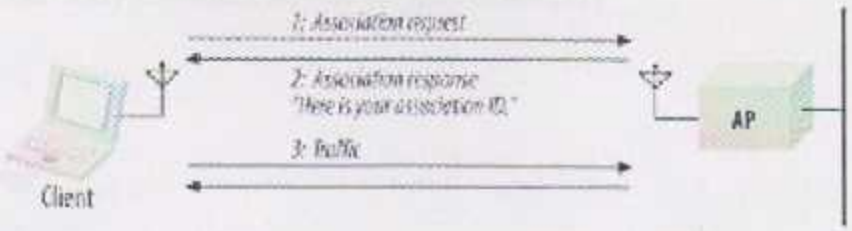

Figure 2.6: Association procedure

Like authentication, association is initiated by the mobile station. No sequence numbers are needed because the association process is a three-step exchange. The two frames are management frame subtypes defined by the specification. As unicast management frames, both steps in the association procedure are composed of an association frame and the required linklayer acknowledgment:

1) Once a mobile station has authenticated to an access point, it can issue an Association Request frame. Stations that have not yet authenticated receive a Deauthentication frame from the access point in response.

2) The access point then processes the association request. 802.11 does not specify how to determine whether an association should be granted; it is specific to the access point implementation. One common consideration is the amount of space required for frame buffering. Rough estimates are possible based on the Listen Interval in the Association Request frame.

a. When the association request is granted, the access point responds with a status code of 0 (successful) and the Association ID (AID). The AID is a numerical identifier used to logically identify the mobile station to which buffered frames need to be delivered. More detail on the process can be found in the "Power Conservation" section of this chapter.

b. Unsuccessful association requests include only a status code, and the procedure ends.

3) The access point begins processing frames for the mobile station. In all commonly used products, the distribution system medium is Ethernet. When an access point receives a frame destined for an associated mobile station, that

frame can be bridged from the Ethernet to the wireless medium or buffered if the mobile station is in a power saving state. In shared Ethernets, the frame will be sent to all the access points and will be bridged by the correct one. In switched Ethernets, the station's MAC address will be associated with a particular switch port. That switch port is, of course, connected to the access point currently providing service for the station.[31]

2.9 Server

A server is a computer program that provides services to other computer programs (and their users) in the same or other computers. In most common use, server is a physical computer (a hardware system) dedicated to running one or more such services (as a host), to serve the needs of users of the other computers on the network. Depending on the computing service that it offers it could be a database server, file server, mail server, print server, web server, or other.

2.9.1 Servlet

A servlet is a small Java programming language class used to extend the capabilities of servers that host applications accessed via a request-response programming model. It is receive and respond to requests from Web clients, usually across HTTP, the Hyper Text Transfer Protocol. Thus, it can be thought of as a Java Applet that runs on a server instead of a browser.

2.10 Switches

Switches work the same way as hubs, but they can identify the intended destination of the information that they receive, so they send that information to only the computers that are supposed to receive it. Switches can send and receive information at the same time, so they can send information faster than hubs can. If your home network has four or more computers, or you want to use your network for activities that require passing a lot of information between computers (such as playing network games or sharing music), you should probably use a switch instead of a hub. Switches cost a little more than hubs.

In this project, switches are among the Linksys High Performance Wireless-N Router E3000.

2.11 Roaming

In general, the roaming is a technology which enables a wireless device to change its Access Point, internationally, while remaining connected to the network. In GSM , Roaming is a possibility offered by mobile operator and which permits the customer to use his mobile all over world without change phone number ; while WI-FI roaming refer to the rate that your WI-FI client automatically select and switches to another Access Point or route with better signal quality.

In indoor roaming, the given area divided into subarea and Access Point will be placed in different area. The Mobile Station (MS) moves from one AP to another within a home network because the signal strength is too weak. A Mobile Station roaming from one access point to another often interrupts the flow of data between the Mobile Station and an application connected to the network. The Mobile Station, for instance, periodically monitors the presence of alternative access points. The Mobile Station, however, may lose a connection with an access point before associating with another access point. In order to provide reliable connections with applications, the Mobile Station must generally include software that provides session persistence.[32]

A wireless computer can "roam" from one access point to another, with the software and hardware maintaining a steady network connection by monitoring the signal strength from in-range access points and looking on to the one with the best quality. Usually this is completely hidden to the user; they are not aware that a different access point is being used from area to area.

A user can move from Area 1 to Area 2 transparently. The Wireless networking hardware automatically swaps to the Access Point with the best signal.

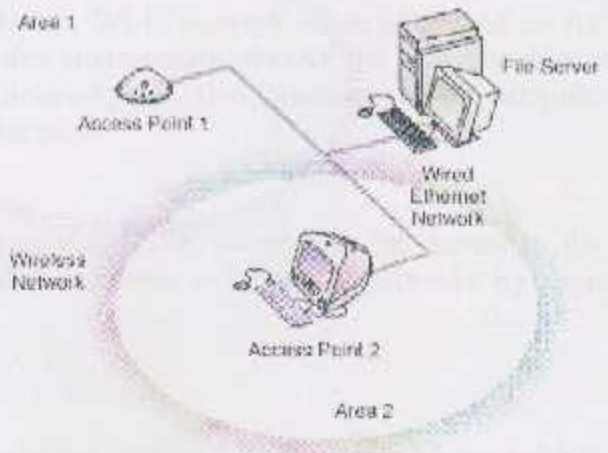

Figure 2.7: Roaming.

Not all access points are capable of being configured to support roaming. In addition, to be were that any access points for a single vendor should be used when implementing roaming, as there is no official standard for this feature.[33]

· Basic Wi-Fi components and terminology :-

The following content is being provided for informational purposes to familiarize end-users with basic terminology and components of Wi-Fi technology.

1) Autonomous access point: Stand-alone Wi-Fi hub that allows any computer with a Wi-Fi network adapter to communicate with another computer and to connect to the Internet. This device is typically used in an enterprise or corporate environment with many users.

2) Ad hoc, peer-to-peer or computer-to-computer network: A communication configuration where every computer has the same capabilities and any computer can initiate a communication session. Also known as a peer-to-peer or computer-to-computer network.

3) Broadband Wi-Fi router: Stand-alone Wi-Fi hub that allows any computer that has a Wi-Fi network adapter to communicate with another computer and to connect to the Internet. This device is typically used in a home or small-office environment with a relatively small number of users.

4) Client computer: The computer gets its Internet connection by sharing either the host computer's connection or the AP/router's connection

5) Infrastructure network: Wi-Fi network centered around an AP or broadband Wi-Fi router. In this environment, the AP not only provides communication with the wired network, but also mediates Wi-Fi network traffic in the immediate neighborhood.

6) Internet service provider (ISP): Subscribers get access to the Internet from their homes, small businesses or corporate networks by paying the ISP for service.

7) Lightweight access point (LWAP): Scaled-down access point that funnels user authentication and association requests to a central Wi-Fi switch.

8) Modem: DSL, cable, or other types of hardware connected to both the AP/router and external line leading to an ISP.

9) Wi-Fi network adapter: A hardware device (embedded in the client or an external PCMCIA card) on client stations consisting of a radio and antenna(s) used for transmitting and receiving Wi-Fi frames. Antennas may also be integrated into the client device itself.

10) Wi-Fi switch: Control point for a group of lightweight access points (LWAP) or autonomous APs.

2.12 Android

Android is a software stack for mobile devices that includes an operating system, middleware and key applications. It was based on Linux with a Java programming interface.

Android applications consists out of different components and can re-use components of other applications if these applications declare their components as available. This leads to the concept of a task in Android, an application can re-use other Android components to archive a task.

Android ships with a set of core applications including an e-mail client, Short Message Service (SMS) program, calendar, maps, browser, contacts, and other features. All applications are written using the Java programming language. So, it is in this layer that you will fit in your next big mobile application.

Android is currently primary developed by Google.

Figure 2.8: Android.

We can develop Android applications with the same high quality tools you use to develop Java applications. The Android core libraries provide the functionality needed to build some amazingly rich mobile applications, and the Android development tools make running, debugging and testing your applications a snap.
We can either use the Eclipse Integrated Development Environment (IDE) (http://www.eclipse.org) or the command line tools available with the software development kit (SDK) to develop your android app. [34], [35].

3

Chapter three
System Design

Chapter contents:

3.1 Main Block Diagram

The main block diagram of the whole system was described on figure3.1. it is contain all components which we will use in this project and how these component will contact to each other to achieve the object of the project.

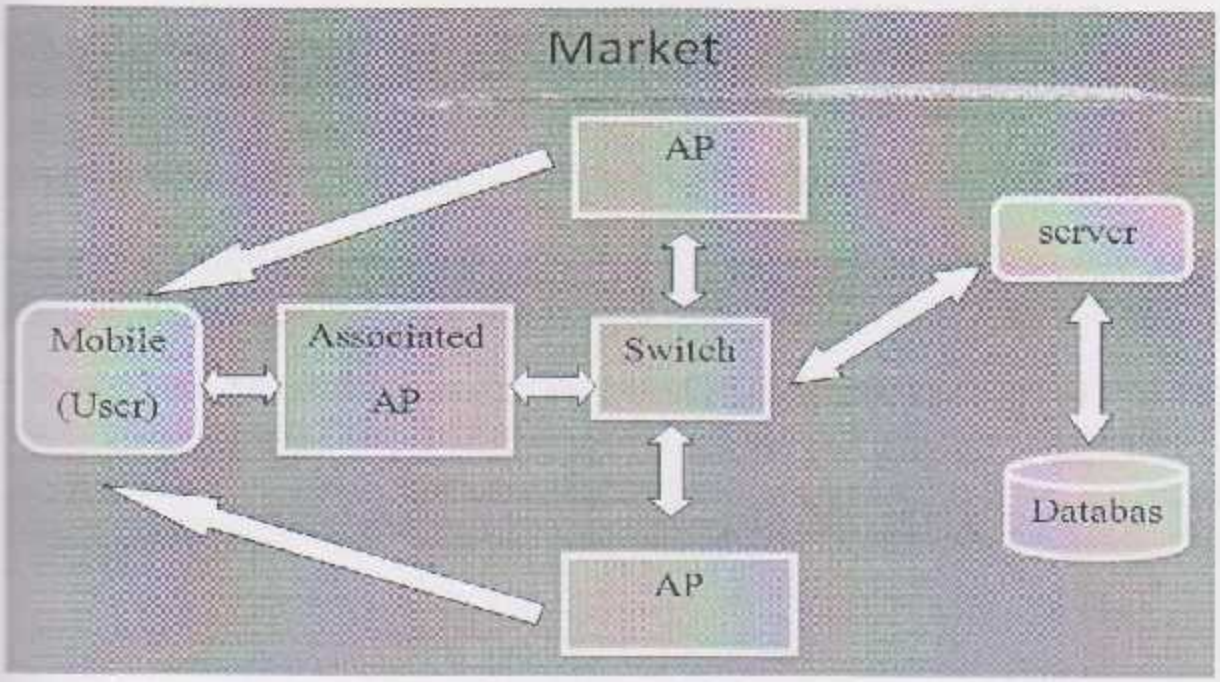

Figure 3.1 : The Main Block Diagram.

The main system components is:

-Access Points.

-Mobile.

-switch.

-server.

And we will describe the function of each component in the next section which is section 3.2.

3.2 Main System Components

In this section we will describe the function of each component we will use in the project, as following:

3.2.1 Mobile Phone (user)

Mobile is the way to connect the user to the system by doing the following tasks:

1. Connect with the associated access point (AP).

2. Show the main menu that gives information about the all shops in the market.

3. Estimate the signal strength between it and the AP's.

4. Show a menu for service required.

5. Show the map that provide information about the user's location in the market and gives the user the path to reach the service required.

3.2.2 Server

Server acts as the brain of the project and it's responsible for :

1. Decide the location of the mobile by comparing the received signals strength values with the reference values in the data base.

2. Provides the main menu and the other menu to the mobile.

3. Provides the map .

The server will have a database; this simple database contains:

1. Main menu.

2. Reference values of the signal strength .

3. Map for each zone.

4. Menu for each service.

3.2.3 Access Point (AP)

Access point (AP) in the project acts as an intermediary between the server and the mobile phone by doing the following tasks:

1. Send the request from the mobile to the server.

2. Broadcast the signals.

3. Send the signals strength values from the mobile to the server.

4. Return of the main menu, map and other menu from the server to the mobile.

In our project we need at least 3 AP's to accurately locate location of the mobile.

3.2.4 Switch

Is a structure of the system by doing the following tasks :

1. connect the AP's to the server .

2. Connects between AP's located on the same floor and connect them to the other AP's in the second floor.

From this connection between APs we can make the roaming process – at this process all AP's take the same name at the setup process- from this process the user can save the connection to the server without any interruption when its moving from the location to other .

3.3 How System Work

The application will be applied on each mobile supporting Wi-Fi technology. The use of this application will be achieved by the following steps:

Step 1

Once the user enters the market, he will turn on the Wi-Fi from his mobile where the application is downloaded if it is the first user's visit.

Step 2

Now the user should be able to associate with AP. If he change his area and be out of the range of the associated AP he will associate directly with another AP it's range cover the new area.

Step 3

The mobile will receive signal values from surrounding APs, then it will be sent to the server by the associated access point.

Step 4

The server will match the signal values with the database.

Step 5

The server will provide the user with a list of possible services. The user should be able to select the choice of service.

Step6

Once the user makes his selection of choice, more information will be sent containing more details about the service selected.

Step 7

The server now will determine the zoning, based on the values collected from the user's mobile, and send back the suitable map of the zone to the user. The map will change during user's movement from one zone to another until he reaches his destination.

3.4 Main flowchart

This flow chart summaries the system operation steps . the system operation is divided into many parts as shown in the following figure 3.1:

- Start application.
- Display menu and read user selection.
- Retrieve map to destination.
- End of the application.

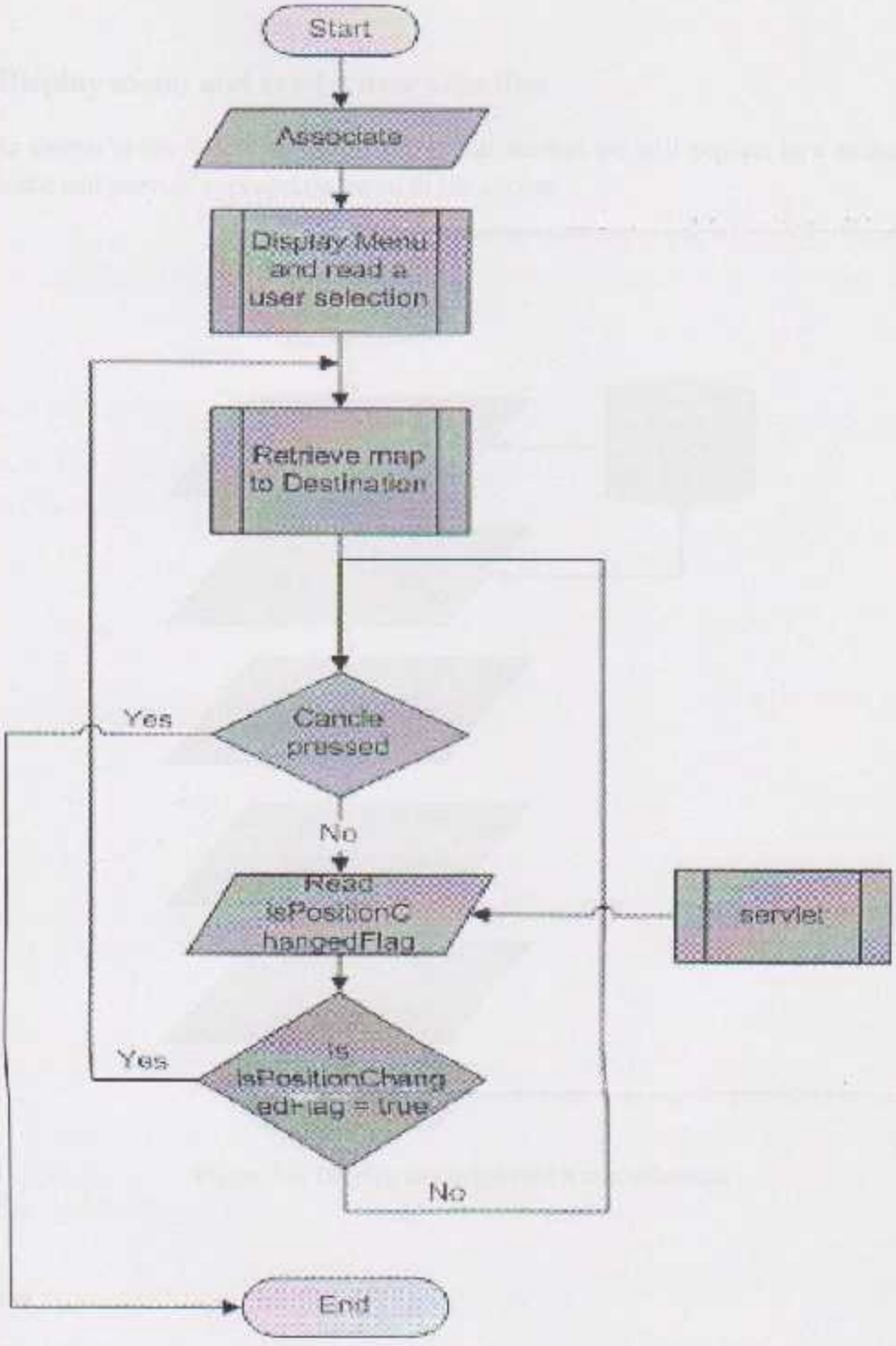

Figure 3.2: Main flowchart.

Here is the description of the main idea for each part:

3.4.1 Display menu and read a user selection

As shown in the following figure 3.3, in this section we will explain how to deal with the user's choice and provide appropriate menu to his choice:

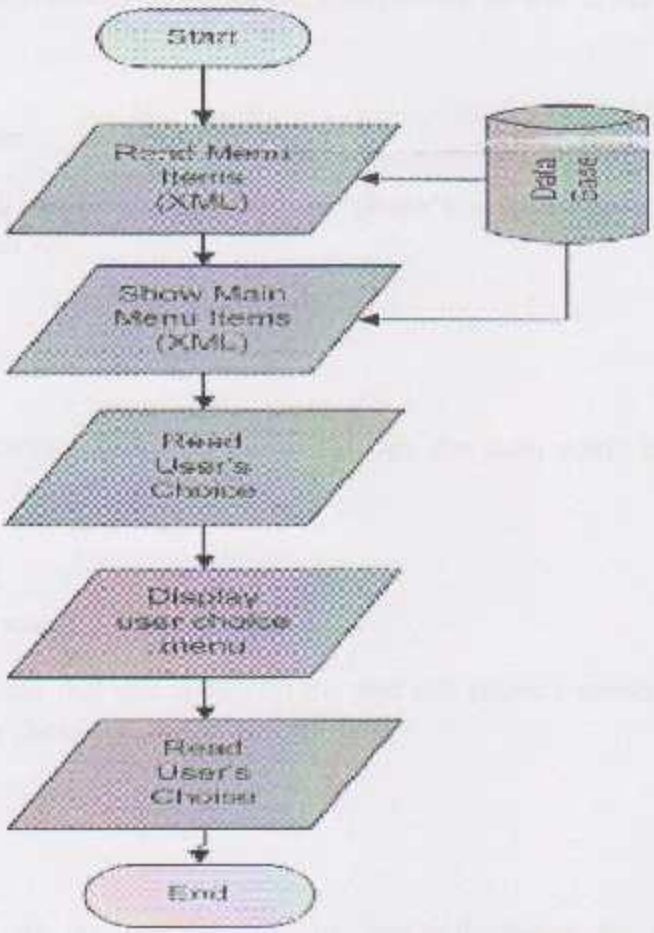

Figure 3.3: Display menu and read a user selection.

Data Base

The data base that we are going to use in our project is file which contains all data that the server needs to help the user to reach the service.

Associate

The mobile will associate with the AP which send the highest power value . This AP will be the mediator between the mobile and the server and visa versa.

Read menu items

These items will be read from file that exists in the database in the server which contains all the existing services available in the market. This file will be sent to the user upon request.

Show main menu items

This menu will appear on the user cell phone's screen, after the server send this it through the associated AP.

Read users choice

The user will choose the service he wants from the main menu have been sent to him before.

Display user's choice menu

It is another menu that will appear on the user cell phone's screen which contains more details about the user's choice.

Read user's choice

Final selection of the service will be sent to the server by the associated AP to return map for the user to be inferred from the place in the service, and we will describe these steps from figure 3.4.

3.4.2 Retrieve map to destination

From figure 3.4 we will describe how the map retrieve to user's:

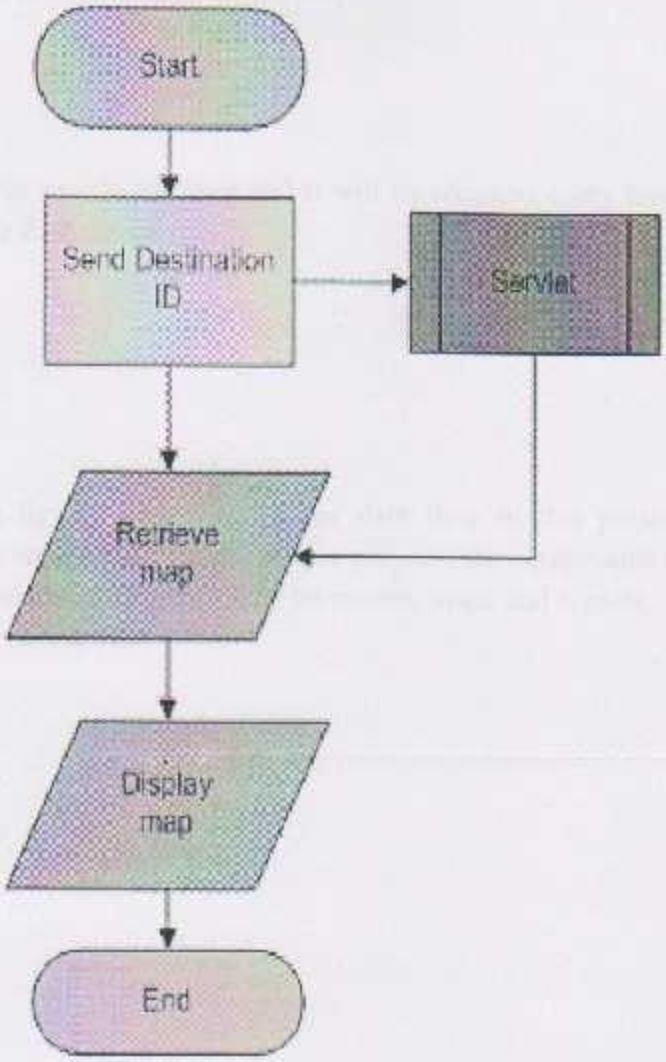

Figure 3.4: Retrieve map to destination.

Send destination ID

The destination is the place where the user can find the services he selects. Destination ID will be sent by the mobile to the server after the user choose the service.

Retrieve map

The server will retrieve the map that describes the place where the services exist Based on division of zones in the database in the server.

Display map

The map will be sent to the user and it will be changed every time the user change his place until he reach the destination.

3.5 Data Flow

The following figures will describe the data flow in this project. there is data will exchange between the equipments we use in this project . the equipments need this data to help the user to reach the services. The data may be menus, maps and signals . Here is the parts we need to exchange data through it:

-Power measurement.

-Association.

-Retrieve menus.

-Retrieve map.

3.5.1 Power measurement

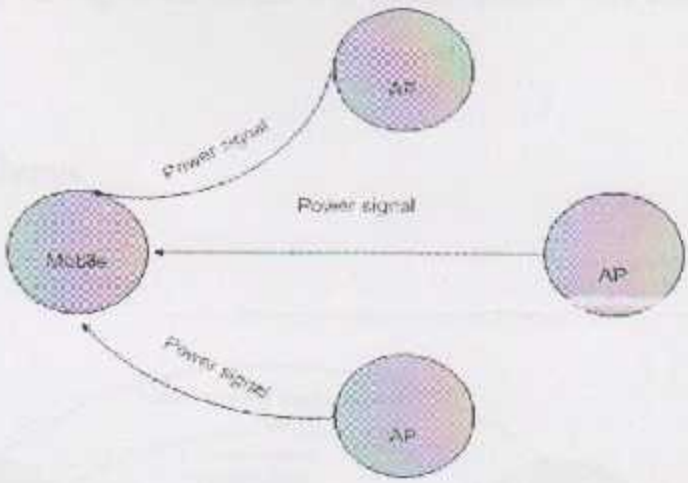

Figure 3.5: Power measurement.

Power measurement will use in many places in the project:

- Help the mobile to associate with the AP which sends the highest power signal.
- Help the server to determine user's place to retrieve the map to him.

3.5.2 Association

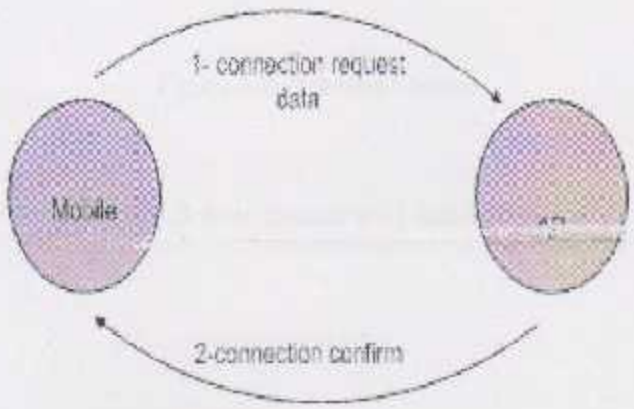

Figure 3.6: Association.

The mobile will associate with the AP which sends the highest power signal. If the user go out the associated AP region the mobile will connect directly with another AP with higher power signal.

3.5.3 Retrieve Menus

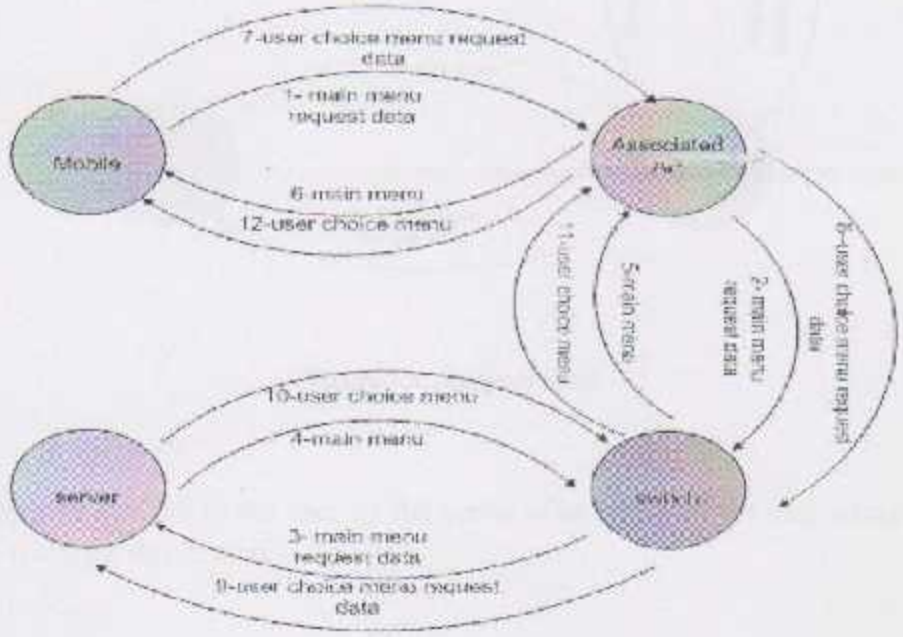

Figure 3.7: Retrieve Menus.

As we describe in section 3.3 tow menus will send to the user if he sends the menus request.

3.5.4 Retrieve Map

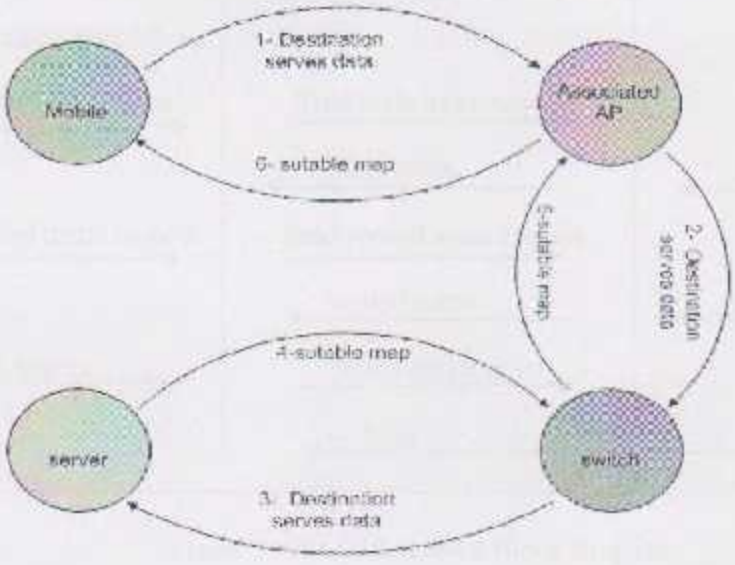

Figure 3.8: Retrieve Map.

A map will retrieve to the user by the server after he sends the map request. This map help them to reach the destination.

3.6 Functional Block Diagram

Here we describe the functions in each part on the project. We will describe the functions on the mobile, server and AP.

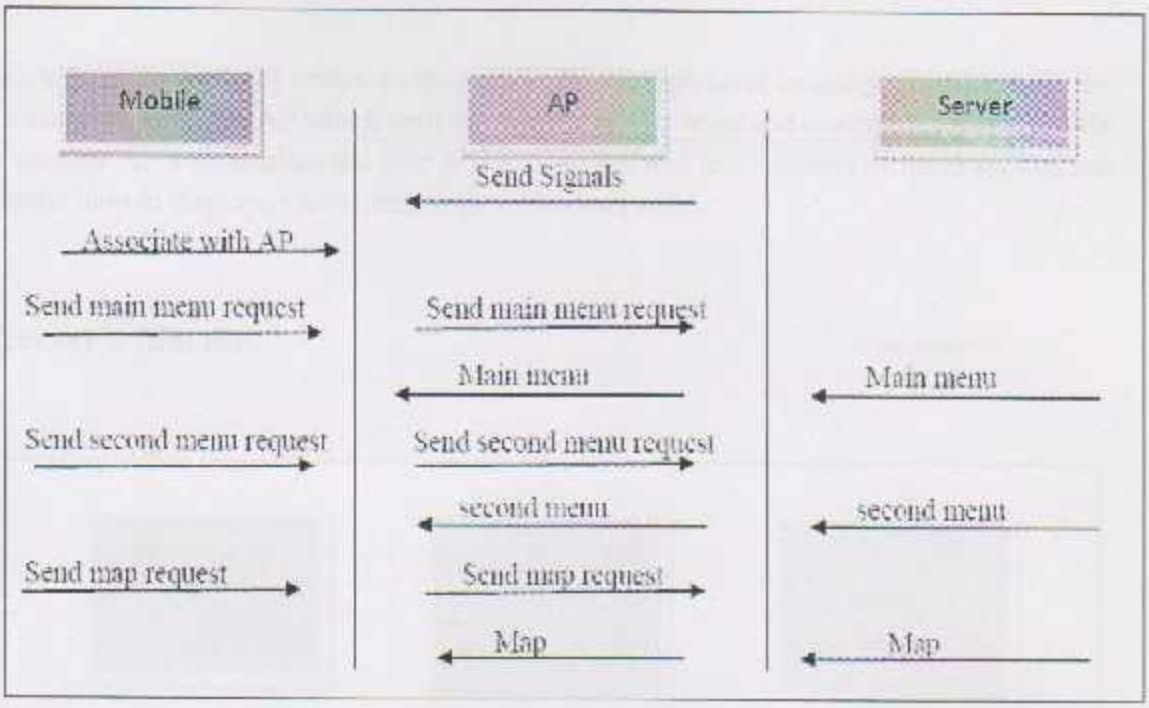

Figure 3.9: Main functional Block Diagram

3.6.1 Mobile's function

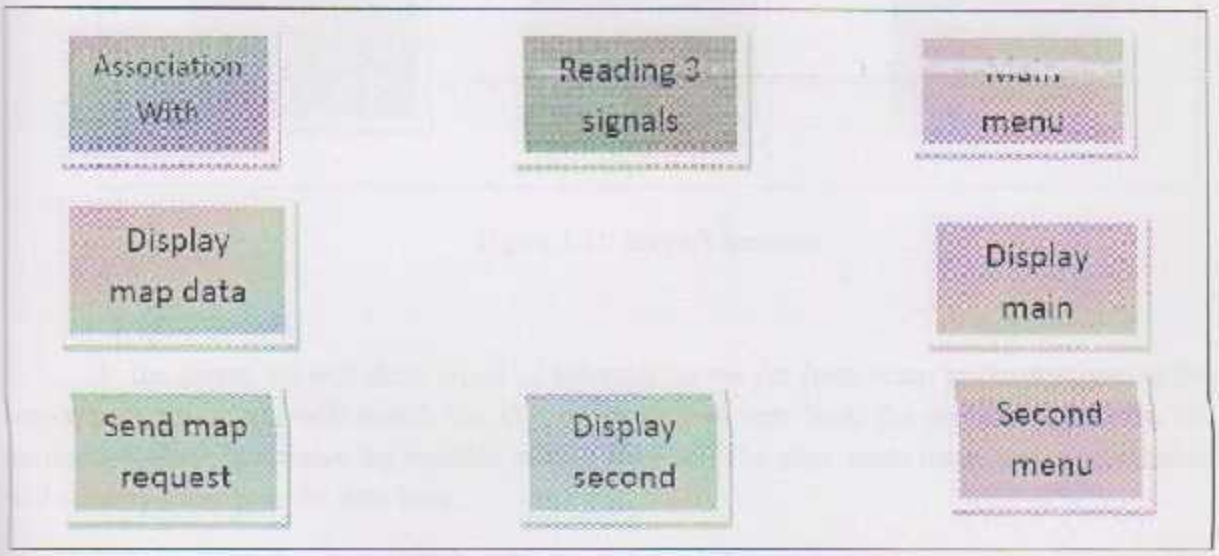

Figure 3.10: Mobile's function.

We will apply group of orders on the mobile by use high level language (Java) to help the mobile to associate with the AP which emit the highest power level and reading the power levels from the another AP's to localize the user place. Also we will use Android to build application on the mobile help in displays menus and maps which user need.

3.6.2 Server's function

Figure 3.11: Server's function.

At the server we will store group of information we get from setup in the database at the server then the server will match the signal which was sent from the mobile to localize the destination place to retrieve the suitable map to the user. The map, main menu and second menu will send by files from the data base.

3.6.3 Access Point's function

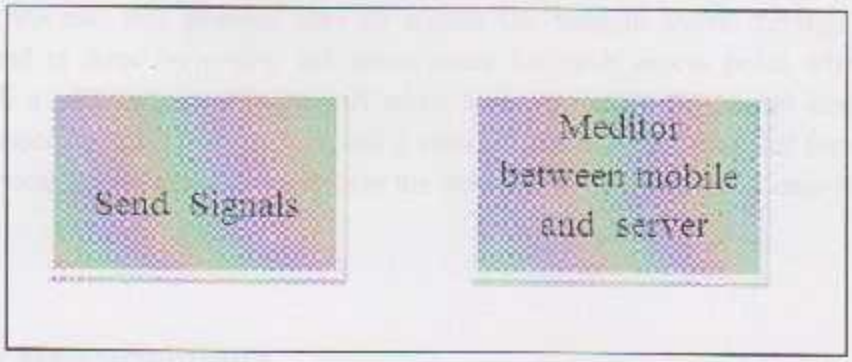

Figure 3.12: Access Point's function

The AP will send signals which mobile read, and it also will be the mediator between the mobile and the server.

3.7 Setup

1. We use AP's from Cisco E3000 quality for use in the project that have default IP 192.168.1.1 and then we made a setup for these access points.

2. We have distributed access points through the floor has preliminarily and then we measure the signal strength from different points through the floor of each access point (using the program INSSIDER that has been pre-loaded on the device) so that we can see the points where the signal strength is good and the points where the signal strength weak (from inside the room, next to the access point and at the different dimensions of access points).

3. In Reading start from a certain point and then we run the program and movement in a certain direction to see at any moment that the signal strength is weak from the access point to see at any point the next access point can be put.

4. Depending on these reading we have identified suitable locations to put access points through the floor to cover the largest possible area of the floor.

5. After selecting the appropriate locations for access points through the floor, and we divide the floor to the zones has preliminarily and then we measure the signal strength in every region of all access points to select the area correctly.

6. After divided the floor to zones we took several readings of signal strength from all access points in each zone based on these readings we have developed a certain range of signal strength from each access point in this zone.

7. Roaming process: this process uses to enable the user to move through floor without interruption, and is done by giving the same name for each access point where the user is connected with a certain access point and when the user move, the signal strength from the access point associated with it starts decreasing until we reach to the point that the signal strength from the next access point to be stronger than the signal strength from the access point associated with it.

3.8 Power Measurements

Power measurement was taken after divided the floor to zones. We divide the floor to 15 zone then we were taking power level values as describe in the following table, table 3.1:

Zone	AP1	AP2	AP3
Z1	-50	-65	0
	-60	-75	0
Z2	-35	-37	-75
	-45	-47	-85
Z3	-37	-73	0
	-47	-83	0
Z4	-49	-75	0
	-59	-85	0
Z5	-60	-60	-83
	-70	-70	-85
Z6	-75	-54	-70
	-85	-64	-80
Z7	-55	-35	-67
	-65	-45	-77
Z8	-65	-55	-70
	-75	-65	-80
Z9	-58	-55	-40
	-68	-65	-50
Z10	-74	-75	-49
	-84	-85	-59
Z11	-74	-70	-65
	-84	-80	-75

	-70	0	-63
Z12	-80	0	-73
	0	-77	-54
Z13	0	-82	-64
	0	0	-64
Z14	0	0	-74
	0	-80	-65
Z15	0	-85	-75

Table 3.1: Power measurement.

Note : the unit of the reading in dBm.

After we distribute AP's we depend on the power emits from this AP's to divide the floor into 15 zone as describe in figure 3.13a and 3.13b. we take many readings in different places in each zone then we select a suitable threshold to take the final power range for each AP in each zone.

From table 3.1 and figures 3.13a and 3.13b that there is high interference because of the similarity in power reading in zones, so we will redistribution of the AP's until we get the most accurate power levels with less error rate.

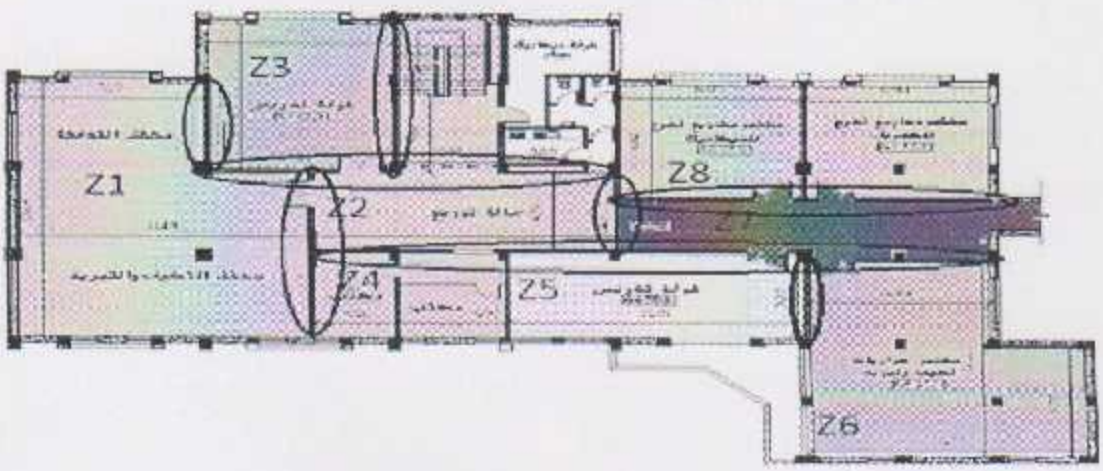

Figure 3.13a : Distribution zone on floor 7B.

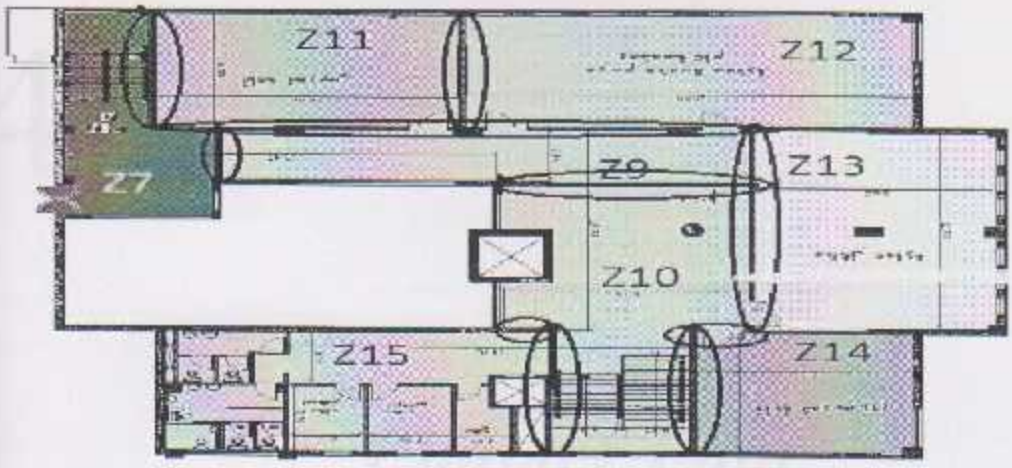

Figure 3.13b : Distribution zone on floor 7B+.

Note: the circle in the figure mean the there is interferenee.

4

Chapter Four

Hardware System Design

Chapter contents:

4.1 Introduction

This chapter describes the main hardware components used in this project and a description of the steps we have made to build a network, it's contains many sections as follows:

Figure 4.1 shows the main hardware components:

Figure 4.1: Main hardware components

4.2 Mobile Specification

We choose Galaxy mini mobile as in figure 4.2, it supports Wi-Fi technology that can be used to download the application from the web page on the mobile phone and to connect with server, Also memory inside mobile phone.

Figure 4.2: Galaxy mini

It supports:

1- Java application specially Android application.
2- Wi-Fi technology

4.3 Server

Server is a physical computer (a hardware system) dedicated to running one or more such services (as a host), to serve the needs of users of the other computers on the network.

Personal computer was used as a server; this server contains the Servlet, DataBase(DB), desktop application and web application as in the figure 4.3:

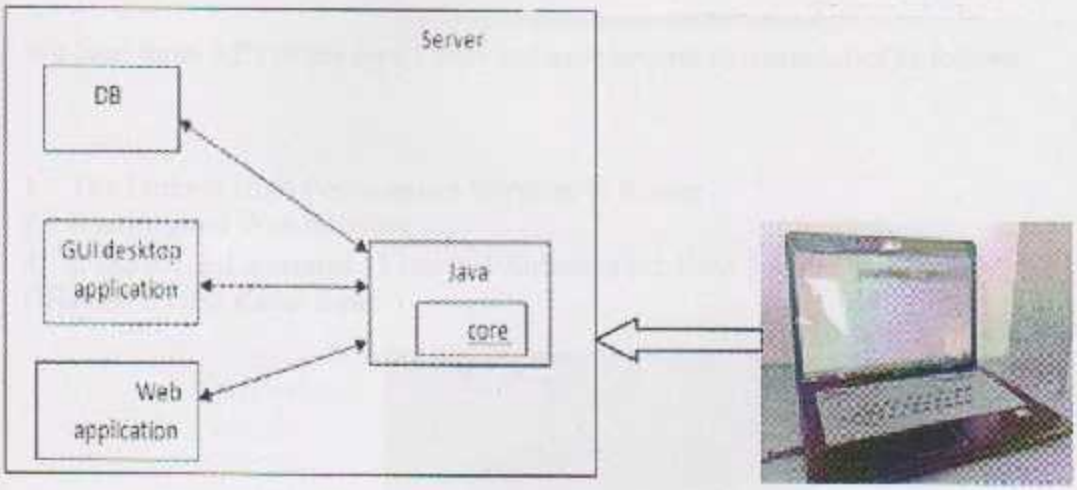

Figure 4.3: Server

- **servlet**

A servlet is a small Java programming language class used to extend the capabilities of servers that host applications accessed via a request-response programming model. It is receive and respond to requests from Web clients, usually across HTTP.

- **DataBase (DB)**

is an application that manages data and allows fast storage and retrieval of that data, in this project we use Microsoft office access to build the DB , it's contains many tables that stores data as a reference values .

4.4 Access point (AP)

AP is a station that transmits and receives data (sometimes referred to as a transceiver), it's provide wireless access to a wired Ethernet network and sends out wireless signals and this enables computers and devices to connect to a wired network wirelessly.

We used three AP's of the type Cisco and have several characteristics as follows:

1. The Linksys High Performance Wireless-N Router .
2. It has a good Web interface
3. It has 6 Total antennas , 3 Internal Antennas per Each 2.4 GHz and 5 GHz Radio Band

Figure 4.4: Access point (Cisco Linksys E3000)

It supports:

1. 4 wireless internal antennas
2. Broadcast the signals
3. support roaming process
4. Comes with 4 LAN ports and one WAN port on the back as in the figure 4.5:

figure 4.5: Access point ports

4.5 Access Network

After we have chosen the seventh floor to apply the idea of the project on the basis that the floor is the market and the rooms are the shops, we have built a network for the project at the floor; there are several steps which we follow to build the network:

Step1:

We have used three AP's from Cisco type .

Step2:

Then we have programmed AP's by the default IP(192.168.1.1) as follow: We choose 2.4 GHz frequency and a different channel for each AP, we used the following channels 1,6 and11 because these channels have less overlap.

Step3:

During the programming of the AP's. The AP's are named the same name to avoid outages network when moving from place to place. so we have applied the Roaming.

Step4:

Then AP's have been distributed in the floor as in Figure 4.6

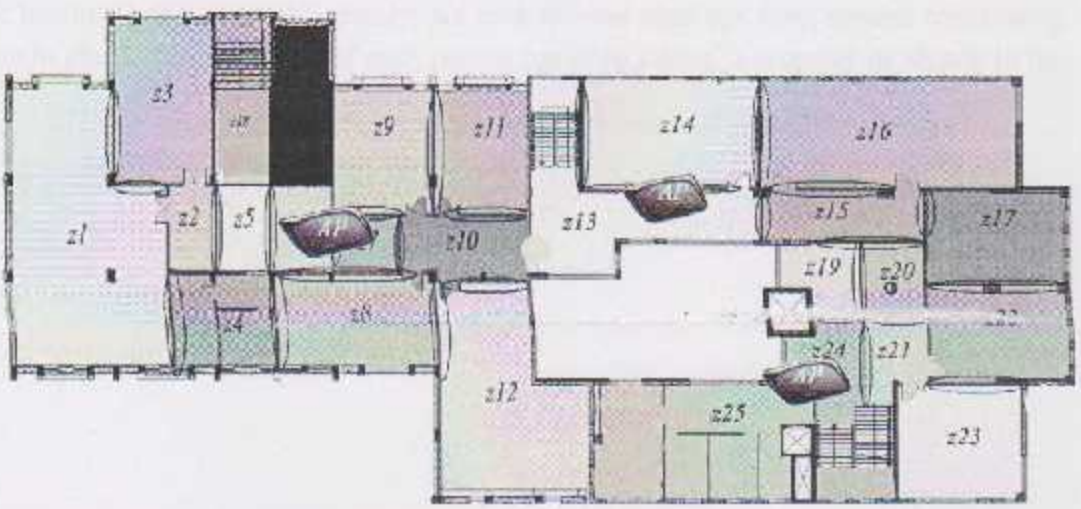

Figure 4.6 : Locations of access points through the floor

Step5:

After that, we have used Ethernet cables to connect the AP's with the switch at port 24, as in the figure 4.7

Figure 4.7: Switch

Step6:

After becoming the network is ready, we took several readings from several areas using mobile phone to check that the range of each region has been taking it properly as shown in the Figure 4.8:

Figure 4.8: Example of the readings that were taken by the Mobile phone

5

Chapter Five
Software System Design

Chapter contents:

5.1 Introduction

In this chapter , the detailed description for the project software, in previous chapter we talked about the hardware system design, here we will describe software used to give hardware connection goals.

Then we will describe Mobile Programming in details, this is very important side in our project and open to use completely new window to programming world, our mobile programmed using Android language in order to create android application which used to install on mobiles.

5.2 Software Contents

The following diagram figure 5.1 shows all contents of the software side in the project. Later we will describe each content alone.

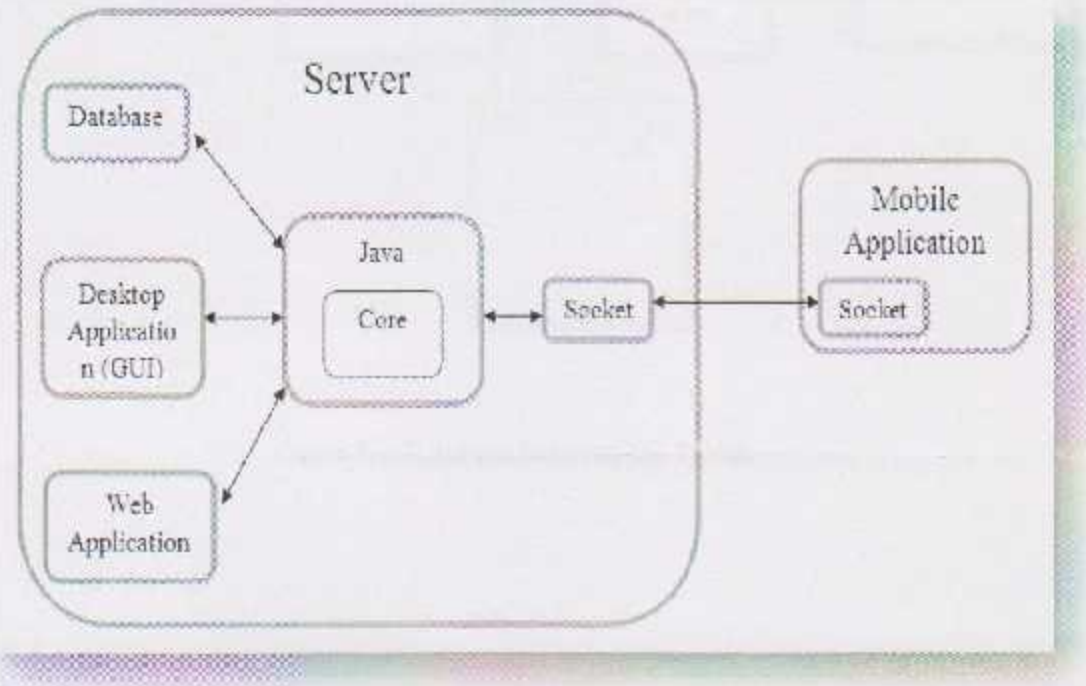

Figure 5.1: Software Diagram.

5.2.1 Data Base

We have created our project database using Microsoft Office Access 2007. It contain all data required for the server to be able to complete its task, starting from the compared the arrived signals power with the signals on the data base to locate the user location and ending with the appropriate map to send to customers so they can access the services they want.

Here we will display the relations between tables in the database as on figure 5.2 and describe the contents for each table used and its uses in more detail:

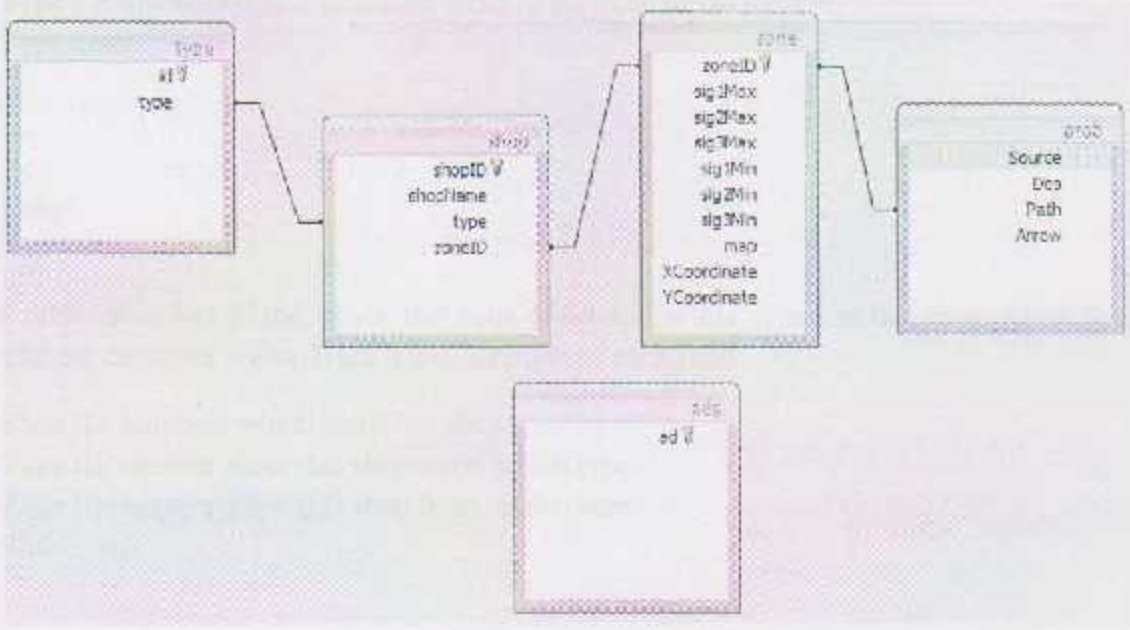

Figure 5.2: Relations Between DB Tables.

- **Zone :**

This table describes all the fields that help to determine the user's location and a map appropriate for each zone. Here is a description of each field:

- Zone ID(Identification): numbers which identifies zones.
- Minimum and maximum value for the signal power at each zone.
- Map ID: numbers which identifies maps.
- X-coordinate and Y- coordinate: coordinates help to determine the appropriate location to place a sign on the place where the customer must go to.

- **Type:**

This table describes all the fields that help to determine the type of service provided in the market. Here is description of each field:

- Type ID: numbers which identifies types of services on the market.
- Type name.

- **Shop:**

This table describes all the fields that help to determine the name of the shop where the service that the customer wants. Here is a description of each field:

- Shop ID: numbers which identifies shops.
- Type ID: number show this shop from which type.
- Zone ID: number show this shop from which zone.
- Shop name.

- **Ads:**

This table contains all the ads that can appear suddenly in the market to enable the customer to identify it. And its field is filled if there is an ad, and return empty after a period of time to allow another ad to appear to customers through their mobile phones.

- **Probabilities:**

This table describes all the fields that help to determine the arrow need to determine the direction which user must follow to reach the service he need. Here is a description of each field:

- Source: determine the number of the current zone.
- Destination: determine the number of the destination zone which has the service which user need.
- Path: determine the path number which user need to follow to reach the service .
- Arrow: determine the arrow number which determine the direction the user must follow to reach the service.

5.2.2 Desktop application

We have built two desktop applications GUI(Graphical User Interface) :

- The first application is used to insert or delete data from the database used, shown in this figure 5.3:

Figure 5.3: To modify the contents of the database.

- The second application used to display signal power that have been read by the mobile phone in addition to the number that identifies every device from the other. It also shows map and service ID which server returned to mobile, shown in this figure 5.4:

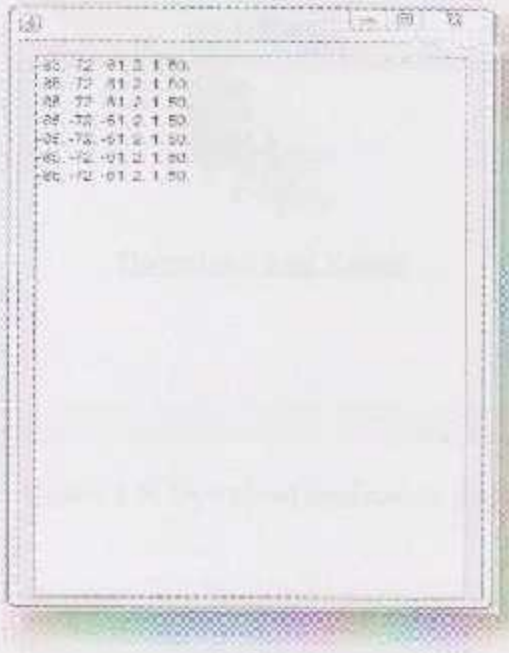

Figure 5.4: Contact with mobile

5.2.3 Web Application

By this Web Page the users can download the application to their mobile phones. Figure 5.5 shows this page:

Figure 5.5: Download application page.

5.2.4 Mobile Programming

First we import requires packages, the next step is to make classes which we need to complete application, these classes are ordinary java classes. The classes we use are:

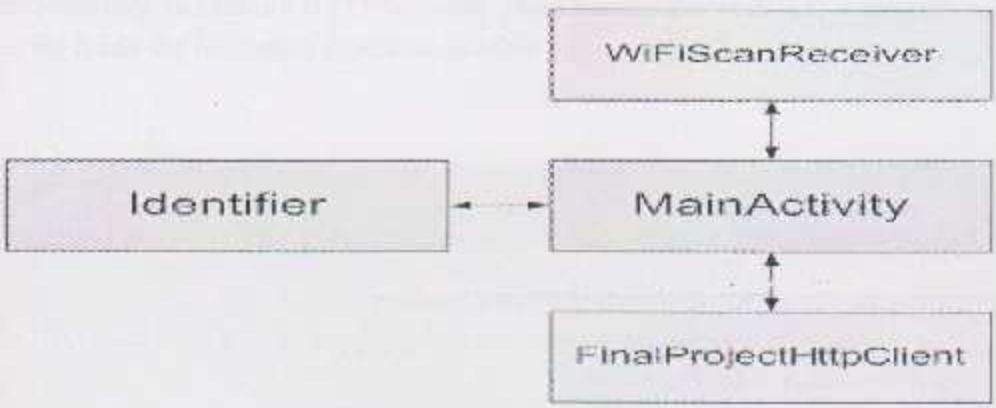

Figure 5.6: Mobile Application Classes.

- **WiFiScanReceiver**

This class contains all the functions necessary for the mobile to find the AP with same name in the network and read the power signal from each one. The functions are shown in table 5.1:

Function	Objective
`onReceive()`	This method is called when the Broadcast Receiver is receiving an Intent broadcast, then its responsible to find all APs that are related to our network and to read the power signal from each one.
`getCounter()`	This method is responsible to return the number of the existing APs .

Table 5.1: WiFiScanReceiver Functions

- **FinalProjectHttpClient**

This class is responsible to create an HTTP client. HTTP clients encapsulate a diversified of objects required to execute HTTP requests while handling connection management, and other features. It has the following functions in table 5.2:

Function	Objective
`getHttpClient()`	In this method the HTTP client object is created and the connection properties are set, such as connection duration.

`getCounter()`	This method uses the HTTP client object, connect to the getMap servlet which returns the suitable map.

Table 5.2: FinalProjectHttpClient Functions.

- **MainActivity**

This class contains all main activity's functions as describe below in table 5.3:

Function	Objective
`onCreate()`	This method uses to create the object Responsible for scanning process and create menus.
`getParameters()`	This method starts scanning process, gets signal values, then sends these values to the *`executeHttpGet` method in* FinalProjectHttpClient class.
`onCreateOptionsMenu()`	Initializes the contents of the application menus, which will be read from the server .
`onOptionsItemSelected()`	When you click on one of the menu items this method show Sub menu items, either when you press on one of the elements of the sub-menu it send the choice to the server.
`Runnable Read_Ad`	Task that will be applied each time to read the if there is new ad .
`Runnable checkPosition`	Task that will be applied each time to check if there is change on position .

`changePositionTimer`	Timer for checking the change the location of the customer every specific time duration.

Table 5.3: MainActivity Functions.

- **Identifier**

This class has one function describe in table 5.4:

Function	Objective
`getAddress()`	Network Interfaces address.

Table 5.4: Identifier Function

5.2.5 Server

Hosting Server of our project is Apache Tomcat 5.5. Our web project contain more than one Function helps on completing connection between server and mobile application there is two main funnctions getDBConnection and getServerr . The classes are in table 5.5:

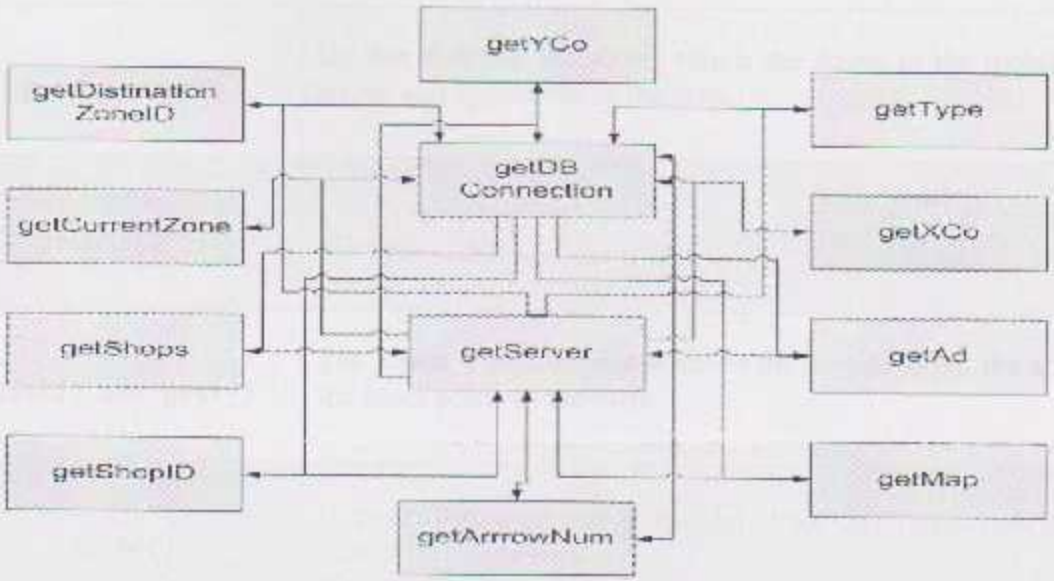

Figure 5.7: Server Functions.

Function	Objective
`getType()`	By this function the server brings all menu items then send it to the mobile.
`getShops()`	When user select one of the menu item this function bring the submenu items which is suitable to the menu item choose.
`getShopID()`	By this function the server bring the shop ID from the Database to know the suitable zone ID.
`getCurrentZone()`	By the power signals which read from the mobile server can determine the current zone by this function.
`getDestinationShopZone()`	When user select one of the submenu item this function determine the destination zone which suitable to the choice.

`getArrowNum()`	By this function the server return the arrow to the mobile, this arrow will appear above the map.
`getMap()`	The suitable map return to the mobile from the server due to the submenu choose.
`getX() and getY()`	The X and Y coordinates sends to the mobile to put the arrow in the exact point on the map.
`getAd()`	If there is new ad add to the data base this function bring and view it on the mobile.
`DBConnection()`	Creates a database connection, and retrieves the required data.
`Server()`	Setup the connection with the host server to all servlets .

Table 5.5: Server Functions.

5.2.6 Socket

A socket is one endpoint of a two-way communication link between two programs running on the network. A socket is bound to a port number so that the TCP layer can identify the application that data is destined to be sent.

Normally, a server runs on a specific computer and has a socket that is bound to a specific port number. The server just waits, listening to the socket for a client to make a connection request.

On the client-side: The client knows the hostname of the machine on which the server is running and the port number on which the server is listening. To make a connection request, the client tries to rendezvous with the server on the server's machine and port. The client also needs to identify itself to the server so it binds to a local port number that it will use during this connection. This is usually assigned by the system.

Figure 5.8: Connection request from client to serve.

If everything goes well, the server accepts the connection. Upon acceptance, the server gets a new socket bound to the same local port and also has its remote endpoint set to the address and port of the client. It needs a new socket so that it can continue to listen to the original socket for connection requests while tending to the needs of the connected client.

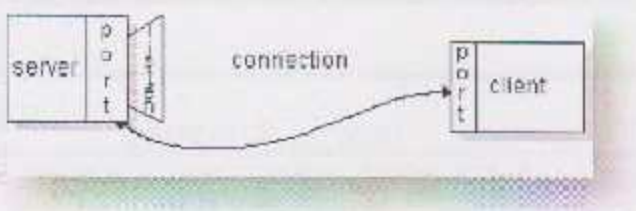

Figure 5.9: Connection required.

On the client side, if the connection is accepted, a socket is successfully created and the client can use the socket to communicate with the server.

5.2.7 Sequence Diagram

The following sequence diagram describes the connection between server and mobile in this project, figure 5.8 show this connection:

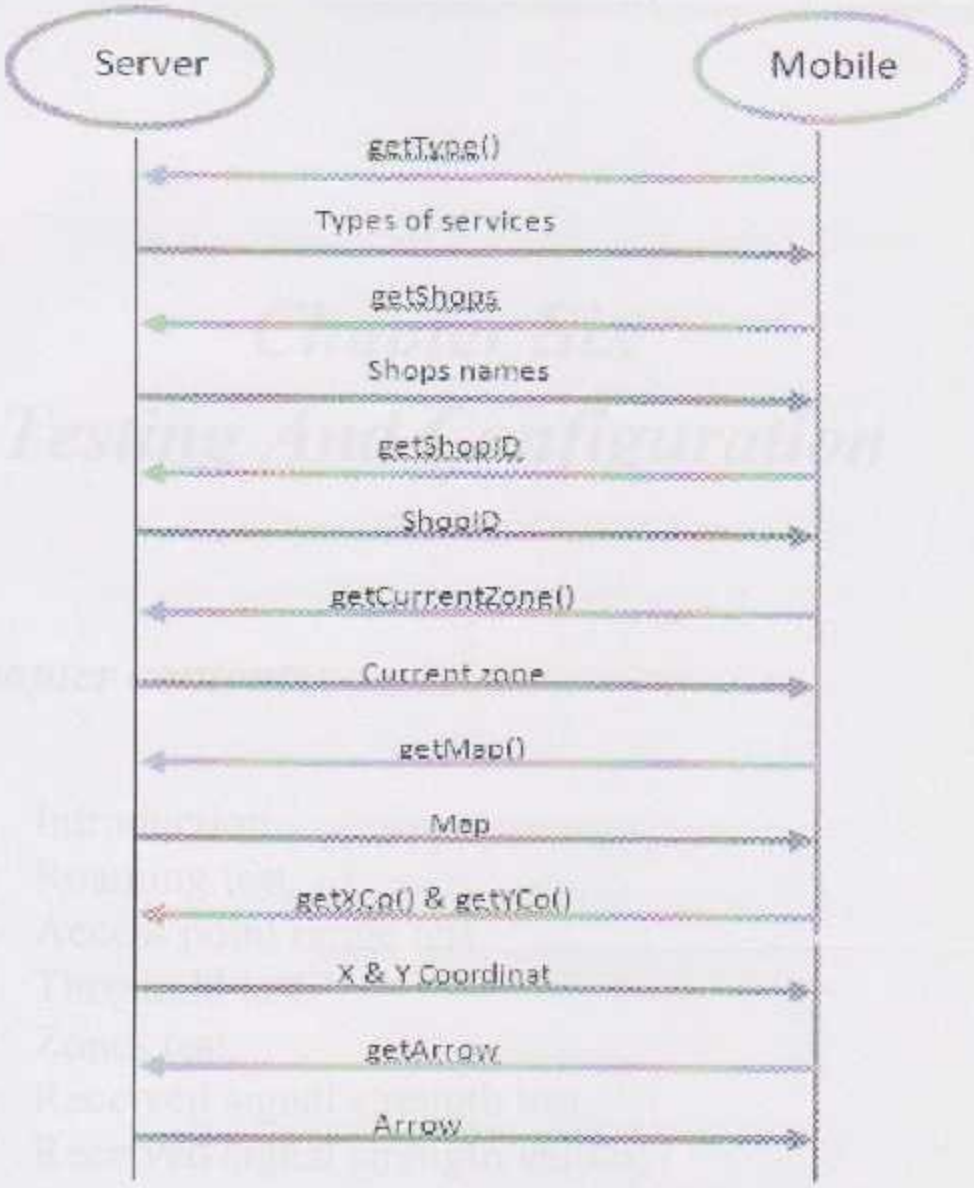

Figure 5.10: Sequence Diagram.

6

Chapter Six
Testing And Configuration

Chapter contents:

6.1 Introduction

In this chapter we have included all the practical issues associated with the project, that's included: roaming test, testing AP's range and signal strength, dividing zones at the floor and the codes which we used separately at first and then in group after.

In this chapter we have describe what we have done and what the results were.

6.2 Roaming test

To make sure that the roaming is working probably, first we have tested the roaming using Skype program. Installing the Skype program was done on the laptop and mobile phone, and then we initiated the connection, which stayed on while we were moving around within the B and B+ seventh floor, we as shows in figure 6.1.

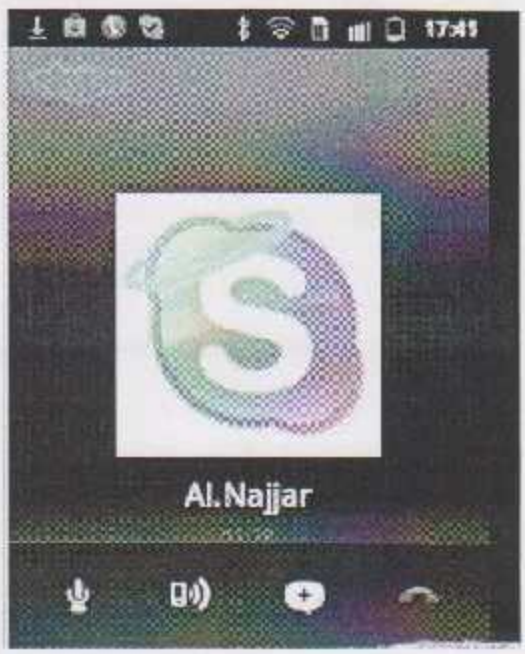

Figure 6.1: Roaming test using Skype program.

Second, after establishing the network connection we used the mobile phone to connect with the network and while moving from one place to another the mobile phone kept being connected to the network by changing MAC address to the AP .

figure 6.2 represent the second test, where the sign shows the mobile phone changing the AP but still connected to the same network.

Figure 6.2 :Roaming test using mobile phone.

6.3 Access point range test

To find out the range an AP can cover, we started up the mobiles application and then turned on the AP, and kept moving away from the AP to check the maximum distance the AP can cover, to find out that the radius is approximately 40 meter in each direction.

6.4 Threshold test

We knew the value of the threshold when the mobile phone change its connection from one AP to another within network, we do so by ,running the application and then taking the signals strength value in different places to find out that the threshold value was -82dB.

6.5 Zones test

At the beginning, we had distribute the AP's as planed on the floor, and by calculating the signal strength resulting from the AP's and with minimal interference (overlap), floor was divided into several areas as "Zones", which amounted to 25 Zones. As in the following figures:

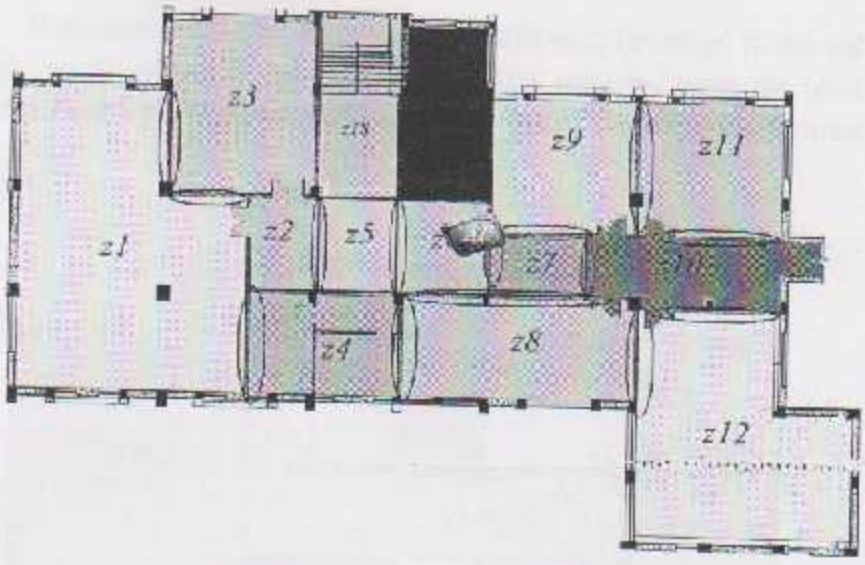

Figure 6.3 Distribution zone on floor 7B.

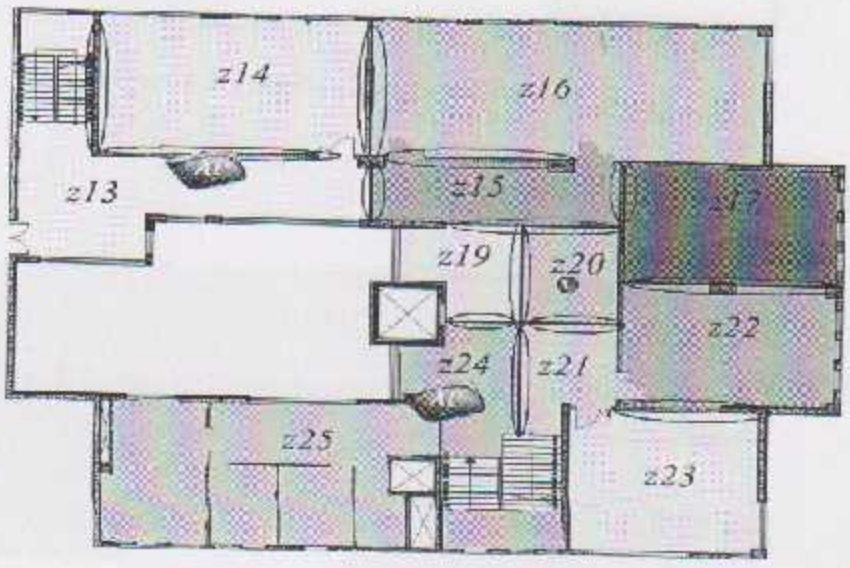

Figure 6.4 Distribution zone on floor 7B+.

However, this result showed the interference (overlap) in the values of signal strength, so we changed the locations of AP's until we have the least interference (overlap) Zones, which amounted to 9 Zones. As in the following figures:

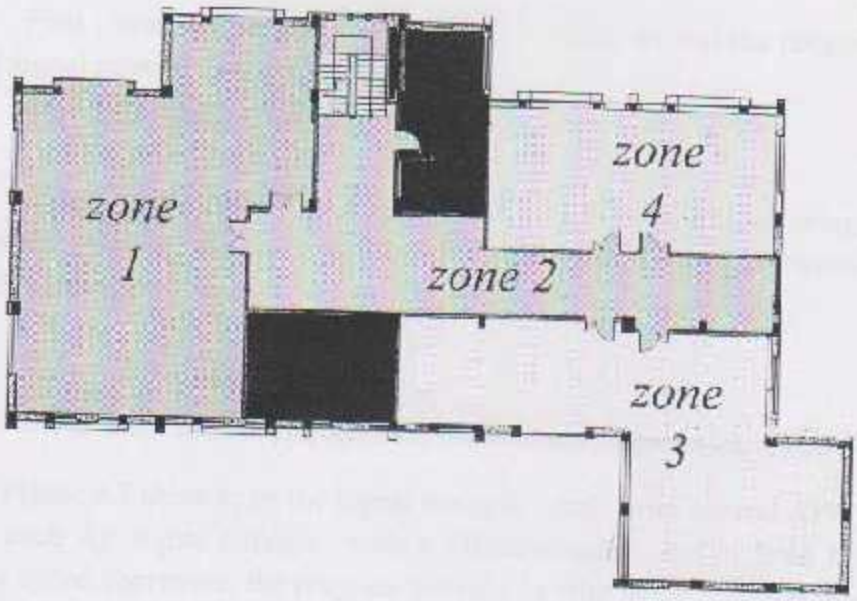

Figure 6.5: Distribution zone on floor 7B.

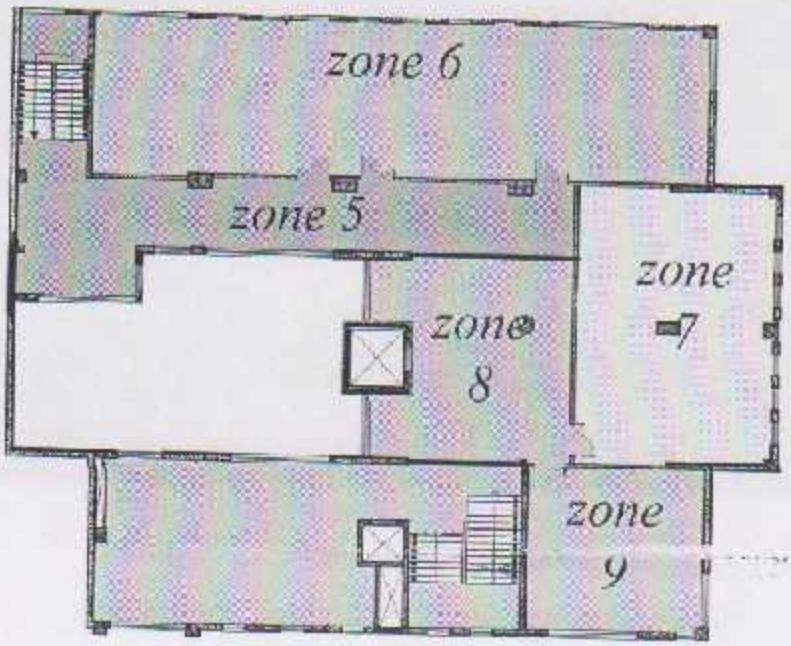

Figure 6.6: Distribution zone on floor 7B+.

6.6 Received signal strength test

We have measured the signal's strength values using two relative ways:

First , inssider program , after we run the program its start to record signal strength values for the read.

Second , the mobile phone application, which programmed using the Android application (Java) , the main purpose for this application is to measure the signal strength values.

Here is some pictures to illustrate the above:

Figure 6.7 show to us the signal strength reads from several AP's, the program shows each AP signal strength with a different color sorted from right to left to create a curve, moreover, the program provide us with average signal strength to each AP.

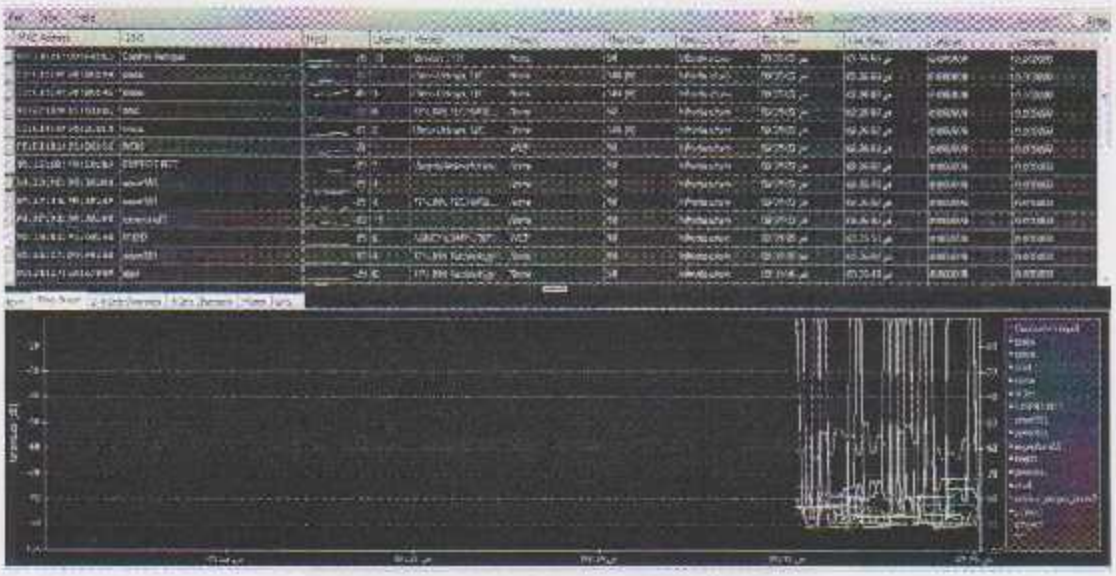

Figure 6.7: Measuring RSS using inssider program

Figure 6.8 and 6.9 show to us the signal strength reads using the mobile application, which demonstrate each AP signal strength.

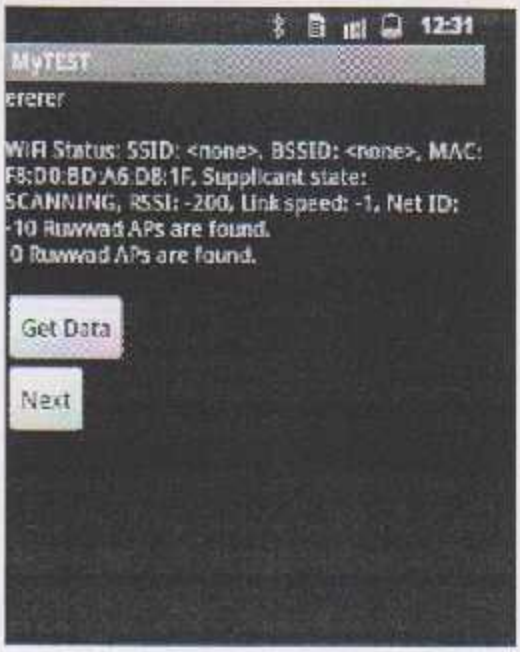

Figure 6.8: Measuring RSS using mobile phone.

Figure 6.9: Measuring RSS using mobile phone after

press Get data.

6.7 Received signal strength values

The Signal strength values at different AP's at the first stage where we divided the floor into 25 zone as flow in table 6.1:

zoneID	sig1Max	sig2Max	sig3Max	sig1Min	sig2Min	sig3Min
1	-77	0	0	-87	0	0
2	-83	-77	-59	-88	-82	-64
3	-78	0	0	-88	0	0
4	-74	-85	0	-84	-95	0
5	-85	-80	-55	-90	-85	-60
6	0	-83	-50	0	-88	-55
7	-84	-71	-59	-88	-76	-64
8	-78	-85	0	-88	-90	0
9	-74	-78	0	-84	-88	0
10	-80	-75	-63	-85	-80	-68
11	-82	-79	0	-92	-89	0
12	0	-80	0	0	-90	0
13	-65	-75	0	-75	-85	0
14	-78	0	0	-88	0	0
15	0	-62	-73	0	-67	-78
16	0	-83	-78	0	-93	-88
17	0	-85	-80	0	-95	-90
18	0	-87	-65	0	-92	-70
19	-64	-72	0	-69	-77	0
20	-64	-79	0	-69	-84	0
21	-55	-79	0	-60	-84	0
22	0	-88	-73	0	-98	-83
23	0	0	-79	0	0	-89
24	-52	-85	0	-57	-90	0
25	0	-84	-60	0	-94	-70

Table 6.1: RSS Values In First stage.

For example if the server read the values of the signal strength from the AP's respectively -80dB, 0dB and 0dB , the server will retrieve three zone, zone 1, 3 and 14 because of this overlap we not use this table in database.

While the Signal strength values at different APs at the final stage where we divided the floor into 9 zone as flow in table 6.3, this values has been taken using mobile phone application , this test has been repeated four times until we reach the most accurate values:

zoneID	sig1Max	sig2Max	sig3Max	sig1Min	sig2Min	sig3Min
1	-70	0	0	-85	0	0
2	-55	-66	0	-70	-81	0
3	-62	-79	0	-77	-84	0
4	-70	-75	0	-85	-80	0
5	-75	-49	-75	-90	-64	-80
6	0	-65	-70	0	-80	-85
7	0	-70	-65	0	-85	-70
8	0	-75	-45	0	-90	-60
9	0	0	-70	0	0	-85

Table 6.2: RSS Values In Final Stage.

For example if the server read the values of the signal strength from the AP's respectively -60dB, -74dB and -0dB , the server will retrieve only one zone, zone 2, this table give us accurate values of the signal strength with lowest interference .

6.8 Servlet test

Before doing the final test to the application we have tested each servlet alone, to be assured that all servlets are working properly.

Figure 6.10 shows one of these tests, we called the servlet getType which provide the correct values from the database, in this way we made sure that the servlet work properly.

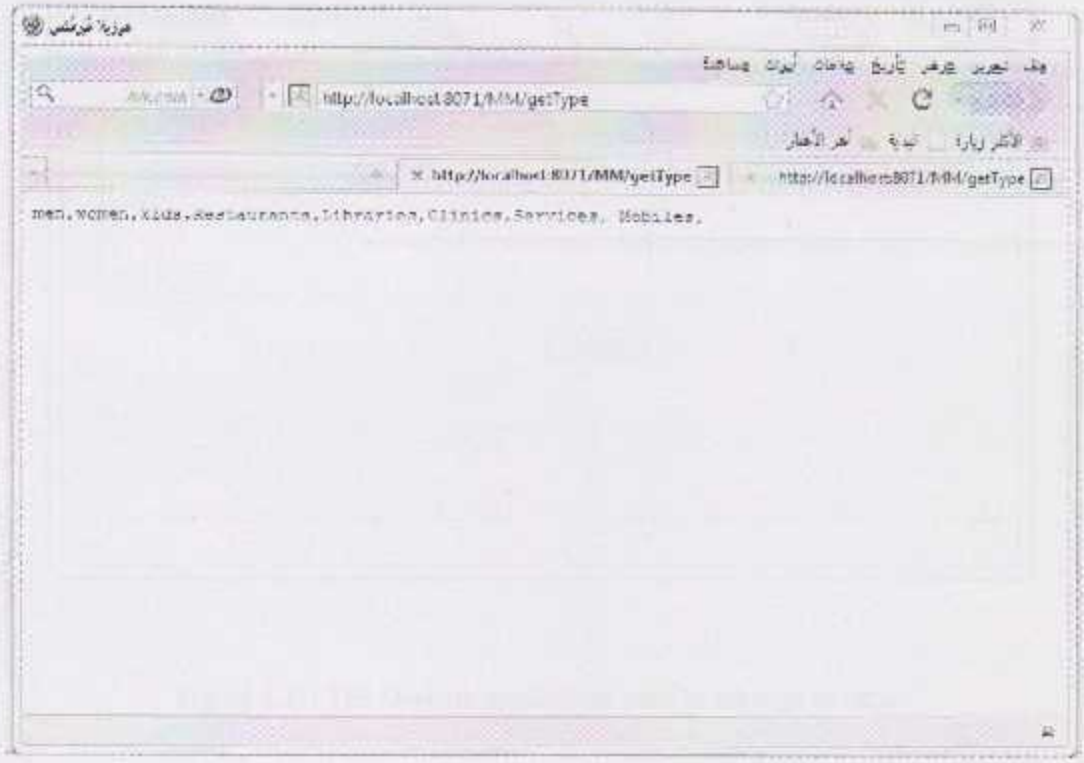

Figure 6.10 Get Type servlet test

6.9 Ads test

If any shop owners decide to do sale advertising, our platform is the best choose for him, where we can provide the service easily and cost effective. This can be done through a direct request to the administrator, who in his turn using a computer desktop application adds the advert as shown in figure 6.11. As a result, the advert will pop up on each user device-screen connected to the service for a short time as shown in figure 6.12. The advert shortly and automatically will be deleted allowing new ones to come.

Figure 6.11: The Desktop application used to manage adverts.

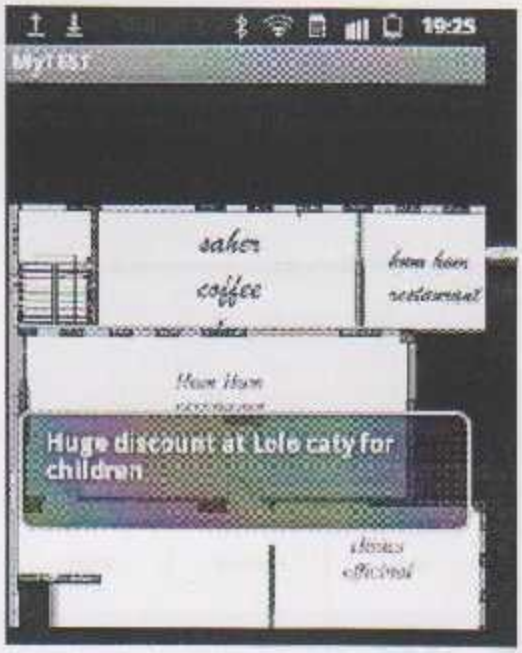

Figure 6.12: The advert appear on the mobile sides.

6.10 Final test

After we made sure that the network is established promptly , and the AP's where rightly placed, we ran the application from its web page as show in the figure 6.13, which started by showing us the menu, figures 6.14 and 6.15 show to us the main menu.

Figure 6.13: Download application page.

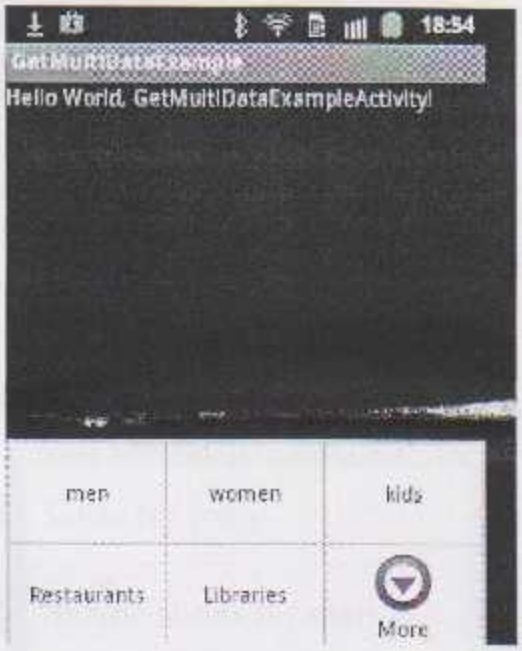

Figure 6.14 :The main menu.

Figure 6.15: The main menu when press more.

After we choose any choices from the main menu, submenu shows up, figure 6.16 show the submenu for the men shops.

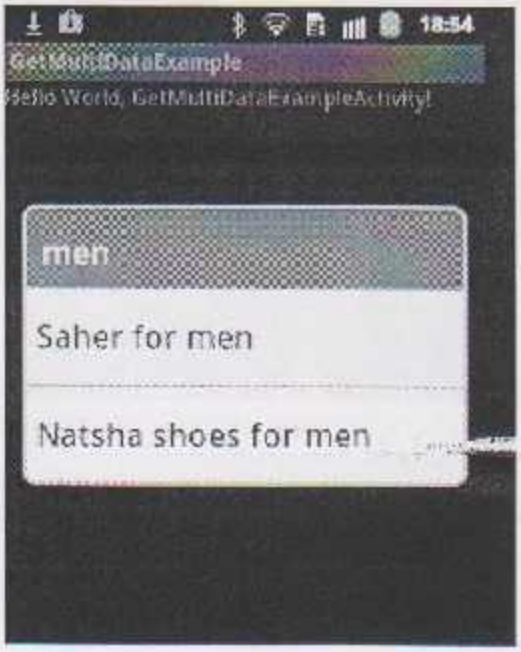

Figure 6.16: The submenu for men.

After we choose a choice from the sub menu, a map with arrows show up guiding us to the way we should take to reach our target (shop). Figure 6.17 and 6.18 show example of this process.

For example, if the user in jasmine center for women and he want to go to Saher for men ,after he press to have the menu and choose the men, and then choose his target from the sub menu the map will appear on the screen as shown in figure 6.17 , then arrow will appear guiding the user to the way he should take to reach his target as shown in figure 6.18, 6.19 and 6.20.

Arrow Direction and Map will change when move from one zone to another until reach the destination zone which contain the service the user need.

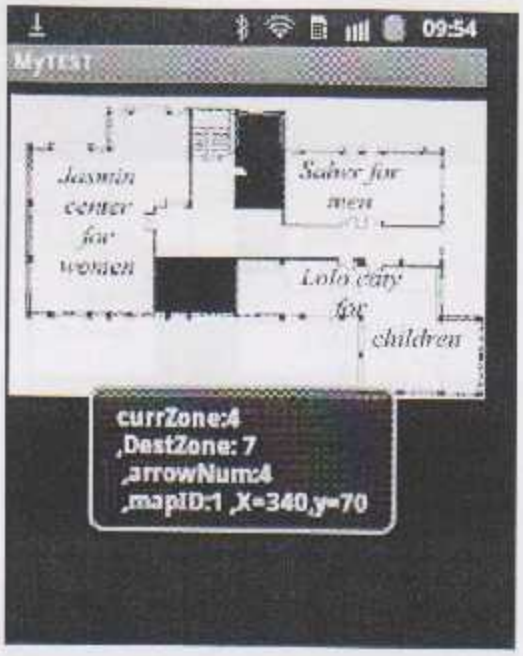

Figure 6.17 :The map appear on the mobile phone after the user choose from the sub menu.

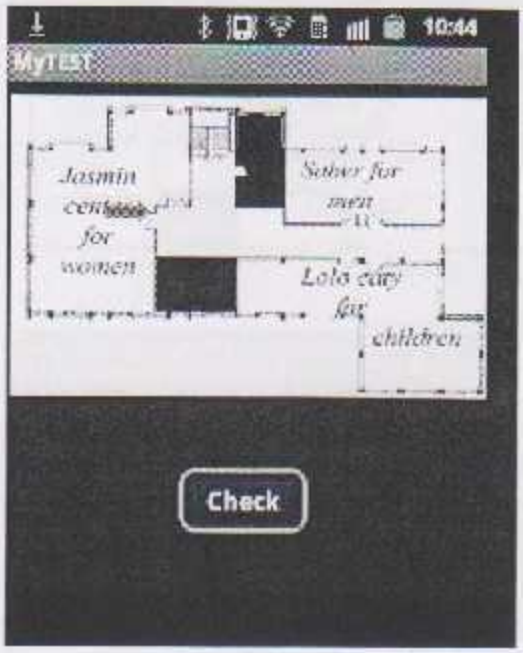

Figure 6.18: The arrow when it appear in the map.

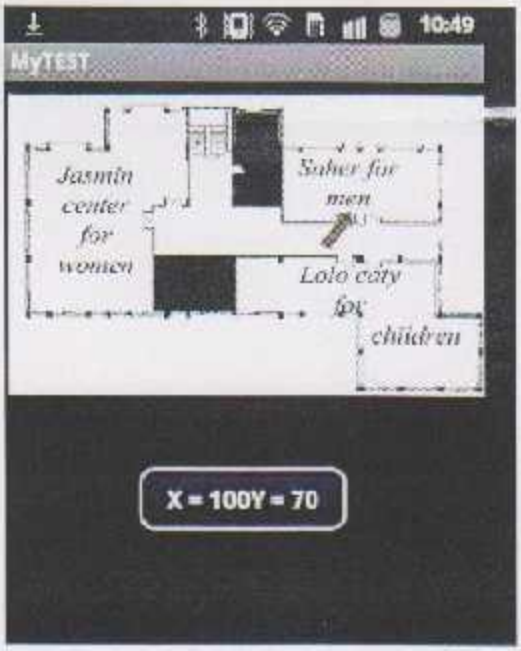

Figure 6.19: The arrow change when user change his place.

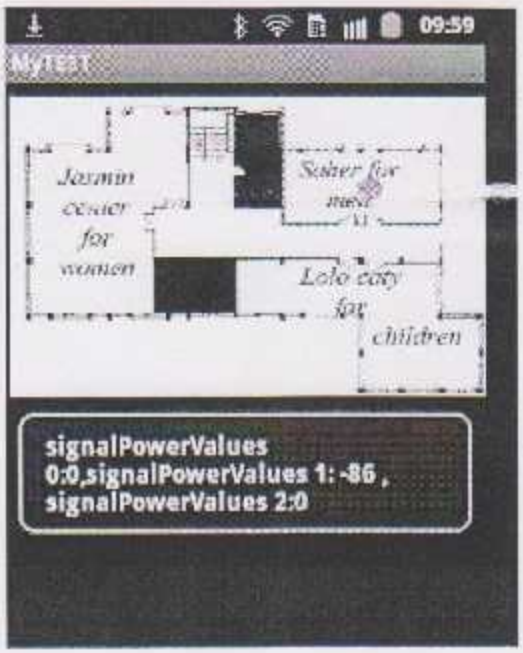

Figure 6.20:This arrow will appear when the user reach his target.

Appendix

cisco

Datasheet

Linksys E3000 | High Performance Wireless-N Router

Simultaneous Dual-Band (2.4 and 5 GHz)
Gigabit Ethernet (10/100/1000) Ports

Linksys E3000 | High Performance Wireless-N Router

From the worldwide leader in wireless networking

Features

- Give visitors simple and password-protected Internet access
- WPA, WPA2, and other enhanced security features
- Stream your stored multimedia to devices around your home
- Up to 300 Mbps wireless speeds*
- Gigabit Ethernet 10/100/1000 Mbps wired speed
- Extended wireless coverage for larger homes
- 5 GHz band avoids interference from 2.4 GHz wireless networks
- Connect and share USB storage throughout your home and over the Internet. Includes built-in UPnP AV media server
- Optimized for streaming HD video
- Optimized for wireless gaming

Specifications

Model Name	Linksys E3000
Description	High Performance Wireless-N Router
Model Number	E3000
Number of Antennas	6 Total, 3 Internal Antennas per Each 2.4 GHz and 5 GHz Radio Band
Detachable (Yes/No)	No
Modulation	802.11b: CCK, QPSK, BPSK 802.11g: OFDM 802.11a: OFDM 802.11n: BPSK, QPSK, 16-QAM, 64-QAM
Receive Sensitivity	2.4 GHz 11 Mbps: -87 dBm @ Typical 54 Mbps: -77 dBm @ Typical MCS15 (20MHz): -71 dBm @ Typical MCS15 (40MHz): -68 dBm @ Typical 5 GHz 54 Mbps: -74 dBm @ Typical MCS15 (20 MHz): -68 dBm @ Typical MCS15 (40 MHz): -65 dBm @ Typical
Antenna Gain in dBi	2.4 GHz: RIFA 1 and RIFA 2 and RIFA 3 <= 4 dBi (Typical) 5 GHz: RIFA 1 and RIFA 2 and RIFA 3 <= 3.5 dBi (Typical)
UPnP	Supported
Security Features	WEP, WPA, WPA2
Security Key Bits	Up to 128-Bit Encryption

Environmental

Dimensions	8.86" x 1.38" x 7.09" (225 x 35 x 180 mm)
Weight	15.94 oz (452 g)
Power	12V, 2A
Certification	FCC, IC, CE, Wi-Fi A/B/G/N
Operating Temperature	32 to 104°F (0 to 40°C)
Storage Temperature	-4 to 140°F (-20 to 60°C)
Operating Humidity	10 to 80% Noncondensing
Storage Humidity	5 to 90% Noncondensing

Minimum System Requirements

- **Internet Browser:** Internet Explorer 6, Safari 3, or Firefox 2 for Optional Browser-Based Configuration
- **PC:** Wireless Network-Enabled PC with CD or DVD Drive, Running Windows XP SP3, Windows Vista SP1, or Windows 7
- **Mac:** Wireless Network-Enabled Mac with CD or DVD Drive, Running OS X Tiger 10.4.11, Leopard 10.5.8, or Snow Leopard 10.6.1

Package Contents

- Linksys E3000 High Performance Wireless-N Router
- CD-ROM with Cisco Connect Software
- Ethernet Network Cable
- Power Adapter

*Theoretical performance for wireless is derived from IEEE Standard 802.11 specifications. Actual performance can vary, including lower wireless network capacity, data throughput rate, range and coverage. Performance depends on many factors, conditions and variables, including distance from the access point, volume of network traffic, building materials and construction, operating system used, mix of wireless products used, interference and other adverse conditions.

Specifications are subject to change without notice.

[illegible]

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Abbreviations		
1	Wi-Fi	Wireless Fidelity
2	LANs	Local Area Networks
3	WLAN	Wireless Local Area Network
4	IEEE	Institute of Electrical and Electronics Engineers
5	AP	Access Point
6	RP	Reference Points
7	PC	Personal Computer
8	RSS	Received Signal Strength
9	GPRS	General packet radio service
10	GSM	Global System for Mobile Communications
11	GNSS	Global Navigation Satellite System
12	GPS	Global Positioning System
13	TOA	Time- Of- Arrival
14	RF	Radio Frequency
15	PDAs	personal digital assistant
16	WEP	Wired Equivalent Privacy
17	FHSS	Frequency Hopping Spread Spectrum
18	DSSS	Direct Sequence Spread Spectrum
19	MIMO	Multiple-Input Multiple-Output
20	QOS	Quality Of Service
21	BSS	Basic Service Set
22	OFDM	Orthogonal Frequency Division Multiplexing
23	CCK	Complementary Code Keying
24	LOS	Line-Of-Sight
25	NLOS	No Line Of- Sight
26	BER	Bit Error Rate
27	PCMCIA	Personal Computer Memory Card International Association
28	USB	Universal Serial Bus
29	MAC	Media Access Control
30	ARP HTTP	Address Resolution Protocol Hyper Text Transfer Protocol.
31	MS	Mobile Station
32	ISP	Internet Service Provider
33	LWAP	Lightweight Access Point
34	SMS	Short Message Service
35	IDE	Integrated Development Environment
36	SDK	software development kit
37	Z	Zoon
38	GHz	Giga Hertz
39	MHz	Mega Hertz
40	MB/S	Mega Bit Per Second
41	DB	DataBase
42	ID	IDentification

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