

**CERTIFICATION OF APPROVAL**

Geographic Information System;  
Route Tracking System Using Personal Digital Assistant (PDA)

By

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Approved by,



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## CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgments, and that the original work contained herein has not been undertaken or done by unspecified sources or persons.



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RIZAWATI BINTI ROHIZAN

## ABSTRACT

Nowadays the mobile mapping which incorporation with handheld PDA devices for field data collection is rapidly expanding its wings of Geographic Information System (GIS). While the wireless technology is increasing through time, the usage of mobile GIS has become a very useful tool in any organizations and companies. The introduction of mobile technology actually has resulted in the fundamental paradigm which shifts into the integration of a centralized GIS database engine and other web presentation formats with the mobile data collection units. For mobile mapping, the lightweight GIS application ArcPad and small portable computers such as for example; the Compaq PocketPC are a viable option for field GIS. ESRI® ArcPad™ software is a mobile mapping and geographic information system (GIS) technology. Mobile computing is creating fundamental changes in the way we utilize geography with the ability to bring your work with you and interact directly with the world around you. Mobile GIS comprises the integration of four technologies: GIS, lightweight hardware, the global positioning system (GPS), and wireless communication. Here it emphasizes the research on the GIS, more on focusing on the GIS in the mobile environment. It presents the idea of applying GIS concept in tracking route where mobile GIS will combine up with GPS as a tracking movement coordinate tool. The Sashimi Model is used as a guidance to monitor the project progress. The methodology is suitable as it stresses on both side which is the requirement side and the implementation side. A simulation of route tracking system would be presented as the findings of the while research. Further more the simulation present the idea of the real-time tracking the route using data output from the GPS receiver.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Background of Study

Mobile mapping nowadays with its incorporation of handheld PDA devices for field data collection is a rapidly expanding field of GIS. While the wireless technology is increasing through time, the usage of mobile GIS is very useful in any organizations and companies. The introduction of mobile technology has resulted in a fundamental paradigm shift into the integration of a centralized GIS database engine and web presentation formats with mobile data collection units. The importance of implementing the location technologies is obviously useful in certain working environment, especially to university organization with large geographic area, University Technology Petronas as for the example, the tourism field and others.

From research there are huge interest in this emerging technology which comes from many different fields including Geology, Surveying, Business and Urban GIS, Biology, Disaster Management and Hydrology. It's not just concentrate on one area field, but open widely to other field to used the technology to fully utilized the benefit that it provide.

With the availability of this technology, mostly professionals look towards mobile platforms to increase productivity through efficient into handling which results in cost reduction and a well informed workforce, as well as faster, better decision making based on faster, better information .Further more the users of the client PDA interface required little or no training as the data entry tools provide simple and intuitive choices .No need for professional expertise to use the client PDA interface because of the easy



and simple interface, any level of education person can use it. Finally, the public consumers are provided with access to map- related information that is current, updated and available at any time. Fully access of the services since it created to be available for 24 hours and can be access at any current location.

There is an increasing future trend towards integrated, map-enabled internet-based GIS systems as well as mobile field data collection systems. Surveys have shown a trend of GIS application shifting from an operational support tool to a strategic decision support system.

Following the needs and after studying the potential utilization of transaction data from the server and client, location technologies and also with the emerging of the mobile devices, the author has stepped forward with a proposal to develop a system to meet this demand as call Route Tracking System (RTS).

## **1.2 Problem Statement**

### **1.2.1 Problem Identification**

Here the target user is the outsider which actually has a little knowledge about the university surrounding. And because of that situation basically the user does not know well the best route in the geographic environment that they are in, so the user intends to make mistake in determining the route to get to the places that the user supposes to go. The limitation of time frame here actually plays a major role. The user will definitely will lose lots of time in searching the route to go to the intended places. Further more, previously the user intends to take a long time or the wrong route to go to any particular places even though there still another available route to go there but unfortunately the user seems not to notice that particular route which can save the user time rather than wasted it and not to be in time.

Even though there are a web based system that are available in providing the services for searching the best route to go to one particular place but it still give a major problem to the user because the none usage of any wireless technology. Without the usage of the wireless technology it's still going to be wasteful because it still loses lots of time to go and search for any available network/internet access to be able to use the web service and find the exactly best route to go to that particular place.

### **1.2.2 Significant of Project**

A solution is needed to ease the user in obtaining the best route so the user can save time rather than wasting it by making a bad decision; to gain accurate and update map in real time based; and enabled for the user to have the information (map) available all the time.

## **1.3 Objectives and Scope of Study**

### **1.3.1 Objectives**

Objectives:

- i) To ease the user from the outside which are unfamiliar with the environment they have entered in reaching the intended place much faster and reliable by using the wireless equipment which is the PDA.
- ii) To help the user in making decision which route is the best to apply in order to reach the intended place in time.
- iii) To be able in saving time for the user

### **1.3.2 Scope of Study**

Scope of study would cover the definition establishing connection between the client and the server which is the PDA will act as client which gathers data from the personal laptop which acts as the server. And the servers will response to the request that had been made by the PDA and transmit the data request by the PDA through wireless connection.

It will also cover the function of the ArcPad and for the map-enabled section so that it can be view on the PDA. It also will cover the VB for the system to gather information from the client and communicate with the ArcPad software.

#### **1.3.2.1 Relevancy of Project**

Location technologies nowadays are expanding it wings in the information technologies field. Further more the mobile computing is creating fundamental changes in the way in utilize geography with the ability to bring the work with the user and interact directly with the world. Because of the high potential of mapping system, lots of organizations involve in it, to find a better solution in many areas such as the habitat studies, road pavement management and others.

#### **1.3.2.2 Feasibility of Project**

Actually, there are a lot of things that we can do with the ESRI® products such as involving in the field surveying, incident reporting & inspection tasks and others. It's a wide prospect an as far as the Final Year Project concerns, the project is only emphasis in providing the route solution in the UTP geographic area, and to demonstrate the capabilities of ArcPad and the VB in the transmission and receiving data and also viewing the map to the end user.

## **CHAPTER 2**

### **LITERATURE REVIEW AND /OR THEORY**

#### **2.1 Introduction To GIS (ArcPad) And Mobile Environment**

ArcPad is a mobile mapping and geographic information system (GIS) technology. It's providing database access, mapping, GIS and GPS integration to users out in the field via handheld and mobile devices. Further more, the data collection with ArcPad is fast and easy and significantly improved with immediate data validation and availability. ArcPAD is a part of the enterprise GIS solution and is integrated with ArcGIS™.

ArcPad support both image display which is vector and raster map, includes the ESRI's shapefiles and LizardTech's MRSID® imaging language formats. The data can be provided by the internet via wireless communication and the ArcPad also offer integration with an optimal GPS or differential global positioning system for real-time data capture.

There are many potential applications that can be implementing with the mapping system, such as:

- i) Street sign inventory
- ii) Power pole maintenance
- iii) Meter reading
- iv) Road pavement management
- v) Military fieldwork
- vi) Habitat studies

- vii) Toxic inventory
- viii) Crop Management
- ix) Property damage assessment
- x) Field surveying
- xi) Incident reporting & inspection

ArcPad can be used directly from an individual desktop or an organization enterprise formats. ArcPad uses vector data in industry-standard shapefile format and it's also support the following raster image format:

- i) JPEG
- ii) MrSID (compresses images)
- iii) Window® bit map (BMP)

Both formats can be combined but the limitations of it were the speed and memory capacity of the hardware it used. ArcPad also includes the wireless data acquisition. The data is downloaded to ArcPad using the TCP/IP connection such as wireless local area network, cellular phone/wireless modem.

## **2.2 New Generation of Mobile Solution in GIS Field**

GIS actually is in improving all sorts of operations in organizations through the usage of mobile and wireless technology. Further more GIS is expand in 3 major groups area such as information resources, process management system and real-time and location based services. Second area that GIS fall is the information resources equals which divided in to two, the mobile GIS, which is related to the growth of GIS in organization, in order to achieve better result, user need to do research on the architecture suitable in implement the GIS and improving productivity field, and also need to determine on how to integrate new mobile technology with existing system (support) while improve it.

Further more location based services benefit the distributed workers in achieving their intended result in their work field.

Nowadays the popularity of handheld PDA's once again altered the GIS world. The popularity of PDA's on the market, made the software and hardware companies keep by developing mobile GIS software. And there are two data collection software packages dominate the market which is ArcPad from ESRI, and TerraSyns from Trimble (GPS manufacture). Both are able to perform field data collection on PDA, either with or without an add-on GPS. It's also elaborate about the usage of images, transferring images size an others.

### **2.3 Mobile GIS Background, Components and Benefits**

With the availability of the mobile phones, laptop computer and personal digital assistants (PDA's) in the mobile devices fields, it's basically offers a myriad of options for improving communication across the organization and also with the customers and including all the trading partners and others. Because of the such "go-anywhere" gadgets which enable all the users to access the organization network from anywhere and at any time the technology is improving by time through time.

In accomplish the mobile GIS into a reality, the recent technologies advancement comes in handy such as the Global Positioning System (GPS) technology. Further more in a business environment the mobile GIS is a natural expansion of the business system. It's provides an entire workforce, from office-based analysts to field-based managers, with immediate access to the information ant any place and at any time. This function actually will result in faster achieving the intended solution and better decision. As real-time access becomes more of a reality, mobile GIS will use existing data for more sophisticated query and analysis operations.

There are 4 basic components of mobile GIS technology which is the client: mobile end-user devices, the location: position determining equipment, the network:

telecommunication service providers and the servers: GIS content provider. See figure 2.3.1 below for a view of the component of mobile GIS. But for the project it's only emphasis on the circle area only since it only for FYP project.

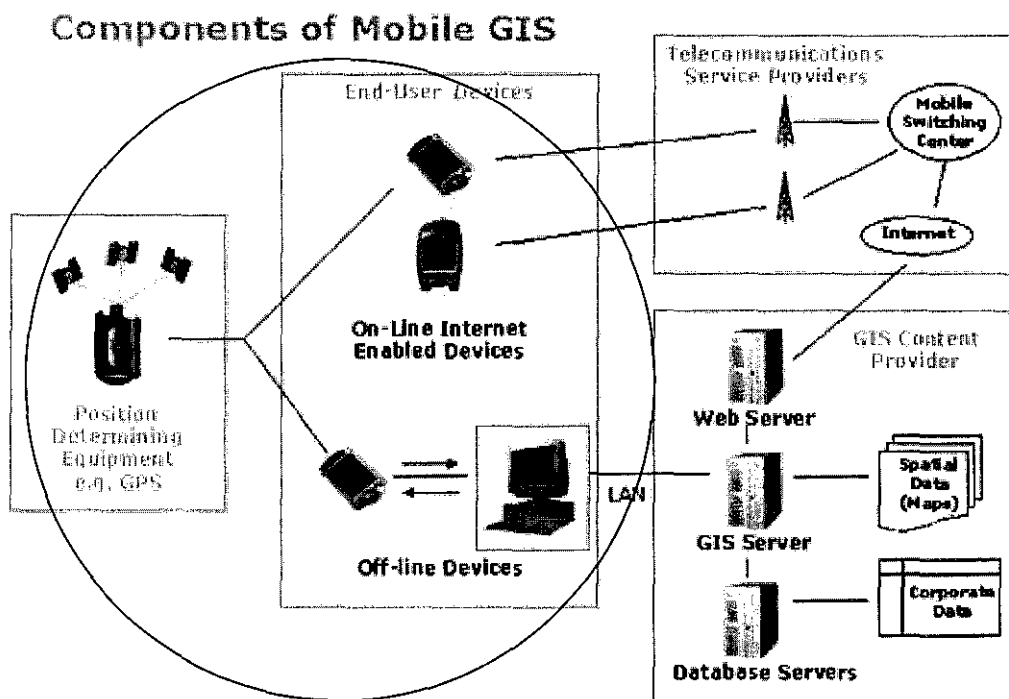


Figure 2.3.1: Mobile GIS Technology

For the position determining equipment (PDE) – the location (see figure above) the mobile GIS is usually coupled with Global Positioning System satellites (GPS) and wireless communication to facilitate exchanges between the existing spatial server and the mobile devices. While the mobile end-user devices – the client (see figure above), it's emphasis on the client devices utilized in the field. A full range of client devices can be used for mobile GIS from mainstream laptop computers with all the computing power of a PC to PDA or Pocket PCs with smaller screens to cellular telephones with even smaller displays, simple input devices and limited processing power. There are two main ways in access and use of GIS data and function through mobile and wireless devices which is the online, with real time access to service/corporate data and the offline, where data is downloaded and used without a real-time connection to a server/corporate database.

Then the telecommunication service providers- communication networks side (see figure above) which is the part of wire-line or wireless communication networks. The internet Enabled Devices relies on the wireless network to transport information. Further more different wireless networks have different transmission rates. Then the last is the GIS content provider – the server side (see figure above) where it's serves data and applications to the user for an example its offers location information content and information processing services. Typically a GIS content provider includes the GIS server (with GIS content), Information Processing Services and Gateway services.

There are few benefits of the usage of mobile devices such as:

- ✚ Increased productivity due to less driving
- ✚ Increased flexibility
- ✚ Improved accuracy of data
- ✚ Access to relevant datasets
- ✚ Smarter decision making
- ✚ Enhance field worker safety

Table 2.3.2, below are few of examples of different industries which apply the GIS application such as:

Industry	Example organizations:	Use Mobile GIS to:
<ul style="list-style-type: none"> <li>▶ Personal</li> </ul>	<ul style="list-style-type: none"> <li>▶ Consumers</li> <li>▶ Tourists</li> <li>▶ Vehicle Drivers</li> <li>▶ Specialist Sports</li> </ul>	<ul style="list-style-type: none"> <li>▶ Find and locate nearest services eg. pub, campsite etc.</li> <li>▶ View tourist / environmental maps and data</li> <li>▶ Interactive Tourist Venue Guides - maps instead of just Audio</li> <li>▶ In-car navigation systems</li> <li>▶ Track personal location</li> <li>▶ Vehicle tracking - report accidents, track stolen vehicles etc.</li> </ul>
<ul style="list-style-type: none"> <li>▶ Central Government</li> </ul>	<ul style="list-style-type: none"> <li>▶ Government Departments</li> <li>▶ Advisory Organizations</li> <li>▶ Regulatory Organizations</li> <li>▶ Umbrella Agencies</li> </ul>	<ul style="list-style-type: none"> <li>▶ Many of the uses in industries below</li> </ul>



	<ul style="list-style-type: none"> <li>‣ Semi-state companies</li> <li>‣ Information Agencies</li> </ul>	
‣ Emergency Services	<ul style="list-style-type: none"> <li>‣ Ambulance</li> <li>‣ Police</li> <li>‣ Fire</li> <li>‣ Emergency/Disaster Planning</li> <li>‣ Breakdown assistance &amp; recovery</li> </ul>	<ul style="list-style-type: none"> <li>‣ Emergency Response Systems - identify nearest vehicle and dispatch to site</li> <li>‣ Find destinations and display routes</li> <li>‣ Monitor progress from incident site</li> <li>‣ Gain real-time access to emergency / disaster data to enable better decision making.</li> <li>‣ Profile locations eg. Hazardous conditions / materials / environments</li> <li>‣ View plans of buildings.</li> <li>‣ Access historic incident data</li> </ul>
‣ Financial	<ul style="list-style-type: none"> <li>‣ Banks &amp; Building Societies</li> <li>‣ Financial Services and Agencies</li> <li>‣ Others</li> </ul>	<ul style="list-style-type: none"> <li>‣ Add/modify property details</li> <li>‣ Provide location-based consumer information on service locations / types</li> </ul>
‣ Healthcare	<ul style="list-style-type: none"> <li>‣ Health Authorities</li> <li>‣ National Disease Monitoring Agencies</li> <li>‣ Hospitals</li> <li>‣ Surgeries &amp; Doctors</li> <li>‣ Veterinarian Services</li> </ul>	<ul style="list-style-type: none"> <li>‣ Find / locate and route to cases</li> <li>‣ Log patient details and feed into national surveillance databases directly</li> <li>‣ Access patient and public health information real-time</li> </ul>
‣ Insurance	<ul style="list-style-type: none"> <li>‣ Property</li> <li>‣ Vehicle</li> </ul>	<ul style="list-style-type: none"> <li>‣ Add / modify graphics and data associated with road traffic accidents</li> <li>‣ Record property damage assessments in the field and update real-time</li> <li>‣ Access vehicle, building and policy information in the field</li> <li>‣ View environmental data in the field eg. flood risk</li> <li>‣ Track stolen vehicles</li> <li>‣ Monitor speed of insured drivers</li> <li>‣ Find nearest services based on location in case of breakdown</li> </ul>
‣ Local Government	<ul style="list-style-type: none"> <li>‣ Planning &amp; Development</li> <li>‣ Roads &amp; Traffic</li> <li>‣ Environment</li> <li>‣ Engineering &amp; Sanitary Services</li> <li>‣ Social &amp; Housing</li> </ul>	<ul style="list-style-type: none"> <li>‣ Find locations and view location-based data eg. Development plans, utilities etc.</li> <li>‣ Log survey data - conditions, incident locations, traffic counts etc.</li> <li>‣ Add / modify graphic and non-graphic data in the field eg assets, services, conditions etc.</li> <li>‣ View detailed plans &amp; proposals on site</li> <li>‣ Respond quickly to service</li> </ul>

		<ul style="list-style-type: none"> <li>requests</li> <li>‣ Route nearest personnel, vehicles and plant</li> <li>‣ Input customer information on-site</li> <li>‣ Manage vehicle clamping</li> </ul>
‣ Manufacturing	<ul style="list-style-type: none"> <li>‣ Food &amp; Drink</li> <li>‣ Pharmaceuticals</li> <li>‣ Others</li> </ul>	<ul style="list-style-type: none"> <li>‣ Access corporate data including customer details</li> <li>‣ Remote input of sales &amp; competitor data</li> <li>‣ Plan routes for multiple deliveries / visits and feed to field staff</li> <li>‣ View / Add / modify building and site layouts</li> <li>‣ Find items in warehouses</li> </ul>
‣ Property Management	<ul style="list-style-type: none"> <li>‣ Estate agents</li> <li>‣ Property developers</li> <li>‣ Land &amp; Property managers</li> <li>‣ Resource managers</li> </ul>	<ul style="list-style-type: none"> <li>‣ Find and view location information eg. Nearest school / zoning / new developments etc.</li> <li>‣ Add / modify property and asset data eg. Boundaries, condition etc.</li> <li>‣ Access and update location based environmental information eg. Habitat condition etc.</li> <li>‣ Update soil/crop conditions</li> </ul>
‣ Retail	<ul style="list-style-type: none"> <li>‣ Major retailers &amp; wholesalers</li> <li>‣ Chain shops &amp; stores</li> <li>‣ Specialist retailers - eg. motor, IT etc</li> <li>‣ Bars &amp; restaurants</li> <li>‣ Tourism, Leisure and Entertainment</li> </ul>	<ul style="list-style-type: none"> <li>‣ Sales force and delivery planning and routing</li> <li>‣ Input of sales and competitor data in the field</li> <li>‣ View / Add / modify property and asset information</li> <li>‣ Provide location-based consumer information eg. find nearest, on-line Yellow Pages etc.</li> </ul>
‣ Telecoms	<ul style="list-style-type: none"> <li>‣ Wireless (mobile) service providers</li> <li>‣ Fixed line service providers</li> </ul>	<ul style="list-style-type: none"> <li>‣ Find and locate assets and other information</li> <li>‣ Add / modify assets data</li> <li>‣ View customer details in the field</li> <li>‣ Monitor network statistics eg. Coverage condition.</li> <li>‣ Locate closest service crews, route service calls and update on progress</li> <li>‣ Download work schedules and work orders</li> </ul>
‣ Transport / Distribution	<ul style="list-style-type: none"> <li>‣ Transport planners</li> <li>‣ Public transport services</li> <li>‣ Private transport services</li> <li>‣ Distribution companies</li> </ul>	<ul style="list-style-type: none"> <li>‣ Vehicle tracking; real-time information systems eg. Trucks and taxis</li> <li>‣ Dispatch route planning and display of route and delivery details</li> <li>‣ Identify and feedback traffic conditions.</li> </ul>

		<ul style="list-style-type: none"> <li>‣ Add / modify field survey data eg. Conditions, incidents, traffic counts etc.</li> <li>‣ Record details on route eg. Road surface conditions.</li> </ul>
<ul style="list-style-type: none"> <li>‣ Utilities</li> </ul>	<ul style="list-style-type: none"> <li>‣ Electricity companies</li> <li>‣ Gas companies</li> <li>‣ Water companies</li> </ul>	<ul style="list-style-type: none"> <li>‣ Add / modify asset data and geometry</li> <li>‣ Record survey data eg condition, status etc.</li> <li>‣ Locate faults, and route closest or relevant service crews</li> <li>‣ View customer information</li> <li>‣ View location-based data eg. environmental conditions</li> <li>‣ Receive weather and traffic updates</li> </ul>
<ul style="list-style-type: none"> <li>‣ Other Industries</li> </ul>	<ul style="list-style-type: none"> <li>‣ Construction &amp; Engineering - architects, engineers etc.</li> <li>‣ Education organizations</li> <li>‣ Service companies - legal &amp; technical</li> <li>‣ Media organizations</li> <li>‣ Mining &amp; exploration companies</li> </ul>	<ul style="list-style-type: none"> <li>‣ Add/modify geometry and data in the field.</li> <li>‣ Schedule work</li> <li>‣ Share data in the field eg. design consultations</li> <li>‣ Find and view location-based data</li> <li>‣ Log survey data on location</li> <li>‣ Monitor field worker locations, conditions and progress</li> </ul>

Table 2.3.2: Example Industries which Apply GIS Technology

## CHAPTER 3

### METHODOLOGY/PROJECT WORK

#### 3.1. SYSTEM DEVELOPMENT LIFE CYCLE (SDLC): SASHIMI MODEL

The Sashimi Model of SDLC has been chosen as the system development strategy for this project. Refer to Figure below:

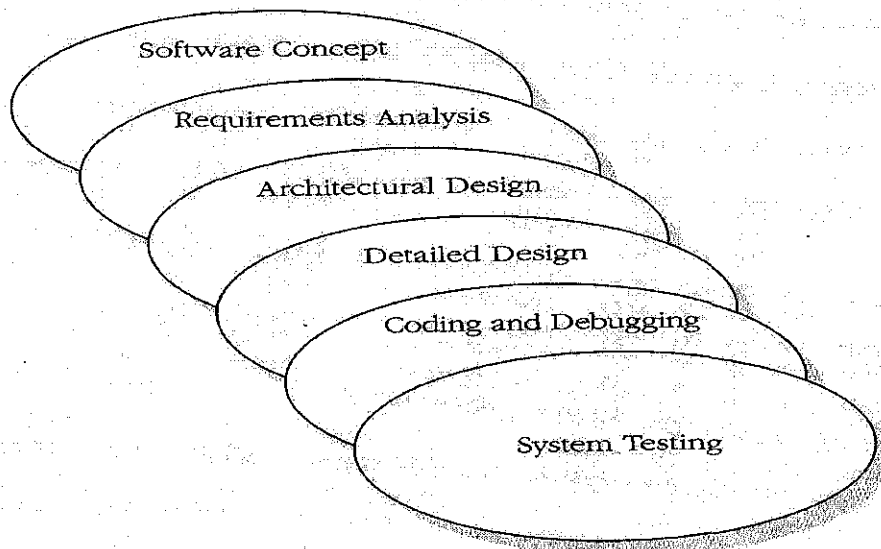


Figure 3.1.1: System Development Life Cycle (SDLC): Sashimi Model.

The Sashimi model is one of the variance of Pure Waterfall Model (PWC) and based on research there are two useful variance of Pure Waterfall Model which is Sashimi (overlapping model) and the Salmon (close to PWC with a mix of Spiral Model) and best suited for the project is the Sashimi model. The Sashimi model is best suited because the project involved with very detailed design framework and coding which can

be well done thoroughly all the steps involved in this type of SDLC model. Future more this kind of SDLC is suitable for a small and well define project.

**3.1.1. Software Concept/Definition**

This is the first stage in the Sashimi model which is the software concept/definition. It’s more alike the planning stage. In this stage, it’s involved the preliminaries activities such as establish the need for the systems, determine the scope of the project by understanding the clients needs and others. This understanding, combined with the advance of new mobile technologies, allows visualizing the complete end product or solution for the clients. In this stage, problem statements are very useful in order to help in analyze further all aspect occurred to develop the project in order to accomplish the desired solution. Further more, the project schedule is useful in analyze and organized all the timeline of the system development. Other than that, development tools which involved in this project also been identified, analyzed and installed. The development tools which is the software part and the hardware part are listed in the table below:

Software	<ul style="list-style-type: none"> <li>• MapObject2 – For integration with Visual Basic and ArcPad</li> <li>• Visual Basic – For programming purposes</li> <li>• ArcPad 6.0.3 – To develop the Map</li> </ul>
Hardware	<ul style="list-style-type: none"> <li>• PDA – For viewing purposes</li> <li>• Laptop/PC – For server and developing the system</li> <li>• Cable – To establish connection between the GPS and the Personal Computer / PDA</li> </ul>

	<ul style="list-style-type: none"> <li>• GPS equipment – TopCon / Leica product</li> </ul>
--	--

Table 3.1.1.1: Software and Hardware list

### 3.1.2. Requirement Analysis

A detailed definition of the system along with the system processes and dependencies is completed during this requirement analysis phase.

#### 3.1.2.1 Requirement Analysis Methodology

Internet surfing, journal and reference books are the methodologies being used to gather all the user requirements for this project

##### i) Journal and Reference Books

The journal and reference books is the main methodologies in the analysis stages and it's going to be used through out the development process of the project

##### ii) Internet Surfing

Internet surfing is the second main methodologies in the analysis stages and it's going to be used through out all the development process of the project.

### 3.1.3. Architectural Design

During this phase, the system and technology architecture for the solution is developed. The architecture for this project is as below:

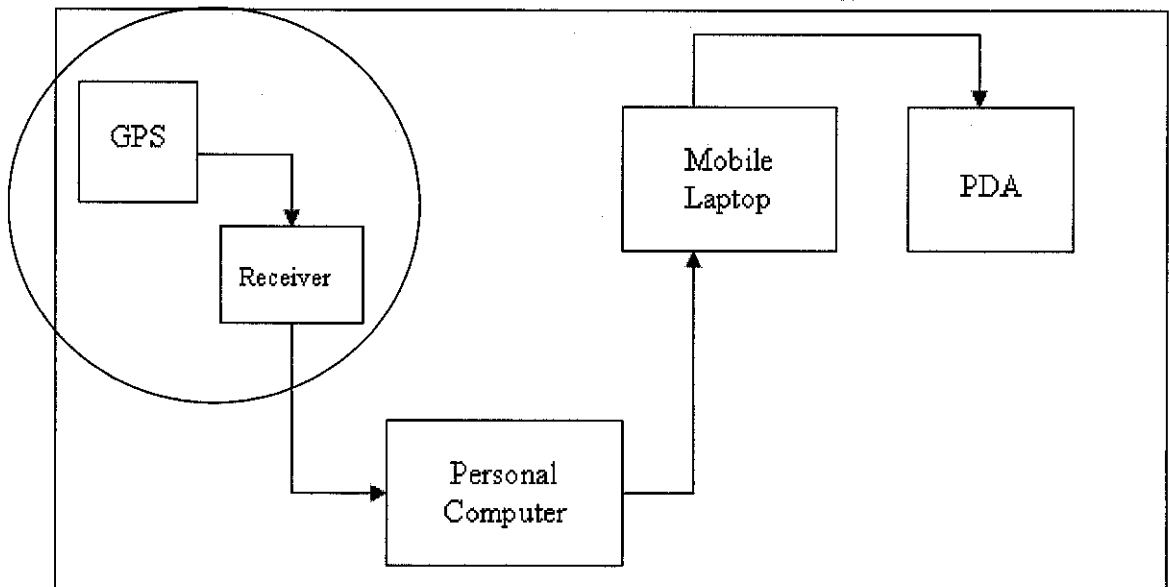


Figure 3.1.3.1: System Design

For the circle area, in this project the coordinate section is actually only simulation. It does not carry out based on real time basis. The design for this project is that after user sending request from the PDA to the system, the system actually retrieve coordinate from notepad based on the user request and send it to the mobile laptop. After that the mobile laptop will send the information and start plotting the coordinate that have been gathered previously in the PDA.

### 3.1.4. Detailed Design

#### 3.1.4.1 Detailed Design Methodology

The design involved in this phase is creating the ArcPad map, creating the VB to gather data from the user, send the request to the server, send data and communicate with the ArcPad in the PDA.

##### i) Create ArcPad Interfaces

For this section, it actually creates the map of Universiti Teknologi Petronas with the ArcPad software. This will include digitizing the map and creating the entire layer that are needed to make a complete map and can be viewed in the PDA.

### **ii) Create VB for Gathering and Integration Section**

The VB will be created for gathering user request; transmitting the data to the system which is the integration part and retrieving the simulation coordinate from notepad and start in plotting the coordinate in the ArcPad.

### **3.1.5. Coding & Debugging**

#### **3.1.5.1 Coding & Debugging Methodology**

For this phase, the developer testing is being used in testing the coding that has been applied in the VB.

#### **i) Developer Testing**

This will consists of primary debugging of the code that have been developed in VB and make sure that everything is working fine. And also detect the errors through all the working progress in completing the coding.

### **3.1.6. System Testing**

#### **3.1.6.1 System Testing Methodology**

There are two testing methodology being used through out the testing phase in the project.



### **i) Unit Testing**

All different components will be tested and debugged by area the PDA and the VB so that both of them can communicate and working accordingly to the original plan.

### **ii) Field Testing**

This component will test the final product after has resembled the entire component to ensure the availability of the information and the right information is being transferred to the user.

## CHAPTER 4

### RESULTS AND DISCUSSION

#### 4.1 Results

The results that have been gained through out the development of the system are shown in the figure 4.1.1 below: The figure briefly explains how the Route Tracking System (RTS) works.

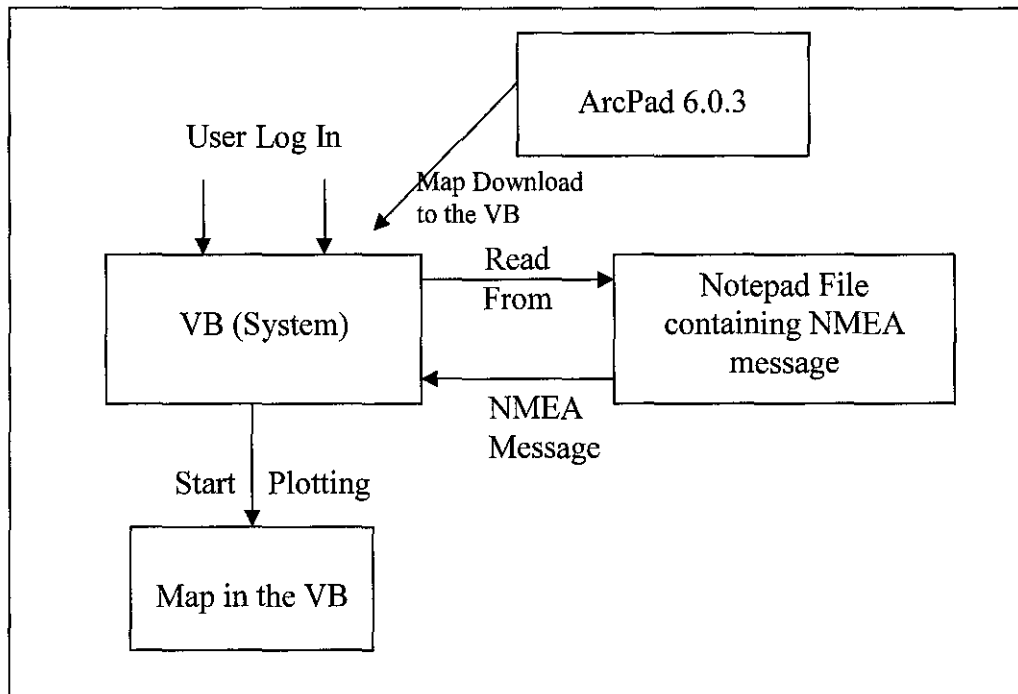
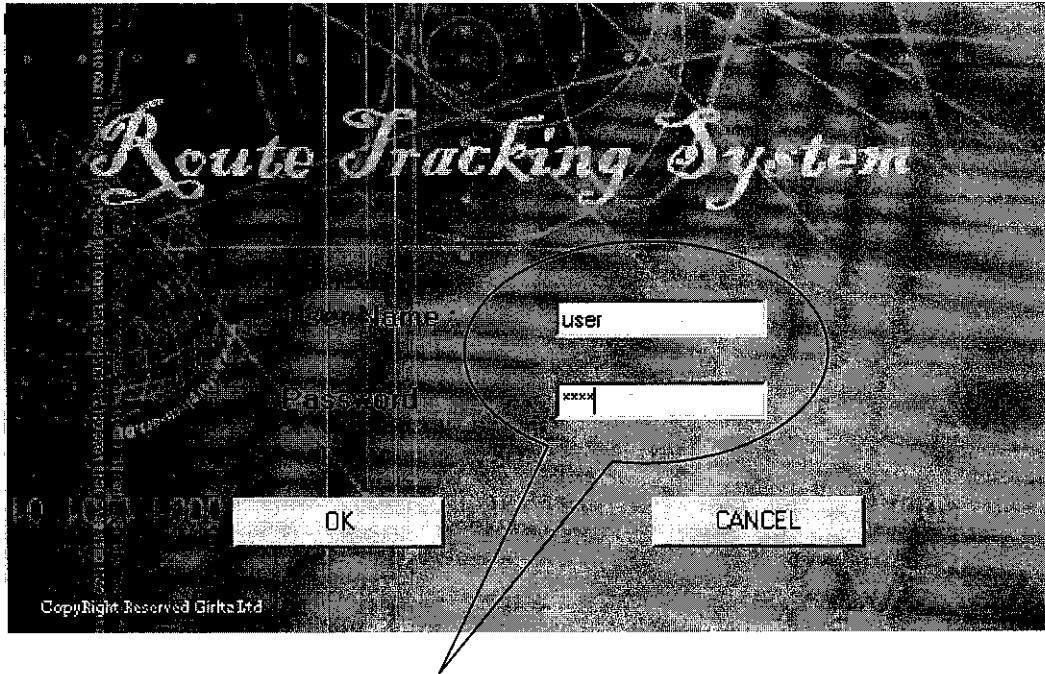


Figure 4.1.1: Conceptual data flow model

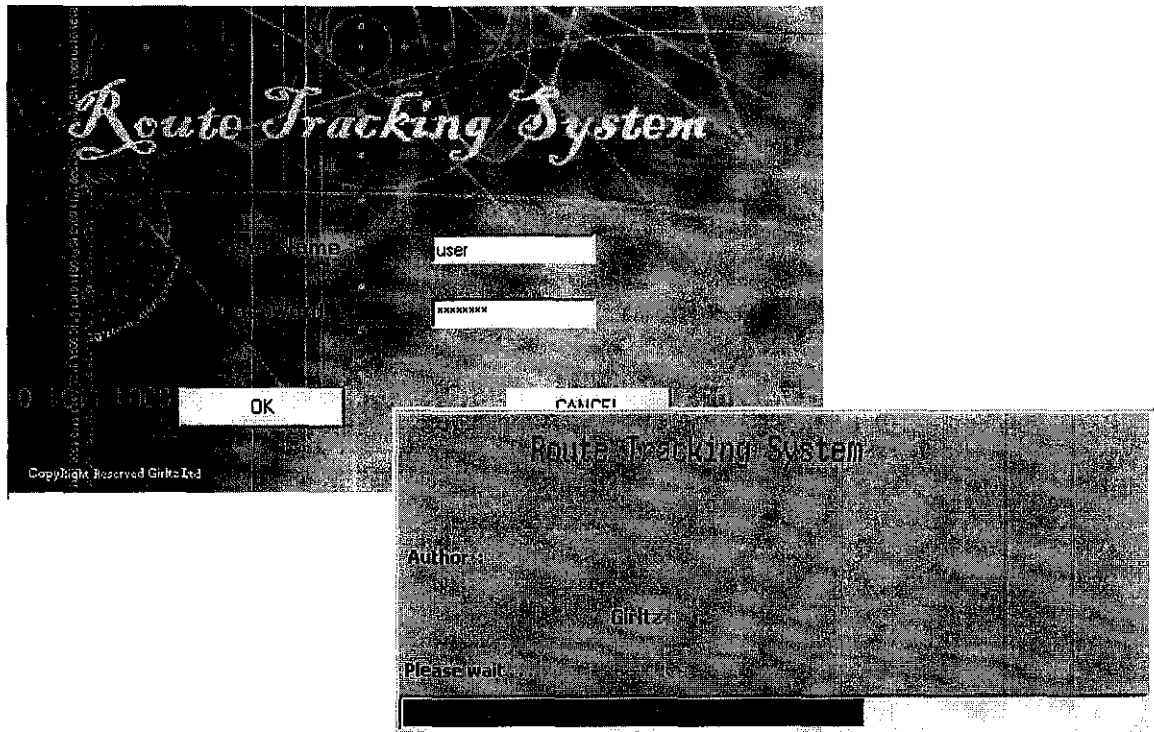
First section is the log in page where the user will log into the Route Tracking System (RTS) as the *“user”* and the password that entitled to the username is the *“password”*.

The username and the password will be given in the user manual which will be prepared with the system. After the user successfully logged into the system it will directly bring the user to the main page of the RTS system. The diagram below show the log in page (figure 4.1.2)



User enter the username and password

Figure 4.1.2: Log in Page for RTS System



4.1.3: Loading Page for the System

Above is the loading page after the user has entered the username and password to access the system (Figure 4.1.3).

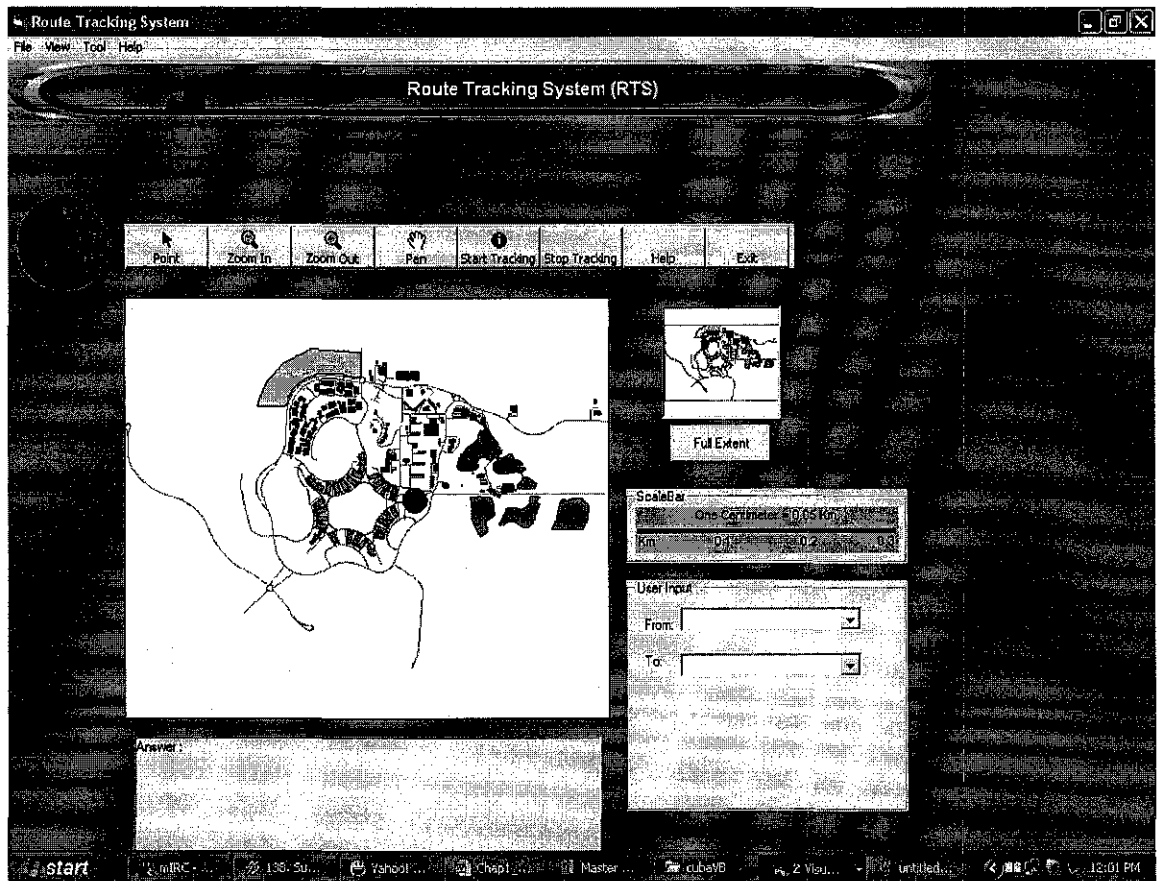
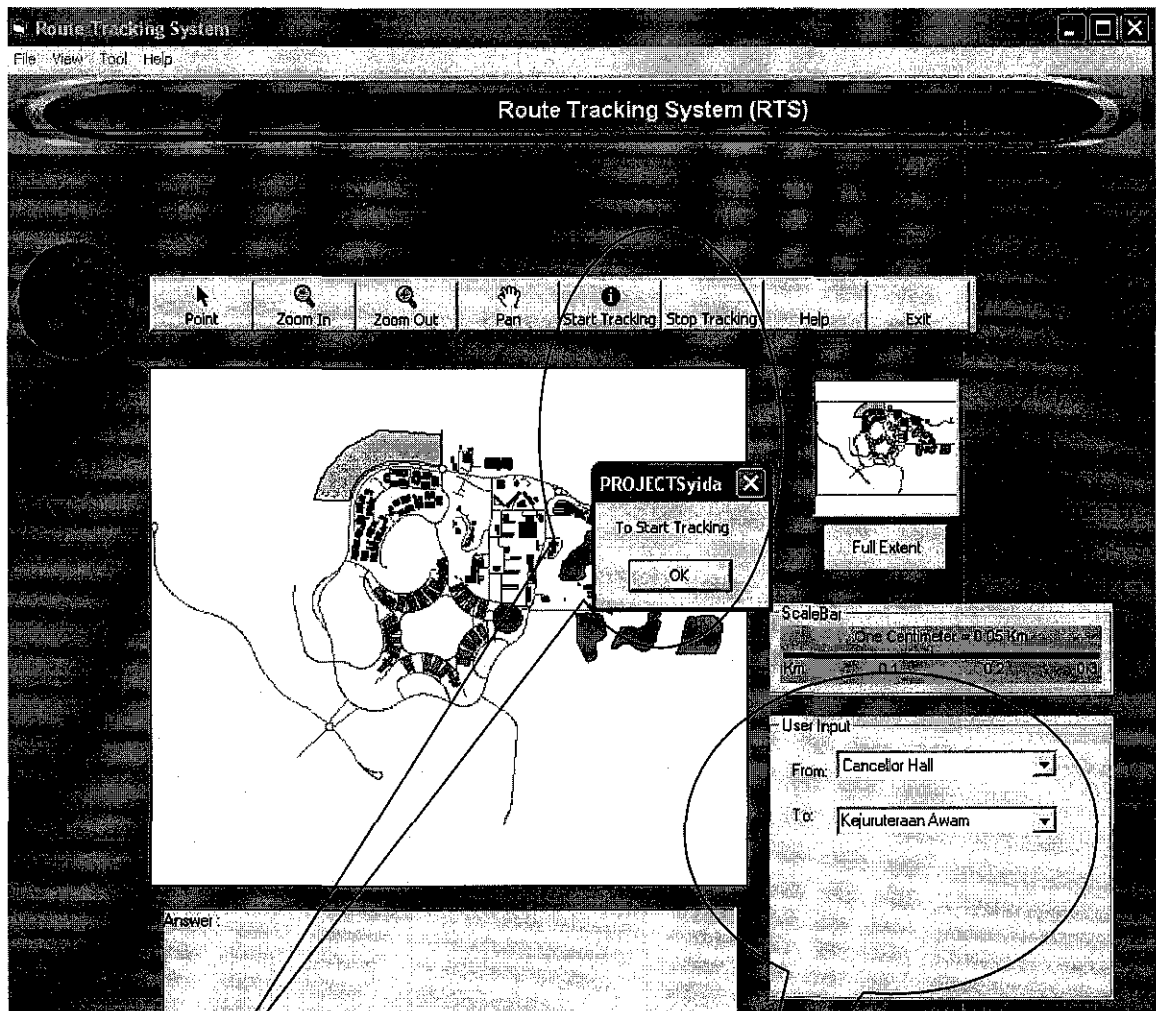


Figure 4.1.4: Main Page for the RTS System

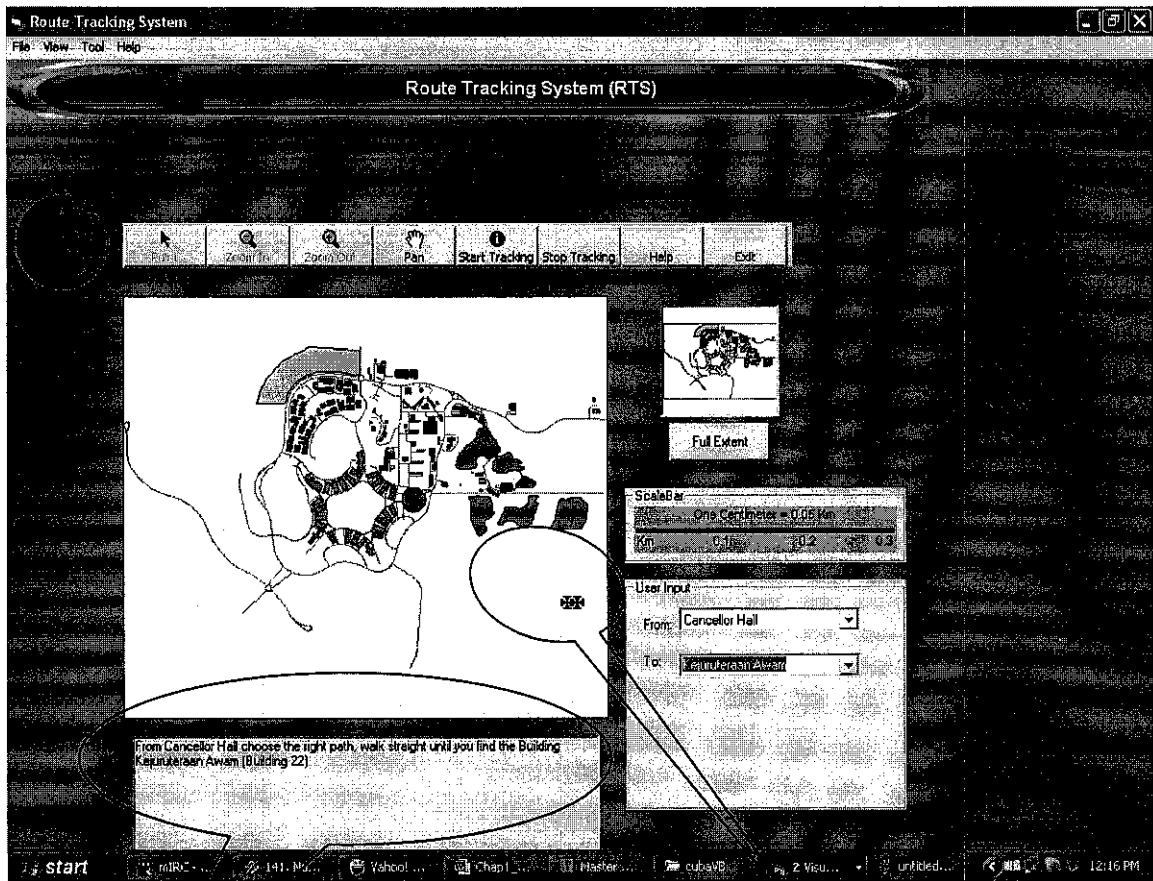
The diagram above is the main page for the RTS system (Figure 4.1.4). In that page the user will enter the input which the current location of the user and the location that the user are desired to seek for (Figure 4.1.5). After has determine the location the user will click the start tracking icon and the system will start tracking the route based on the GPS coordinate that have been retrieve from the notepad by the system (Figure 4.1.5). Here the GPS coordinate that are being used in the system are the dummies data and not the real times basis coordinate since the data are captured and being kept in the notepad to be read by the Visual basic and start plotting in the system.



User press the start tracking icon and it will prompt out the message box indicate it starting to track the coordinate retrieve from the notepad

User insert input

Figure 4.1.5: User input and the Start Tracking



Alternative solution given by providing the route in text

The blue point indicated the coordinate that have been read from the notepad

Figure 4.1.6: Example of the System Tracking Coordinate

The above diagram illustrates the system plotting the coordinate that have been read from the notepad by the system (Figure 4.1.6). After finished plotting the coordinate the system will provide the user with a solution in a text mode. It is for the user benefit if the user is not well in interpreting the map.

Below are the examples of the coordinate that have been saved in the notepad and being used by the system, figure 4.1.7:

```

GPSData1 - Notepad
File Edit Format View Help
$GPGGA,071014.00,422.88349,N,10057.87501,E,5,7,1.4,40.22,M,0.00,M,6.0001*78
$GPGGA,071015.00,422.88349,N,10057.87501,E,5,7,1.4,40.21,M,0.00,M,7.0001*78
$GPGGA,071016.00,422.88349,N,10057.87501,E,5,7,1.4,40.21,M,0.00,M,8.0001*77
$GPGGA,071017.00,422.88349,N,10057.87501,E,5,7,1.4,40.21,M,0.00,M,9.0001*77
$GPGGA,071018.00,422.88349,N,10057.87501,E,5,7,1.4,40.21,M,0.00,M,10.0001*40
$GPGGA,071019.00,422.88349,N,10057.87501,E,5,7,1.4,40.21,M,0.00,M,11.0001*40
$GPGGA,071020.00,422.88349,N,10057.87501,E,5,7,1.4,40.22,M,0.00,M,12.0001*49
$GPGGA,071021.00,422.88348,N,10057.87500,E,5,7,1.4,40.22,M,0.00,M,13.0001*4A
$GPGGA,071022.00,422.88348,N,10057.87500,E,5,7,1.4,40.21,M,0.00,M,14.0001*4D
$GPGGA,071023.00,422.88348,N,10057.87500,E,5,7,1.4,40.20,M,0.00,M,15.0001*4C
$GPGGA,071024.00,422.88348,N,10057.87500,E,5,7,1.4,40.20,M,0.00,M,16.0001*48
$GPGGA,071025.00,422.88348,N,10057.87500,E,5,7,1.4,40.20,M,0.00,M,17.0001*48
$GPGGA,071026.00,422.88349,N,10057.87501,E,5,7,1.4,40.21,M,0.00,M,10.0001*4D
$GPGGA,071027.00,422.88349,N,10057.87501,E,5,7,1.4,40.21,M,0.00,M,11.0001*4D
$GPGGA,071028.00,422.88349,N,10057.87501,E,5,7,1.4,40.21,M,0.00,M,12.0001*41
$GPGGA,071029.00,422.88349,N,10057.87501,E,5,7,1.4,40.22,M,0.00,M,13.0001*42
$GPGGA,071030.00,422.88349,N,10057.87500,E,5,7,1.4,40.22,M,0.00,M,14.0001*4C
$GPGGA,071031.00,422.88348,N,10057.87500,E,5,7,1.4,40.23,M,0.00,M,15.0001*4C
$GPGGA,071032.00,422.88348,N,10057.87500,E,5,7,1.4,40.22,M,0.00,M,16.0001*4D
$GPGGA,071033.00,422.88348,N,10057.87500,E,5,7,1.4,40.23,M,0.00,M,17.0001*4C
$GPGGA,071034.00,422.88348,N,10057.87500,E,5,7,1.4,40.23,M,0.00,M,18.0001*4A
$GPGGA,071035.00,422.88348,N,10057.87500,E,5,7,1.4,40.23,M,0.00,M,19.0001*4A
$GPGGA,071036.00,422.88349,N,10057.87502,E,5,7,1.4,40.21,M,0.00,M,8.0001*76
$GPGGA,071037.00,422.88349,N,10057.87502,E,5,7,1.4,40.21,M,0.00,M,9.0001*7E
$GPGGA,071038.00,422.88349,N,10057.87502,E,5,7,1.4,40.22,M,0.00,M,10.0001*42
$GPGGA,071039.00,422.88349,N,10057.87502,E,5,7,1.4,40.22,M,0.00,M,11.0001*42
$GPGGA,071040.00,422.88349,N,10057.87502,E,5,7,1.4,40.22,M,0.00,M,12.0001*4F
$GP2:01 AM 9/28/2003:01 AM 9/28/2003GGA,071041.00,422.88349,N,10057.87502,E,5,7,1.4,40.22,1
$GPGGA,071042.00,422.88349,N,10057.87501,E,5,7,1.4,40.22,M,0.00,M,14.0001*48

```

```

GPSData2 - Notepad
File Edit Format View Help
$GPGGA,071014.00,5902.88349,N,4008.87501,E,5,7,1.4,40.22,M,0.00,M,6.0001*78
$GPGGA,071015.00,5882.88349,N,4108.87501,E,5,7,1.4,40.21,M,0.00,M,7.0001*78
$GPGGA,071016.00,5872.88349,N,4208.87501,E,5,7,1.4,40.21,M,0.00,M,8.0001*77
$GPGGA,071017.00,5862.88349,N,4258.87501,E,5,7,1.4,40.21,M,0.00,M,9.0001*77
$GPGGA,071018.00,5862.88349,N,4408.87501,E,5,7,1.4,40.21,M,0.00,M,10.0001*40
$GPGGA,071019.00,5862.88349,N,4508.87501,E,5,7,1.4,40.21,M,0.00,M,11.0001*40
$GPGGA,071020.00,5852.88349,N,4608.87501,E,5,7,1.4,40.21,M,0.00,M,12.0001*49
$GPGGA,071021.00,5832.88348,N,4708.87500,E,5,7,1.4,40.22,M,0.00,M,13.0001*4A
$GPGGA,071022.00,5822.88348,N,4808.87500,E,5,7,1.4,40.21,M,0.00,M,14.0001*4D
$GPGGA,071023.00,5812.88348,N,4908.87500,E,5,7,1.4,40.20,M,0.00,M,15.0001*4C
$GPGGA,071024.00,5802.88348,N,5008.87500,E,5,7,1.4,40.20,M,0.00,M,16.0001*48
$GPGGA,071025.00,5832.88348,N,5108.87500,E,5,7,1.4,40.20,M,0.00,M,17.0001*48
$GPGGA,071026.00,5842.88349,N,5208.87501,E,5,7,1.4,40.21,M,0.00,M,10.0001*4D
$GPGGA,071027.00,5802.88349,N,5308.87501,E,5,7,1.4,40.21,M,0.00,M,11.0001*4D
$GPGGA,071028.00,5752.88349,N,5408.87501,E,5,7,1.4,40.21,M,0.00,M,12.0001*41
$GPGGA,071029.00,5722.88349,N,5508.87501,E,5,7,1.4,40.22,M,0.00,M,13.0001*42
$GPGGA,071030.00,5702.88349,N,5608.87500,E,5,7,1.4,40.22,M,0.00,M,14.0001*4C
$GPGGA,071031.00,5692.88348,N,5708.87500,E,5,7,1.4,40.23,M,0.00,M,15.0001*4C
$GPGGA,071032.00,5672.88348,N,5808.87500,E,5,7,1.4,40.22,M,0.00,M,16.0001*4D
$GPGGA,071033.00,5662.88348,N,5908.87500,E,5,7,1.4,40.23,M,0.00,M,17.0001*4C
$GPGGA,071034.00,5651.88348,N,6008.87500,E,5,7,1.4,40.23,M,0.00,M,18.0001*4A
$GPGGA,071035.00,5651.88348,N,6108.87500,E,5,7,1.4,40.23,M,0.00,M,19.0001*4A

```

Figure 4.1.7: GPS coordinate in the notepad

Below is the example of one coordinate from the GPS (Figure 4.1.8). The coordinate that have been taken by the system to plot it is the latitude.



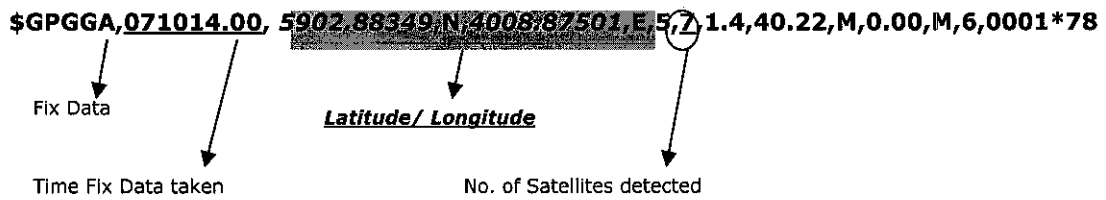


Figure 4.1.8: GPS coordinate

The whole maps of the Universiti Teknologi Petronas environment are shown as below, figure 4.1.9:

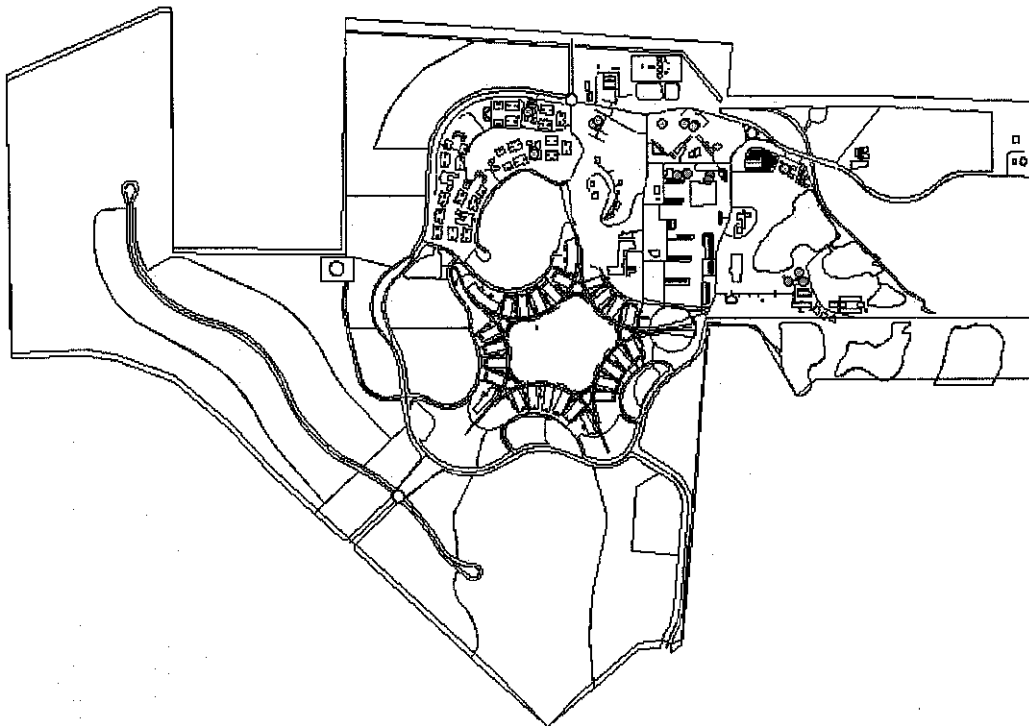


Figure 4.1.9: Map

## 4.2 Discussion

For this project questionnaires session has also been conducted to see the outsider reaction to the system that going to be developed either it is helping the user or just troubling the users. Below are the result of the survey that have been conducted (figure 4.2.1) in the beginning of the project development and basically from the survey it shows the user opinion about the RTS system. From the chart it proves that the system is actually helping the user in understanding the UTP environment and can easily find the route there needed. Briefly from the survey it can indicate that the system is very useful tools to be implemented in the future to ease the outsider in understanding the environment there are in. So that they do not confront any difficulty in reaching the places that they are searching for. And the result that they can achieve by using the system is much faster rather than wasting their precious time in searching manually. Since the percentage of yes is only 65% from overall, the system need to be analyzes again so that the percentage can move up. Then it can strongly prove that the system is preferable to use by the entire user. This can be done by making the system as user friendly as can be. System which the user can understand in how to use it, provide help function and so on to ease the user when using the system.

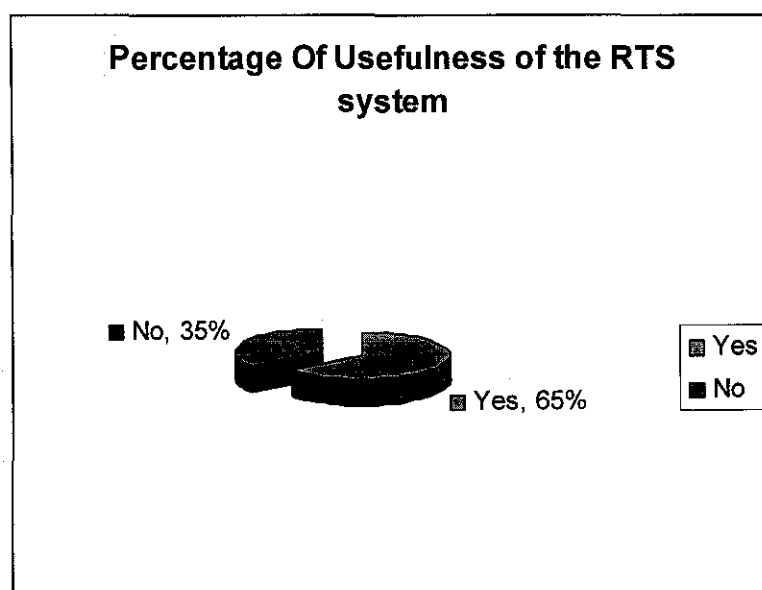


Figure 4.2.1: Questionnaires

About the PDA which is the hardware section, research had been made since that the since PDA has two major branches. So has to identify which one meet the requirement for the project. The two major branches are the Palm Top and the Pocket PC. Even though both of them are PDA but there are running in separate platforms. Which is the Palm Tops generally run Palm OS, while the Pocket PC runs on the famous Microsoft Windows CE/Pocket PC 2003. Here the Palm OS takes up less memory and run faster. In the other hand, Pocket PC easily support color display, graphics, miniaturized Windows packages such as Word and Excel, and other devices such as built-in MP3 player or MPEG movie player.

There are many brands and model of PDA available in the markets which fit the system requirement. There are such Sony, DELL, Hewlett Packard, Tungsten, HP and others. The system requirements for ESRI ArcPad 6.0.3 are listed in the table 4.2 below:

CATEGORY	REQUIREMENTS
Operating System	<ul style="list-style-type: none"> <li>➤ Pocket PC, Pocket PC 2002, and Pocket PC 2003</li> <li>➤ Windows CE 2.11,2.12 and 3.0</li> <li>➤ Windows CE.NET (CE 4.x)</li> <li>➤ Windows 95/98/2000, Windows NT and Windows XP</li> </ul>
CPU Chips for Windows CE	<ul style="list-style-type: none"> <li>➤ Hitachi SH3 and SH4</li> <li>➤ XScale</li> <li>➤ StrongARM</li> <li>➤ MIPS</li> <li>➤ X86</li> </ul>
GPS Protocol Supported	<ul style="list-style-type: none"> <li>➤ NMEA (National Maritime Electronics Association)</li> <li>➤ TSIP (Trimble)</li> <li>➤ DeLorme Earthmate</li> </ul>

	➤ Rockwell PLGR GPS binary protocol
--	--

Table 4.2.2: ESRI ArcPad 6.0.3 system requirement.

In using the ArcPad 6.0.3 the programming language that are most suitable to communicate with it are the VB. VB can communicate with both the notepad and the ArcPad 6.0.3 since there is difficulty in finding the ArcPad Studio which is another ESRI product which help in customizing the form directly and much more easy. Further more during the development of the system there are some problem that need to be faced during the development of the system which is that the implementation of tracking route movement in real time requires the GPS receivers and the PDA as the main hardware component. So because of the difficulties is making it real time basis, the system is based on simulation rather that requires data based on real time basis.

## **CHAPTER 5**

### **CONCLUSION AND RECOMMENDATION**

#### **5.1 Conclusion**

The integration of a mobile field mapping system with a centralized GIS server and a map-enabled, location – based web delivering such as Arc Pad, provides a powerful system for data management and strategic decision making. Mobile mapping with its incorporation of handheld PDA devices for field data collection is a rapidly expanding field of GIS.

While wireless technology will increase the usefulness of mobile GIS in the future, it is not an essential component for the successful operation of mobile GIS now. However, as the technologies improve, wireless data transfer speeds are increasing to levels where real-time data integration and dissemination will be reality.

The simulation project is able to demonstrate the power of GPS coupled up with a mobile device such as PDA. This paper actually shown that hardware and software trends play major role in making mobile GIS a reality in the country.

## **5.2 Recommendation**

Here several aspects have been identified as possible future expansions of the project. First is that suggested to involve the actual physical connection between the GPS and the PDA, along with the full customization of ArcPad 6.03 to uncover the potential of such software which is with the ArcPad Application Builder. Also for the main feature for collecting data, updating attribute with GPS should be explored more. Creating points, lines and polygons in the field at real-time should well tackle so it can make full use of the plotting function of ArcPad 6.0.3.

Widen the RTS function such as providing with more user friendly function such as the Map Tips which provide the area name when the users point the mouse at the map. Also provide the function to calculate the distance between one location to another for better making decision by the user itself.

Further more full understanding and research should be well acquired before the official commencement of the project, so can avoid possibilities of lack resources and materials, lack of knowledge or expertise in certain area, causing the shortening of development time frame.

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6. Any suggestions for ROUTE TRACKING SYSTEM?

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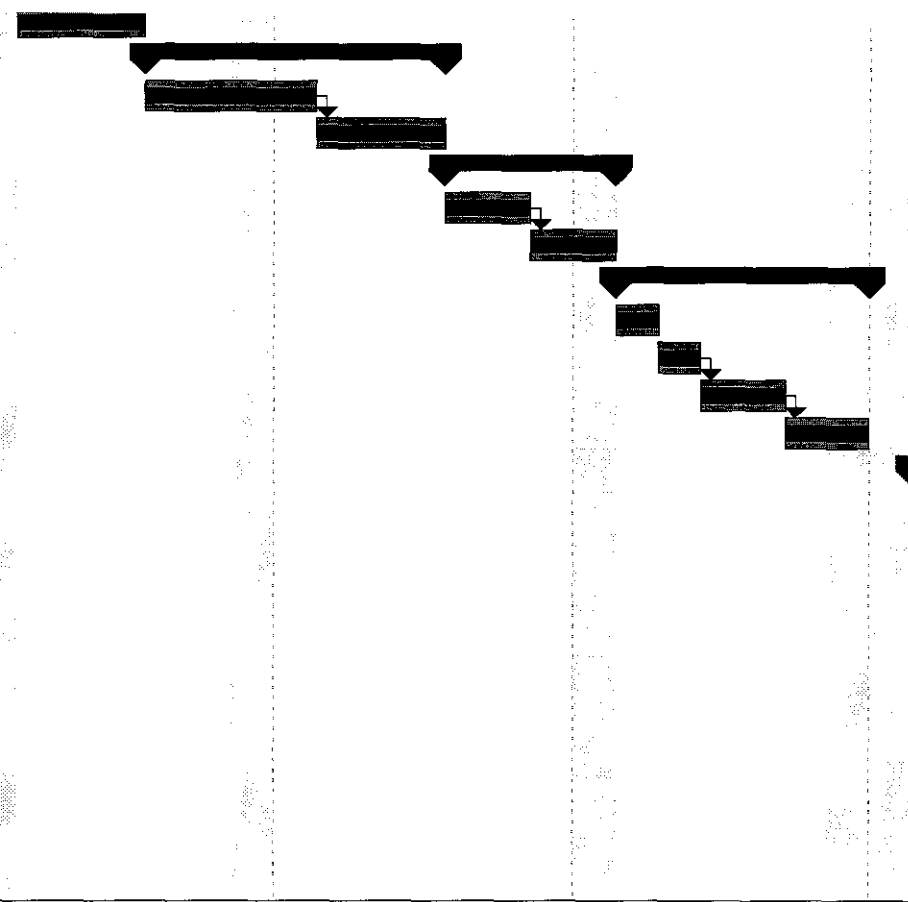
7. From your observation, what are the navigation facilities that you can see around UTP New Academic Building that may help you to navigate around the area?

Sign Board

Map stand

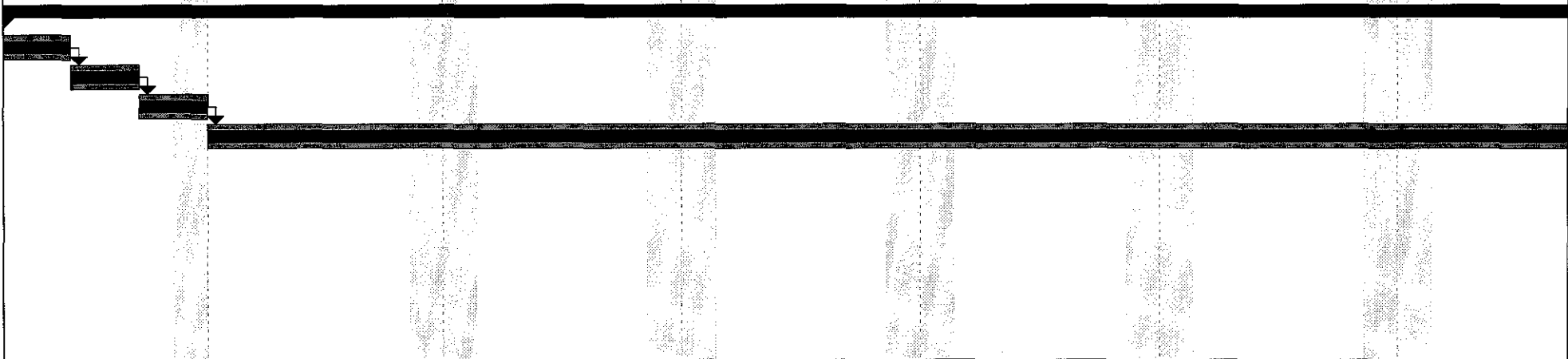
*Thank you for your cooperation.*










2	✓	understand problem statement	3 days?	Mon 7/19/04
3	✓	<b>Requirement Analysis</b>	<b>6 days?</b>	<b>Thu 7/22/04</b>
4	✓	Information requirement	3 days?	Thu 7/22/04
5	✓	sampling and investigating data	3 days?	Mon 7/26/04
6	✓	<b>Architectural Design</b>	<b>3 days?</b>	<b>Thu 7/29/04</b>
7	✓	find the solution from the problem	2 days?	Thu 7/29/04
8	✓	plan the suitable system	1 day?	Sat 7/31/04
9	✓	<b>Detailed Design</b>	<b>5 days?</b>	<b>Mon 8/2/04</b>
10	✓	Identify objective of the project	1 day?	Mon 8/2/04
11	✓	Analyze system needs	1 day?	Tue 8/3/04
12	✓	Analyze user needs	2 days?	Wed 8/4/04
13	✓	Analyze how to build system	1 day?	Fri 8/6/04
14		<b>Coding &amp; Debugging</b>	<b>83 days?</b>	<b>Mon 8/9/04</b>
15	✓	Accomplish logical design	2 days?	Mon 8/9/04
16	✓	Create storyboard	2 days?	Wed 8/11/04
17	✓	Create process flow	1 day?	Fri 8/13/04
18	■	Develop the system	78 days?	Sun 8/15/04
19		<b>System Testing</b>	<b>5 days</b>	<b>Mon 11/29/04</b>
20	■	Test the system (to track errors/problems)	5 days	Mon 11/29/04
21		<b>Implementation</b>	<b>3 days?</b>	<b>Mon 12/6/04</b>
22	■	Introduce the system to the users	2 days?	Mon 12/6/04
23		Train the users on how to use the system	1 day	Wed 12/8/04
24		<b>Submit Final Dissertation</b>	<b>8 days?</b>	<b>Thu 12/9/04</b>
25	■	Submit Final Draft	8 days?	Thu 12/9/04



Project: PROJECT GANTT CHART FI  
Date: Mon 12/13/04

Task	■	Milestone	◆	External Tasks	■
Split	.....	Summary	▬	External Milestone	◆
Progress	▬	Project Summary	▬	Deadline	↓



Project: PROJECT GANTT CHART FI Date: Mon 12/13/04	Task 	Milestone 	External Tasks 
	Split 	Summary 	External Milestone 
	Progress 	Project Summary 	Deadline 

Project: PROJECT GANTT CHART FI  
Date: Mon 12/13/04

Task



Milestone



External Tasks



Split



Summary



External Milestone



Progress

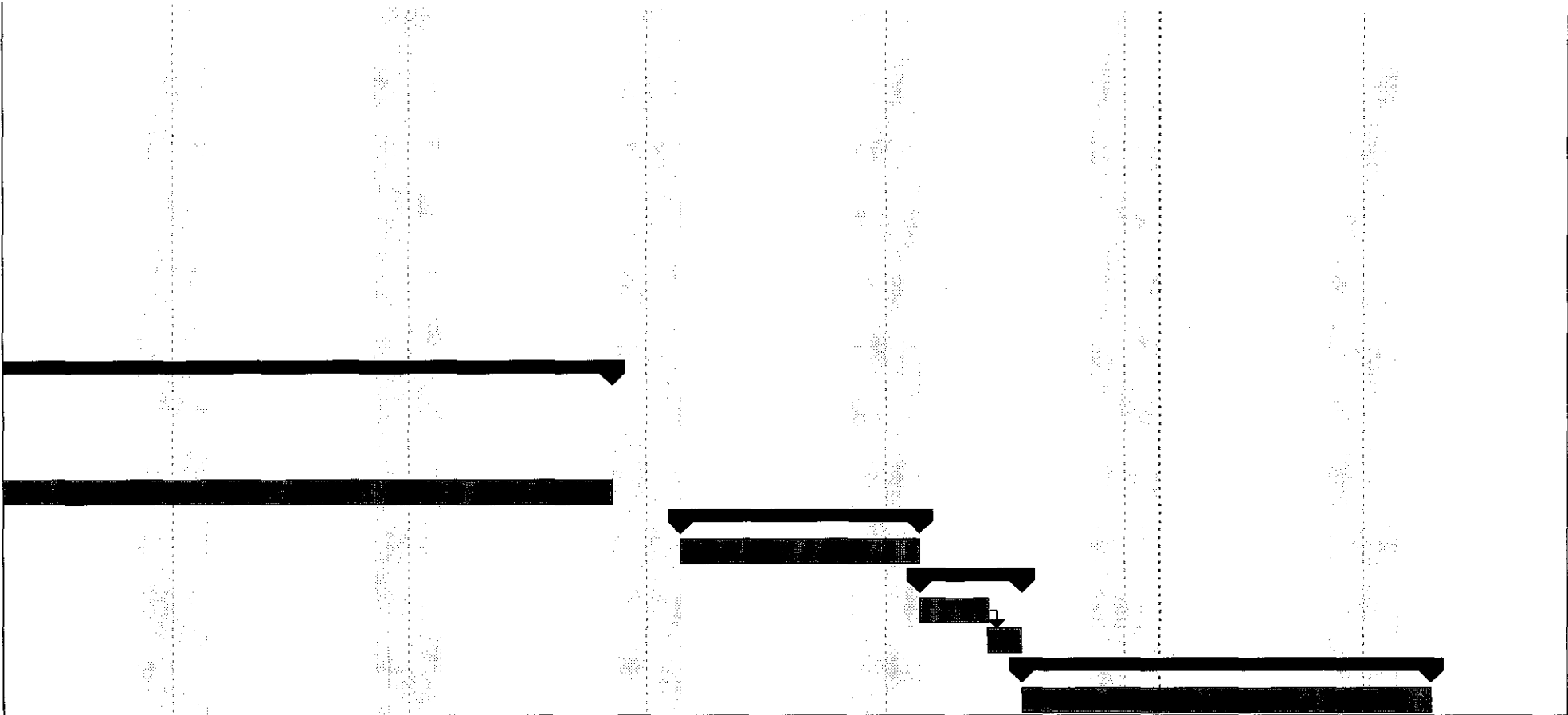


Project Summary



Deadline





Project: PROJECT GANTT CHART FI  
Date: Mon 12/13/04

Task



Milestone



External Tasks



Split



Summary



External Milestone



Progress



Project Summary



Deadline

