ENHANCEMENT OF UNIVERSITI TEKNOLOGI MALAYSIA IMAGE MAP USING GARMIN HANDHELD RECEIVER

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UNIVERSITI TEKNOLOGI MALAYSIA

ENHANCEMENT OF UNIVERSITI TEKNOLOGI MALAYSIA IMAGE MAP USING GARMIN HANDHELD RECEIVER

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requirements for the award of the degree of
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DEDICATION

To my father, *Hj. Othman Ayub* and my mother, *Hjh. Fatimah Sheriff,*
thanks for all the everlasting support, endurance, inspiring spirit, patience and prayers.
To my two elder brothers*, Nur Bukharee Othman* and *Nur Zailan Othman,*
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And lastly,
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ABSTRACT

Maps form an integral part of planning. There are different techniques by which, maps are prepared, depending upon the purpose and accuracy required. The different techniques, range from simple chain and tape measurements to optical methods and further to satellite based technologies. Access to GPS technology has led to advances in techniques for many applications, dramatically upgrading the process of collecting new data and providing a cost-effective means for refreshing the old. A part of the GPS technology is the invention of receivers that are specially used for data collection. The objective of this study is to implement the capabilities of a handheld GPS unit to produce an enhanced image map for the UTM campus. In this study, road features were collected using Garmin GPSMAP 76CSx handheld unit. The road features were then combined together with a base map that was created using Google Maps. Highlighting the places of interest in the UTM image was applied to give the image map an additional feature. The product of this study is an updated version of the UTM campus map that contains enhanced building details from Google Maps and also the latest road tracks that were not displayed in the previous maps. The GPS measurements were proven to be capable in producing small and large scale maps. The use of GPS technologies particularly handheld equipments are effective especially in producing updated maps in the short time.

ABSTRAK

Peta merupakan bahagian yang penting dalam membentuk sesuatu perancangan. Terdapat pelbagai teknik yang berbeza bagi penyediaan sesuatu peta tertakluk kepada tujuan dan ketepatan yang diperlukan. Perbezaan teknik-teknik tersebut merangkumi dari pengukuran rantai dan pita ukur kepada kaedah optik dan dilanjutkan kepada kaedah penggunaan satelit. Pendedahan kepada teknologi GPS telah membawa kepada pembaharuan teknik untuk pelbagai aplikasi, terutamanya dalam menaik taraf proses pengumpulan data dan membekalkan kaedah yg menjimatkan kos bagi menggantikan kaedah lama. Sebahagian dari teknologi GPS adalah penciptaan alat penerima yang digunakan khusus untuk pengumpulan data. Tujuan kajian ini adalah untuk mengaplikasikan keupayaan alat GPS dalam menghasilkan peta imej bernilai tinggi bagi kampus UTM. Di dalam kajian ini, butiran jalan diambil menggunakan alat Garmin GPSMAP 76CSx. Butiran jalan kemudian digabungkan bersama peta dasar yang dihasilkan menggunakan Google Maps. Penandaan kawasan-kawasan penting di dalam imej UTM dilakukan bagi memberikan ciri-ciri tambahan pada peta berimej yang dihasilkan. Produk akhir bagi kajian ini merupakan peta campus UTM yang telah dikemaskini serta mengandungi butiran bangunan yang telah ditonjolkan melalui image Google dan juga laluan jalan terkini yang tidak dimasukkan ke dalam peta-peta terdahulu. Pengukuran menggunakan GPS telah terbukti berupaya menghasilkan peta berskala besar dan skala kecil. Penggunaan teknologi GPS khususnya peralatan pegangan tangan adalah berkesan terutamanya dalam menghasilkan peta-peta terkini untuk jangkamasa yang singkat.

TABLE OF CONTENTS

CHAPTER	TITLE		PAGE
	DECLARATION		ii
	DEDICATION		iii
	ACKNOWLEDGEMENT		iv
	ABSTRACT		v
	ABSTRAK		vi
	TABLE OF CONTENTS		vii
	LIST OF TABLES		xi
	LIST OF FIGURES		xii
	LIST OF ABBREVIATIONS		xv
	LIST OF APPENDICES		xvi
I	**INTRODUCTION**		
	1.1	Background of the Study	1
	1.2	Statement of the Problem	4
	1.3	Objectives of the Study	5
	1.4	Scopes of the Study	5
	1.5	Significance of the Study	8
	1.6	Research Methodology	9
	1.7	Project Report Organization	10
II	**LITERATURE REVIEWS**		
	2.1	Introduction	11
	2.2	Global Positioning System	12

2.2.1 GPS Segments 12
2.2.2 GPS Signal Structure 14
2.2.3 Pseudorange Measurements 15
2.2.4 Carrier Phase Measurements 16
2.2.5 GPS Positioning Modes 18
2.2.5.1 GPS Point Positioning 18
2.2.5.2 GPS Relative Positioning 19
2.3 GPS for Mapping 21
2.3.1 GPS Receivers 22
2.3.2 GPS Signal 23
2.3.3 Hand-Held GPS Receiver 24
2.3.4 Mapping Grade Receivers 25
2.3.5 Overview of the Garmin GPSMAP 76CSx 27
2.4 Datum 29
2.5 Digital Mapping 30
2.5.1 Digitization of Features 31
2.5.2 Mapping Line Features 31
2.6 Other Map Production Techniques 33
2.6.1 Mapping of the Surface Temperature 34
2.6.2 Mapping of Campus Area 35
2.6.3 Mapping the Outdoor Path 39
2.7 Related Applications and Software 40
2.7.1 Google Maps 40
2.7.2 Autodesk Map 6 41
2.7.3 GPSMapEdit 42
2.7.4 ExpertGPS 43
2.7.5 MapSource 45

III RESEARCH METHODOLOGY

3.1 Introduction 46
3.2 Image Map Creation Process 47
3.2.1 Theoretical Study 49
3.2.2 Data Acquisition 49
3.2.2.1 Data Input 49

		3.2.2.2 Data Arrangement	51
	3.2.3	Image Digitizing	54
	3.2.4	Data Collection for Road Features	56
		3.2.4.1 Position Format and Map Datum	58
		3.2.4.2 The Satellite Page Interpretation	59
		3.2.4.3 Wide Area Augmentation System	59
		3.2.4.4 Data Recording Method	60
	3.2.5	Data Transfer	63
	3.2.6	Data Display	64
	3.2.7	Data Conversion	65
	3.2.8	Combination Layers of Data	67
	3.2.9	Data Editing	70
3.3		Final Enhanced Image Map of the UTM Campus	72
IV	**RESULTS AND ANALYSIS**		
4.1		Introduction	73
4.2		Image Digitization Process	73
4.3		Data Collection for Road Features	74
4.4		Comparison of GPS Points	75
	4.4.1	Existing GPS Points and Garmin GPS Points	76
	4.4.2	Garmin GPS Points and Google Maps Coordinates	80
	4.4.3	Google Maps Coordinate and UTM GPS Points	85
	4.4.4	Garmin GPS Points, Google Maps Coordinate And UTM GPS Points	87
4.5		Mapping Issues	89
	4.5.1	Data Quality	89
	4.5.2	Reference System	90
	4.5.3	Data Structure	93
		4.5.3.1 Data Format	93
		4.5.3.2 Data Scale	95

V CONCLUSION AND RECOMMENDATIONS

5.1 Introduction 98

5.2 Obstacles and Challenges 99

5.3 Conclusion 100

5.4 Recommendations 101

REFERENCES 102

Appendix A - F 107-124

LIST OF TABLES

TABLE NO.	TITLE	PAGE
4.1	Difference of Coordinate Value between Garmin GPS Points and UTM GPS Points.	78
4.2	Difference of Coordinate Value between Garmin GPS Points and Google Maps Coordinate Points.	83
4.3	Difference of Coordinate Value between Google Maps Coordinate Points and UTM GPS Points.	86
4.4	Comparison between Garmin GPS Points and Google Maps Coordinate Points with the UTM Known Points.	88
4.5	Distance for the Road Features Collected by the Garmin Unit and the Google Maps Image at Five Selected Points.	92
4.6	Distance Comparison of Two GPS Points between Garmin Point Measurements, Google Maps Coordinates and UTM GPS Known Point Value.	96

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
1.1	London GPS Map.	3
1.2	UTM Campus.	6
1.3	Research Methodology Flow Chart	9
2.1	GPS Segments.	13
2.2	(a) A sinusoidal wave; (b) A digital code.	14
2.3	The Pseudorange Measurements.	16
2.4	The Carrier Phase Measurements.	17
2.5	Principle of GPS Point Positioning.	19
2.6	Principle of GPS Relative Positioning	20
2.7	GPS Receiver Categories.	22
2.8	GPS Signal	24
2.9	Hand-held GPS Receiver.	25
2.10	Garmin GPSMAP 76CSx.	28
2.11	Thermal Map of the University of Northern Iowa Campus.	34
2.12	Final Campus Map of Elizabeth City State University.	35
2.13	Periphery of ITT Roorkee Campus.	36
2.14	Polygons for Buildings such as Departments, Bhawans etc. of IIT Roorkee Campus.	37
2.15	Roads as Linear Features of IIT Roorkee Campus.	37
2.16	Map of IIT Roorkee Campus.	38

2.17	The final display showing the shortest paths from the Science Centre to the McCabe Library with the Blaha Factor set to 1 and 0.1.	39
2.18	Google Maps.	41
2.19	Autodesk Map 6 Main Window.	42
2.20	GPSMapEdit Main Window.	43
2.21	ExpertGPS Main Window.	44
2.22	MapSource Main Window.	45
3.1	Research Methodology Flow Chart	48
3.2	Google Maps of the UTM Campus with Zooming Level of 500 meters.	50
3.3	Google Maps of the UTM Campus with Zooming Level of 50 meters.	51
3.4	Captured Image of Google Maps in Paint Application.	52
3.5	Process of Inserting Raster Image in Autodesk Map.	52
3.6	Arrangements process of the Google images in Autodesk Map.	53
3.7	Complete Arrangements of the Google Image in Autodesk Map.	53
3.8	Digitization Process for Building Features.	54
3.9	Different Types of Layers.	55
3.10	Complete Digitized Features in Autodesk Map.	55
3.11	Data Collection Procedures.	57
3.12	On-Screen Position Display.	58
3.13	Satellite Page.	59
3.14	An Active and Saved Track Log.	61
3.15	Track Log Page.	61
3.16	The Configuration in Activating the Track Log.	62
3.17	The Active Tracks in the Micro-SD Card.	63
3.18	Eight Regions which is Represented by Different Track Logs.	64
3.19	Combination of All the Eight Regions in GPSMapEdit.	65
3.20	Exporting Different Track Logs into One File.	66
3.21	Data Conversion in ExpertGPS Software.	66

3.22	Result of Data Conversion in DXF Format.	67
3.23	Data Combination Technique Using Rubber Sheet Tool.	68
3.24	Five Selected Reference Points and Base Points.	68
3.25	Combination Results of Road and Building Features.	69
3.26	Before and After Data Editing Process for Road Features.	70
3.27	POI Marked in the Image Map.	71
3.28	Completion of Data Editing Process in Autodesk Map.	71
3.29	Enhanced Image Map of UTM Campus in Vector Format Only.	72
3.30	Enhanced Image Map of UTM Campus in Vector and Raster Format.	72
4.1	Digitization Results for *Lingkaran Ilmu* Area.	74
4.2	Comparison Results for (a) 5 Seconds Interval, and (b) 1 Second Interval for Roundabout features.	75
4.3	Overall Preview of Five Selected GPS Points.	76
4.4	Location of Five GPS Points.	77
4.5	Formula for the Conversion from Decimal Degree to Meter Units.	79
4.6	Coordinate Displayed in Google Maps.	80
4.7	Overall Preview of the Coordinate Points that were Selected in Google Maps and Collected by the Garmin Unit.	81
4.8	Location of Four Google Maps Coordinate Points.	82
4.9	Comparison between Garmin GPS Points and Google Maps Coordinate Points with the UTM Known Points.	88
4.10	The Five Points that were Selected for the Rubber Sheeting Process.	91
4.11	The Display of GPS Points in MapSource.	93
4.12	The Tracks Tab.	94
4.13	Comparison of Images in Google Maps and Autodesk Map.	97

LIST OF ABBREVIATIONS

AS	-	Anti-Spoofing
C/A-code	-	Course Acquisition Code
DGPS	-	Differential Global Positioning System
DMA	-	Defence Mapping Agency
DoD	-	Department of Defence
GLONASS	-	Global ‘naya Navigatsionnaya Sputnikovaya Sistema
GPS	-	Global Positioning System
LOP	-	Lines of Position
GB	-	Gigabyte
NIMA	-	National Imagery and Mapping Agency
OCS	-	Operational Control Segment
PC	-	Personal Computer
PDOP	-	Position Dilution of Precision
POI	-	Point of Interest
PRN	-	Pseudo Random Noise
P-code	-	Precision Code
SNR	-	Signal-to-Noise Ratio
SRTM	-	Shuttle Radar Topography Mission
US	-	United State
USGS	-	United States Geological Survey
UTM	-	Universiti Teknologi Malaysia
WGS84	-	World Geodetic System of 1984

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	GPSMAP 76CSx Keypad Layout	107
B	GPSMAP 76CSx Specifications	108
C	Garmin GPSMAP 76CSx Configuration Settings	109
D	UTM GPS Geodetic Coordinates (WGS84)	111
E	Location of GPS Stations in UTM	112
F	Tracks File	113

CHAPTER I

INTRODUCTION

1.1 Background of the Study

The Global Navigation Satellite System (GNSS) is a space-based radio-positioning system that includes one or more satellite constellations, augmented as necessary to support the intended operation, and that provides 24-hour three-dimensional position, velocity, and time information to suitably equipped users anywhere on, or near, the surface of the earth. GNSS implies several existing system like GPS, GLONASS and Galileo (Hofmann-Wellenhof et al., 2008).

The present navigation system with timing and ranging (NAVSTAR) Global Positioning System (GPS) is a satellite based radio-positioning and time transfer system designed, financed, deployed, and operated by the U.S. Department of Defence (Leick, 2004). The abbreviation GLONASS derives from the Russian "Global'naya Navigationnaya Sputnikovaya Sistema", translated to its English equivalent, this means Global Navigation Satellite System is the Russian counterpart to GPS which ran parallel with the U.S development. The purpose of GLONASS is to provide an unlimited number of users in the air, marine, and any other type of users with all-weather three-dimensional positioning, velocity measuring and timing

anywhere in the world or near-earth space (Hofmann-Wellenhof et al., 2008). Galileo is the European satellite navigation program under civil control. In contrast to GPS and GLONASS, the aspect of the civilian program under civilian control is a key issue (Hofmann-Wellenhof et al., 2003).

GPS has been used by surveyors long before many other professions, primarily because their tasks were area-defined and focused and because they did not need continuous coverage to realize significant gains from use of the technology. Today, with the help of GPS techniques and devices, labour-intensive surveys are being carried out with higher accuracy, lower cost per earth-feature identified and fewer persons needed in the field. Access to GPS technology has led to many improvements in geophysical equipment. It has led to advances in techniques for many applications, dramatically upgrading the process of collecting new data and providing a cost-effective means for refreshing the old. A part of the GPS technology is the invention of receivers that are specially used for data collection. GPS receivers have grown from only a handful to a huge variety of receivers available today. Some push the button to achieve ever-higher accuracy; others offer less sophistication and lower cost. The civilian user's options are broader with GPS than any previous satellite positioning system, broader than as originally planned. GPS will likely replace more of its predecessors in both the military and civilian arenas, as it has replaced the TRANSIT system. In fact, GPS has developed into a system that has more civilian applications and users than military ones (Jan, 2008).

Nowadays, the used of GPS receivers among civilians are becoming increasingly popular where GPS based navigation and route guidance systems are implemented by bus operators, fleet managers and travellers. In order to provide this functionality, one has to have a GPS receiver, a digital map of the travelled network and software that can associate (match) the user's position with a location on the digital map (Greenfeld, 2002). On the other part, navigation technologies such as the GPS have revolutionized cartography by enabling greater precision and certainty in the creation, use and enjoyment of maps. The falling price and increasing accuracy of civilian GPS devices has brought cartography into the realm of everyday life and

spurred the development of a wave of location base services, applications and games (Sharon, 2004).

A form of personal mapping can be found in GPS Drawing website which is the art of using GPS receivers as “geodetic pencils” or “cartographic crayons” to create sketches by “joining the dots” of the path travelled (Wood and Pryor, 2008). Figure 1.1 shows the London GPS Map which was created from the travelling path recorded with GPS. These drawing subvert the positioning of the GPS units by creating images directly from the journey itself and place less emphasis on the actual position in favour of creating the resulting image (Sharon, 2004). However this attempt is just more to entertainment and represents creative uses of GPS technology, as they are not ideal for accurate mapping purposes.

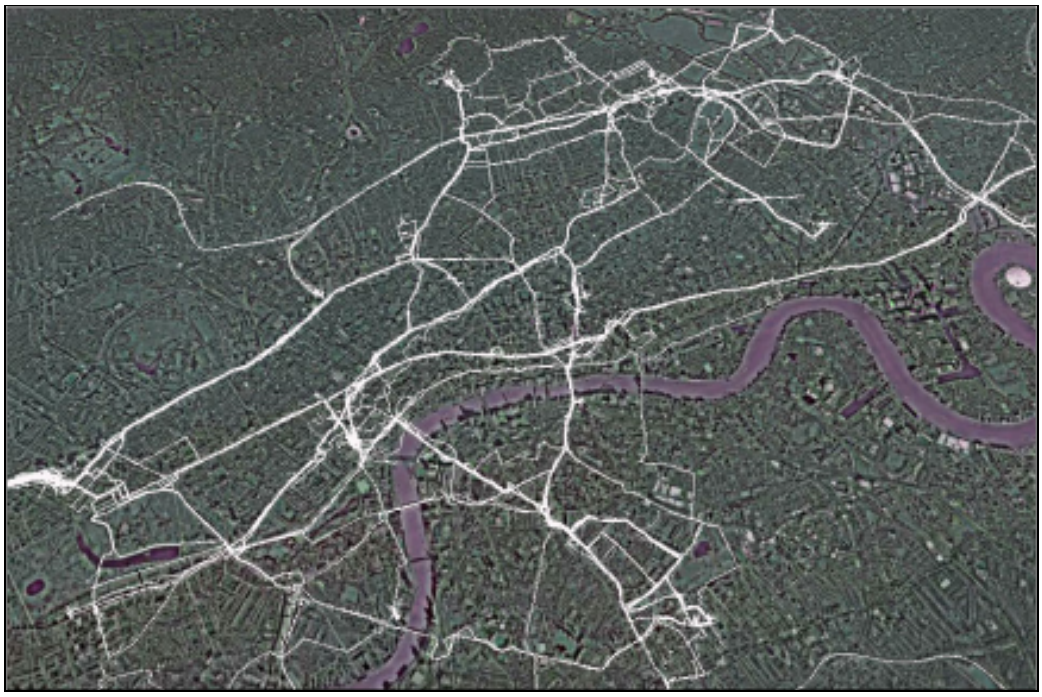

Figure 1.1: London GPS Map.
(Source: Wood and Pryor, 2008)

There are two main types of handheld GPS devices which are for non-mapping and mapping. The Garmin 305 Forerunner is one of the examples of the non-mapping type. It is a running partner and personal trainer which continuously monitors users heart rate, speed, distance, pace, and burnt calories. It also tracks every move with a super-sensitive GPS that even works on tree-covered trails and near tall buildings. It also receives a detailed post-workout analysis on the PC with included Training Centre software (GPS Genie, 2006). On the other hand, the Garmin GPSMAP 76CSx is an example of the mapping type. It can achieve a DGPS accuracy of typically below five meters. Its manufacturers claim that its highly sensitive receiver can receive the satellite signals in heavy tree cover and around tall buildings. The basic operation in the Garmin GPSMAP 76CSx includes using the waypoints, tracks and routes. Waypoints are locations or landmarks that can be record and stored in the GPS. The Tracks feature creates an electronic bread crumb trail or "track log" which contains information about points along its path, including time, location and elevation (Garmin Ltd., 2007). A track log is also a sequence of GPS positions that can be converted to a line or a polygon (Beyerhelm, 2008). Therefore, the use of this device to create a digital map is considered as a good approach in implementing handheld devices for mapping purposes.

1.2 Statement of the Problem

Most maps in Malaysia that were created are represented in different reference systems based on the location of the mapped area and also the different purposes the maps are produced. Topographic maps which represent physical feature of the earth surface are referenced to the Rectified Skew Orthomorphic (RSO) coordinate system while cadastral maps which contain information about the size, location and condition of land parcels are referenced to the Cassini-Soldner coordinate system (Nordin, 2006). New inventions in the GPS technology have made mapping approaches to be much more reliable which uses WGS84 as the reference system. However, the use of GPS handheld in UTM campus for mapping application

is not widely used. This is because most application requires high accuracy method but the procedures of map preparation are quite cumbersome, laborious and require very long time. Nevertheless, it is still the most accurate way of generating small and large scale maps. GPS may be suitable for control establishment and preparation of topographical maps but it is known that GPS handheld receivers can achieve mapping accuracy of 1m to 6m in position, so it can still be used for mapping. Therefore, the purpose of this project is to create a digital map in WGS84 reference system using a handheld GPS device. The testing and project area is the whole Universiti Teknologi Malaysia (UTM) campus.

1.3 Objectives of the Study

The objectives of this study are as follow:

(i) To update mapping of UTM image features using GPS handheld.

(ii) To produce an enhanced image map for UTM campus.

1.4 Scopes of the Study

According to the purposes and objectives of the study as stated above, the scopes of the study has been determined based on four important aspects, which are the study area, software that were used, the source of data involved and the applications that were performed.

i. Study Area

The study area consists of the whole area of UTM campus (Refer Figure 1.2). The approximate area of the campus is 1,177 hectares and the study area includes all the faculties, the residential colleges and the administration buildings.

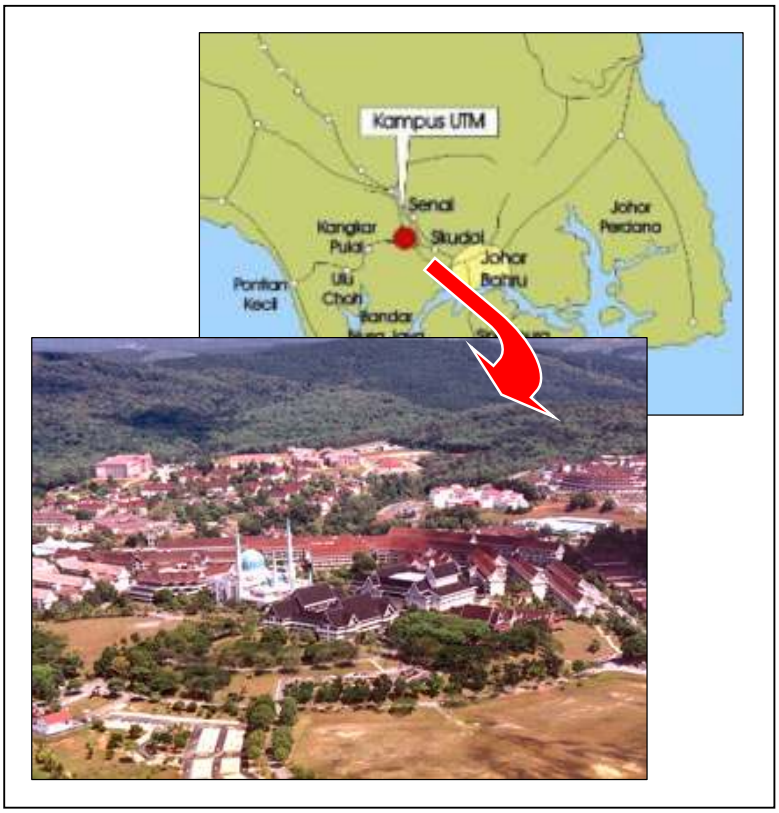

Figure 1.2: UTM Campus.

ii. Software

The software used is one of the important elements in this project because the correct choices of software can smoothes the process in completing this project. The

chosen software should also be appropriate for the applications involved in this project. In this project, there were three software used, which are the GPSMapEdit application software for displaying in GPX (GPS eXchange) format, the ExpertGPS software for the data conversion process and the Autodesk Map software for the data combination, editing and presentation of the final output.

iii. Source of Data

The data that were used in this project are from Google Maps webpage for the buildings features and the road features were collected using Garmin GPSMAP 76CSx handheld approach.

iv. Applications Involved

The applications that involved in this project were:

a. Digitization of building features were done in Autodesk Map based on the images from Google Maps.

b. Data recordings methods that were used for the data acquisition process is the Time recording method.

c. Data conversion was done by using ExpertGPS software.

d. Data combination, editing and final output presentation using Autodesk Map software.

1.5 Significance of the Study

This study was carried out to evaluate the capability of using GPS handheld in mapping the UTM campus. The image map that was created is referenced to the WGS84 datum which is reliable for the whole world. The use of this worldwide datum can enable this map to be uploaded in the internet and allow the foreign students who wishes to further their studies in UTM to access the UTM image map and give them an early guide about the campus environment. The unique aspect of the image map is that is has options in viewing vector or together with raster image that can provide clearer details of the UTM campus. It also provides several points of interest that enable maps users to locate important places in the campus where it can be a useful tool for people who come from other places to attend meetings and conference and do not know the way in the campus. The image map is also adequate to be used by Town Planners in planning for future development of the UTM campus. The use of GPS applications allow this map to be updated periodically so that any changes or improvement in the UTM campus area can be detected.

1.6 Research Methodology

The method of this study was done according to the flow chart as shown in Figure 1.3.

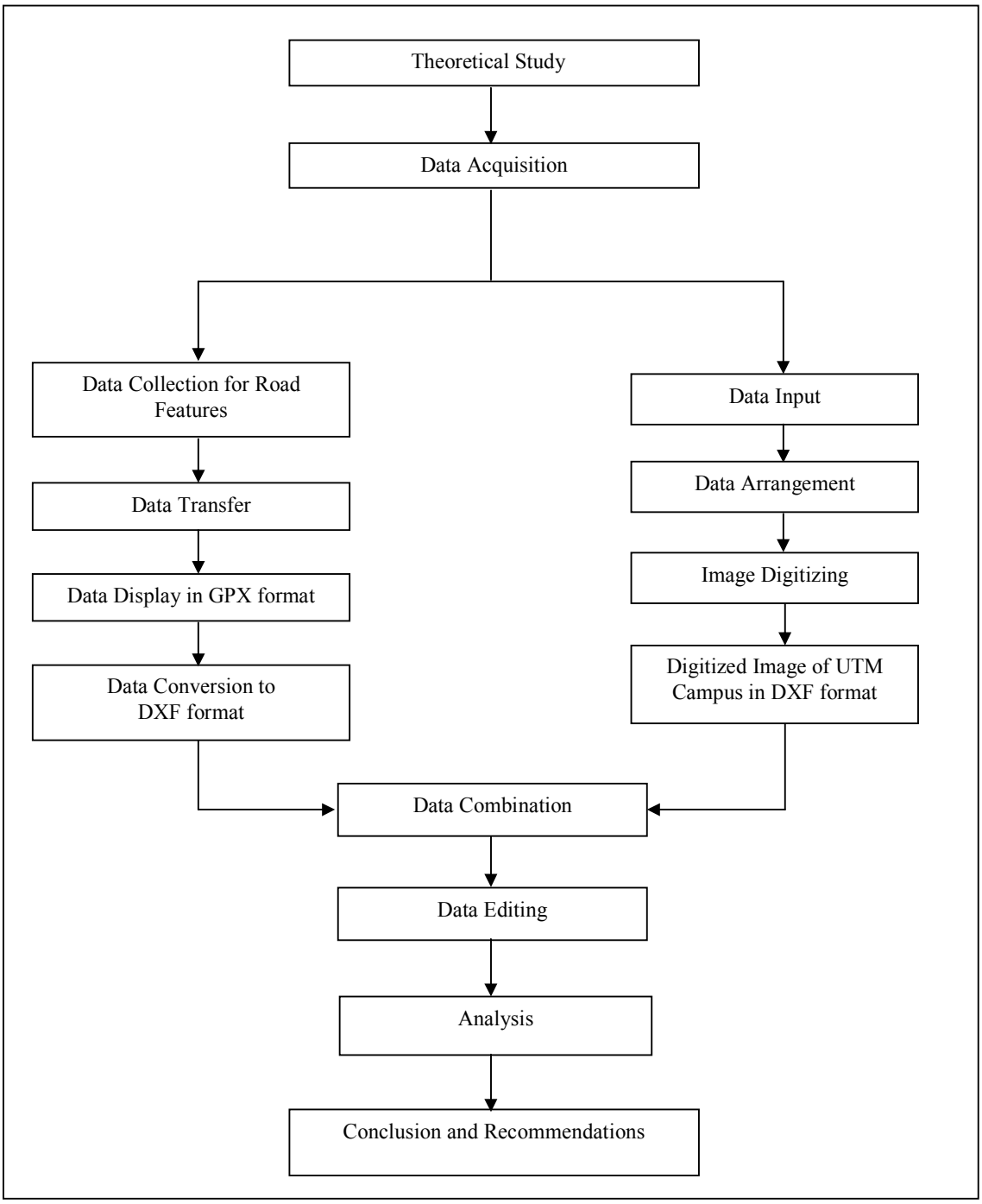

Figure 1.3: Research Methodology Flow Chart.

1.7 Project Report Organization

This project report consists of five chapters which are the Introduction, Literature Review, Research Methodology, Results and Analysis and finally the Conclusion and Recommendations. The first chapter explains about the background of the study, the statement of problem, the objectives of the study, the scopes of the study which includes the study area, software, source of data and applications involved in the study. The significance of the study are also explained at the end of this chapter.

The second chapter explains about the literature review that have been done which covers all aspects including the concept of GPS positioning, digital mapping and reviews from previous researches. Details about the applications and software that relates to this study were also explained in this chapter.

The third chapter explains about the procedures involved in the process of creating the image map of the UTM campus area which includes the image digitizing process and data collection of road features using GPS handheld approach.

The fourth chapter discussed about the results and analysis that have been accomplished from the study that have been done. The analysis were performed to determined the quality of the final output. The results of each process which includes the image digitization, data collection and data combination were discussed in detail throughout this chapter. Issues that relate to the final output were also discussed at the end of this chapter.

The final chapter discussed about the conclusion that have been made according to the final output and the analysis that have been performed. This chapter also includes few recommendations that can be done for further studies.

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