"Cooperative Museum using Push Technology via Bluetooth"

by

Nasheila Aleena Salehuddin
(4566)

A Project Dissertation submitted in partial fulfillment of
the requirements for the
Bachelor of Technology (Hons)
(Information, Communication and Technology)

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Universiti Teknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

COOPERATIVE MUSEUM USING PUSH TECHNOLOGY VIA BLUETOOTH

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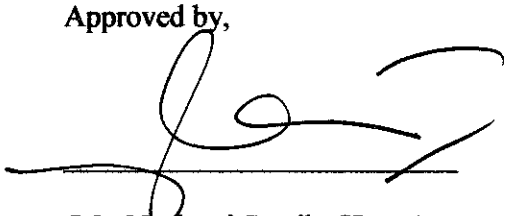
Approved by,



(Ms. Nazleeni Samiha Haron)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

July 2006

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 acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

(NASHEILA ALEENA BINTI SALEHUDDIN)

ABBREVIATIONS

LBS	Location Based Systems
UTP	Universiti Teknologi Petronas
ICT	Information and Communication Technology
WiFi	Wireless Fidelity
PDA	Personal Digital Assistant
GPS	Global Positioning System
PAN	Personal Area Network
WPAN	Wireless Personal Area Network
FHSS	Frequency Hopping Spread Spectrum

TABLE OF CONTENTS

LIST OF FIGURES

APPENDIX

ABSTRACT

This paper comprises of five parts. Those parts are the Introduction, Literature Review, Methodology, Results and Discussion and lastly the Conclusion and Future Work. In the introduction chapter of the research, there is a background of study regarding the location based system. Along with the background of study, it is included with the problem statement of the project which comprises of the identification of the problems involved and as well as the significant of the project. Not only that, the objectives of the study made are also included where the objectives and scope of study are discussed. There are also discussions about the relevancy of the project and the feasibility of the project within the scope and time frame of the project. As for the second chapter of this paper which is the Literature Review, there are a few supporting information included to describe the topics under the research for this project. Those topics are regarding Location Based Systems, Bluetooth technology, Context-Aware computing, and push concept. Proceeding to the third chapter of the paper, there is a review on the methodology that has been used to plan, analyze, design and implement this whole project and tools are used in order to develop this project. Next up is the Results and Discussion section where discussions will be made on the issues stated in the Methodology section. In the Results and Discussion chapter, there are results taken from the questionnaires taken from the analysis phase and also the results from the design and implementation phase that are taken from the Methodology chapter. As for the last chapter of this report, the Conclusion and Future Work discussed the overall conclusion and also future work or future enhancements that are intended to do for this project.

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First of all, I would like to praise the Almighty for His mercy and show my gratitude to Him for his limitless blessings and guidance throughout the hard times that I have endured completely. Without His blessings, I would not have made it this far. I would also like to express my deepest gratitude and highest appreciation to my supervisor, Ms. Nazleeni Samiha Haron who has been patient in sharing his professional thought, guidance, endless support, advice and constructive comments in helping me to complete this research report. I would also like to articulate my thankfulness to my parents for their endless support, encouragement and sincere prayers. I would also like to express my warmest thanks to my fellow colleagues in making this Final Report a success. Thank you.

CHAPTER 1
INTRODUCTION

1.1 Background of Study

Wireless technologies allows computing and communication devices to be used virtually anywhere. It is also to be used in pioneering, progressive activities. Several of these technologies have been adapted to small devices and are now widely accessible mobile phone handsets, increasing the potential for new communicative operations. With the existing prevalent use and familiarity, the use of more complex functionality through wireless technologies has the potential to turn the conventional handset into adaptable, multipurpose equipment. This project is about developing Location Based Systems with the integration of Bluetooth using a Bluetooth enabled device. Location Based Systems (LBS) are systems that are used to detect the location of users or objects in a predetermined area. LBS can detect and give accurate location of specific users and objects using various technologies but the ones that are chosen to compare to implement this project are only three technologies. One is using Global Positioning System (GPS) which is via satellite signal, another technology is using Wireless Fidelity (WiFi) which is signal from a wireless transmitter or access points and the third technology can be used to locate object or users can be done via Bluetooth from a mobile device. For this Cooperative Gallery project; using Push-based Technology via Bluetooth, it will be similar as other location based systems; only it will provide information regarding the section of the gallery or its exhibits. The information is provided at different abstraction levels such as the gallery itself, the section and its physical environment. For implementation of this project using Bluetooth, the location of the section or exhibits around the gallery can be done by a Bluetooth server which will be set up in

a Bluetooth device such as mobile phones. Since Bluetooth even have their own access points for the location system and to access its network, location detection can be made by means of the signal strength received from those access points. The intention of implementing this project to a gallery; specifically UTP Gallery is to assist visitors on getting around the gallery as tourists are excessively visiting to the University's gallery and surely will want to know the historical background of our university, Universiti Teknologi PETRONAS (UTP). Therefore, this Cooperative Gallery project will assist them in experiencing the history of UTP. The enabling technology for LBS is with the usage of Bluetooth, Context-Aware Computing and also Push-Based Technology.

1.2 Problem Statement

1.2.1 Problem Identification

The dilemma is that visitors come to the UTP Gallery with little or zero knowledge on the matter of this university's history and background. Therefore, they would want information about the history or exhibits being displayed to them easily. Visitors may not know where to start their tour around the gallery. For instance, when a visitor first set his or her feet into the UTP Gallery, the visitor may not know which area of exhibition to go first as they have little knowledge on matters regarding this University. Visitors also may not know which section of the gallery they are in exactly without the aid of a location detection system. Consequently, it is hard for visitors to the UTP Gallery to plan their trip around. With this, too, it will decrease the satisfaction of experience in the gallery. So, without the help of a location detection system that can provide the interactivity of experiencing the gallery, could surely affect the attention of visitors coming to the UTP Gallery.

1.2.2 Significance of the Project

The significance of the location based system is to help tourists identify the exact section of the gallery that they are at. This could assist them in getting their way around the gallery better. They could also plan their tour around the museum when they are aware of their location once they are in the gallery. Thus, tourists will be more anxious to go to other parts of the UTP Gallery when they have adequate information on the sections of the gallery. Visitors of the museum could also locate where there are actually at. With that, they will know where they are and are able to locate the next section that they wish to go to.

1.3 Objectives and Scope of Study

1.3.1 Objectives

There are a few objectives for this project. The project's objectives are:

1. To implement a Location Based System using Bluetooth technology.
2. To provide visitors with the location of the UTP Gallery where they are at.
3. To apply push-based concept and context-aware computing in the implementation of this project.

1.3.2 Scope of Study

The degree of this study is by looking into how Bluetooth functions and how it operates with mobile devices. The study includes findings on how to track down visitor's location using signals transmitted from the mobile device with Bluetooth capabilities. The study also includes the study of integration of Bluetooth technology and Bluetooth enabled devices like mobile phones with the project under development. Another subject that is included in the scope is the Push-based technology that is used to implement this project. This project also focuses on one part of the museum as a start but as suggested, the implementation of this project is done in the UTP Gallery first before proceeding to the real museum. In addition, the implementation to the real museum will require approval from the state and the parties involved. To ease the flow of the development of this project, the scope will be inside the UTP Gallery. The last part of my study for this project is the categories of Context-Aware computing that are applied to the project.

1.3.3 Relevancy of the Project

This project is related to the Information and Communication Technology (ICT) field. Since networking using wireless technology is related to the communication of data and technology, this makes the project interrelated to the Information and Communication Technology area. The accomplishment of developing this project related to the mobile communication using Bluetooth is definitely pertinent to the ICT course. Bluetooth is an approach of wireless communication and since Wireless Communication is one of the courses that I have taken during my study period, this makes it more significant to deploy this project. In developing this project, sufficient knowledge on networking is required. All the knowledge associated to the networking domain is appropriate. The information and data involved in applying the networking tools is documented. The

skills of programming using networking tools to implement this project can be considered appropriate to my course of study.

1.3.4 Feasibility of the Project within the Scope and Time Frame

For this project, student has been assigned two semesters to work on the research and development of the project. The research regarding to the project has been completed. On the other hand, in order to complete this project completely will require more time. The process of identifying the requirements to the project and the system workflow are done during the time frame that has been assigned to the student. However, some trivial features of the product may not be available as it requires more time to develop the complete product. Provided with the continuous research on this project, the complete system should be over and done with within the time frame allocated.

CHAPTER 2
LITERATURE REVIEW

2.1 Location Based Systems

Many of the devices used everyday for convenience is affected by location. In spite of that, mobile phones, laptops, PDAs, and even cars have virtually no idea of where they are or what's nearby. Even if you travel from Malaysia to Japan, your high-tech devices won't even know that you have switched time zones [4]. Due to that, a contraption of location based system has been invented.

There are a few types of location based systems. Global Positioning System (GPS) is one of the examples of location based systems. There are also other methods on detecting one's location other than GPS. Using wireless technology like Bluetooth or Wireless Fidelity (WiFi) are the other ways of detecting user's location.

The basic preface to a location detection system is to detect the accurate location and the information of the location. Location information is becoming increasingly important in many persuasive computing applications ranging from human-oriented information appliances to distributed sensor networks to robotic colonies. Applications incorporating location can provide functions such as navigation aids, geographic contextual information, movement tracking, emergency location, geographically selective communication and coordinated spatial sensor measurements. For location based services, the term location refers to the generic concept of a place or situation occupied by a designated user or object. The term position refers to a specific coordinate [5].

Software applications that employ location are being increasingly explored within context-aware mobile applications [5]. These applications may use information identified for museums or tourist information systems as the one that is being under study now. The mobile application devices can be exampled as PDAs or cellular phones and mostly the signaling transmission devices are from Global Positioning System. But now, with the advancement of technology, a new way of detecting location without using GPS is using wireless technology.

As for this project, the exhibits' location or section of the UTP Gallery will be detected using signal strength from Bluetooth device. In particular, for this project, the focus is on the indoor location properties of the Bluetooth wireless protocol. Bluetooth has gained its popularity nowadays due to the short range, low power and easy integration into devices like mobile phones. Bluetooth is chosen to implement this project because of the availability of Bluetooth devices nowadays. Since the current mobile phones in the market are Bluetooth-enabled, this makes it easier to use such resource to implement this project. The details regarding Bluetooth technology will be discussed in the next section.

2.2 Description of Bluetooth

Bluetooth wireless technology is an open specification for a low cost, low power, short range radio technology for ad hoc wireless communication of voice or data. Its estimated over the air communication range using radio waves is 10 meters. Due to the short range, the radios are low power and are suited to small, compacted devices with reduced battery power. Bluetooth networks are ad-hoc by nature, and are known as personal area networks (PAN). Bluetooth is an industrial specification for wireless personal area networks (PANs), also known as IEEE 802.15.1. Bluetooth provides a way to connect and exchange information between devices like personal digital

assistants (PDAs), mobile phones and laptops, globally unlicensed short range radio frequency.

2.2.1 Wireless Personal Area Network (WPAN)

Wireless Personal Area Network (WPAN) is a network for interconnecting devices centered on an individual person's workspace where the connections are wireless. Typically, a wireless personal area network uses some technology that permits communication within a very short range at about 10 meters. A technology that is covered under WPAN is Bluetooth, which was used as the basis for a new standard, IEEE 802.15.

A WPAN could serve to interconnect all ordinary computing and communicating devices that many people have on their desk or carry with them today. It could also serve a more specialized purpose such as allowing the surgeon and other team members to communicate during an operation. A main concept in WPAN technology is known as plugging in. In the ideal scenario, when any two WPAN-equipped devices come into close proximity like within several meters of each other or within a few kilometers of a central server, they can communicate. Another important feature is the ability of each device to lock out other devices selectively, preventing unnecessary interference or unauthorized access.

The technology for WPANs is in its early years and is still undergoing rapid development. Proposed operating frequencies are around 2.4 GHz in digital modes. The objective is to facilitate seamless operation among home or business devices and systems. Every device in a WPAN will be able to plug in to any other device in the same WPAN, provided they are within physical range of one another. In addition, WPANs worldwide will be interconnected. For instance, an archeologist on site in

Greece might use a PDA to directly access databases at the University of Minnesota in Minneapolis, and to transmit findings to that database.

A Bluetooth PAN is also called a piconet and is composed of up to 8 active devices in a master-slave relationship where up to 255 devices can be connected in "parked" mode. The first Bluetooth device in the piconet is the master, and all other devices are slaves that communicate with the master. A piconet typically has a range of 10 meters, although ranges of up to 100 meters can be reached under ideal circumstances.

2.2.2 Bluetooth Basics

The key features of Bluetooth technology are robustness, low power, and low cost. The Bluetooth specification defines a uniform structure for a wide range of devices to connect and communicate with each other.

Bluetooth technology has achieved global acceptance such that any Bluetooth enabled device, almost everywhere in the world, can connect to other Bluetooth enabled devices in proximity. Bluetooth enabled electronic devices connect and communicate wirelessly through short-range, ad hoc networks known as piconets. Each device can simultaneously communicate with up to seven other devices within a single piconet. Each device can also belong to several piconets simultaneously. Piconets are established dynamically and automatically as Bluetooth enabled devices enter and leave radio proximity. Below is the example of piconets.

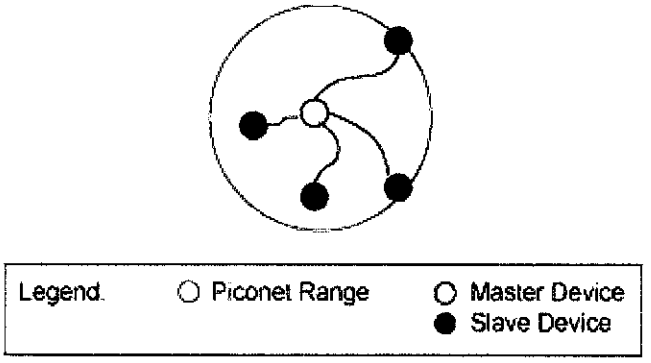

Figure 1: Piconets of Bluetooth Technology

A fundamental Bluetooth wireless technology strength is the ability to simultaneously handle both data and voice transmissions. This enables users to enjoy variety of innovative solutions such as a hands-free headset for voice calls, printing and fax capabilities, and synchronizing PDA, laptop, and mobile phone applications to name a few.

Unlike many other wireless standards, the Bluetooth wireless specification gives product developers both link layer and application layer definitions, which supports data and voice applications. The data rate for Bluetooth communication is 1 Mbps for Version 1.2; up to 3 Mbps supported for Version 2.0 + EDR.

2.2.3 Technicalities of Bluetooth technology

There are a few technicalities of Bluetooth technology. The technicalities include:

- FHSS (Frequency Hopping Spread Spectrum).The Bluetooth radio transmission uses a packet switching protocol FHSS. The hop frequency is 1600 hops per second. The frequency spectrum is divided into 79 hops of 1 MHz bandwidth each, so devices occupy 79MHz, but at any specific moment, only 1 MHz is

occupied.Frequency hopping is used to reduce interference and enhance security. The frequency-hopping scheme is combined with fast ARQ (Automatic Repeat Request), CRC (Cyclic Redundancy Check) and FEC (Forward Error Correction). A binary radio frequency modulation and simple link layer protocols reduce the complexity and the costs of the radio chip. Bluetooth provides a nominal data rate of 1 Mbit/s[21].

- ISM Band : A Bluetooth radio operates in the 2.4 GHz license-free, globally available industrial, scientific and medical (ISM) band. This band is used for other ISM devices like WLAN, microwaves but Bluetooth is designed to endure interference and remain almost unaffected when in contact with other devices in the same band.

In addition to the FHSS used in Bluetooth technology, its adaptive frequency hopping (AFH) capability was designed to reduce interference between wireless technologies sharing the 2.4 GHz spectrum [20]. AFH works within the spectrum to take advantage of the available frequency. This is done by detecting other devices in the spectrum and avoiding the frequencies they are using. This adaptive hopping allows for more efficient transmission within the spectrum, providing users with greater performance even if using other technologies along with Bluetooth technology. The signal hops among 79 frequencies at 1 MHz intervals to give a high degree of interference immunity [24].

2.2.4 Stack

The Bluetooth protocol stack is defined as a series of layers, with each layer representing a different protocol. The Bluetooth profiles, described along with the stack in the Bluetooth specification, are essentially usage models to illustrate how applications should use the stack. The stack can be divided into two major sections, the first is the Bluetooth host, which is the upper section of the stack and is usually

implemented in software. In the case of a mobile phone, the Bluetooth host is integrated with the operating system of the phone. The lower layers are known as the Bluetooth controller. Below is the figure of the Bluetooth controller [24].

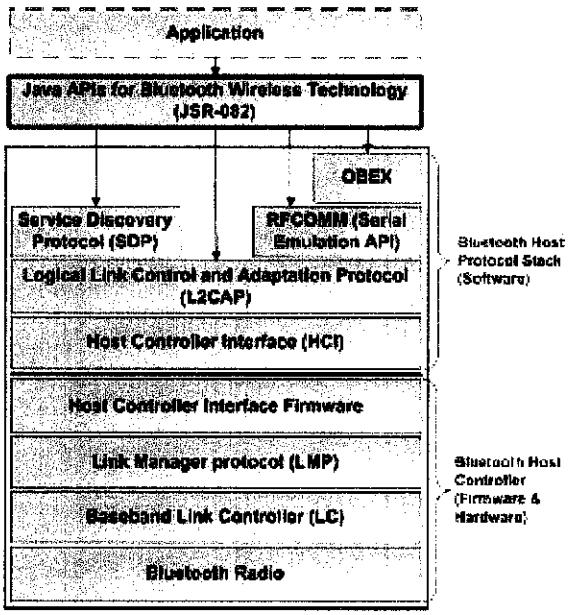

Figure 2: Bluetooth Stack

There are a few layers of the Bluetooth stack. Those layers are:

- Radio

  The Bluetooth radio layer is the lowest defined tier of the Bluetooth specification. It classifies the requirements of the Bluetooth transceiver device operating in the 2.4-GHz ISM band. It defines transmitter and receiver characteristics, including the ability of the receiver to measure its Received Signal Strength Indicator.

- Baseband Link Controller (LC)

  The Baseband tier is the physical layer of the stack. The protocol is implemented as a link controller, and together with the link layer it manages the physical radio frequency link between Bluetooth devices and enables connections. The two kinds of physical links: synchronous connection oriented (SCO) and asynchronous connectionless (ACL) are managed by the Baseband which involves handling packets and the paging and enquiring techniques of Bluetooth discovery.

- Link Manager Protocol (LMP)

  The Link Manager Protocol (LMP) carries out link setup and link configuration between Bluetooth devices, managing and agreeing the baseband packet sizes. Link managers communicate via the LMP using a number of PDU (Protocol Data Units), which are sent between devices to facilitate link management. The LMP is also responsible for managing security issues, such as authentication and encryption, by generating, exchanging, and checking link and encryption keys [22].

- Host Controller Interface (HCI)

  The Host Controller Interface provides a command interface to the radio, baseband controller and link manager, providing a single interface for accessing the baseband resources, the hardware status and control registers.

- Logical Link Control and Adaptation Protocol (L2CAP)

  It is located in the data link layer. It provides both connection-oriented and connectionless data services to upper layer protocols. It is responsible for multiplexing the various connections of the upper layer protocols. This protocol allows higher level protocols to send and receive data packets of up to 64 kb.

Communication over L2CAP is restricted to asynchronous connectionless links and so is a best effort service unsuitable for real time traffic on SCO links.

- RFCOMM

  One of the most frequently used communication techniques in communication Devices makes use of serial ports. The RFCOMM protocol is an emulation of RS232 serial ports over L2CAP. It facilitates a transport service for higher level services using a serial interface and is capable of supporting up to 60 simultaneous links, although most devices, especially mobile phones, have limited capabilities regarding the maximum number of connections. RFCOMM provides a communication mechanism for two Bluetooth enabled endpoints, making it feasible for this project.

- Service Discovery Protocol (SDP)

  This protocol provides a process for applications to query available services and attributes of services on other devices. The discovery of services is distinct from the discovery of devices in Bluetooth, and is a completely separate protocol. It is also distinct from the more traditional notion of service discovery in LAN networks as the set of services available are dynamic and change frequently when devices are active in the PAN.

- Object Exchange Protocol

  The Object Exchange protocol is a relatively new facility built over RFCOMM. It is a protocol for simple file transfers between mobile devices, often used for transferring objects such as electronic business cards. It was originally implemented over IrDA, but is now common on Bluetooth devices.

2.2.5 Benefits of Bluetooth Technology

Bluetooth wireless technology is the simple choice for convenient, wire-free, short-range communication between devices. It is a globally available standard that wirelessly connects mobile phones, portable computers, cars, stereo headsets, MP3 players, and more. Credits to the distinctive concept of profiles, Bluetooth enabled products do not need to install driver software. The technology is now available and continues to develop, building on its natural strengths small-form factor radio, low power, low cost, built-in security, robustness, ease-of-use, and ad hoc networking abilities. Bluetooth wireless technology is the leading and only proven short-range wireless technology on the market today shipping over five million units every week with an installed base of over 500 million units at the end of 2005 [23].

Since start, Bluetooth technology was designed with security needs in mind. Since it is globally available in the open 2.4 GHz ISM band, robustness was built in from the beginning [23]. With adaptive frequency hopping (AFH), the signal hops and thus limits interference from other signals. Further, Bluetooth technology has built-in security such as 128bit encryption and PIN code authentication [23]. When Bluetooth products identify themselves, they use the PIN code the first time they connect. Once connected, user is always securely connected.

2.3 Context-Aware Computing

A context-aware system is one that can determine and react to the current physical and computing context of mobile users and devices, by altering the information presented to users or commands issued by and on behalf of those users [7]. It focuses on mobile-computing where mobile people are also considered. Context-aware systems become familiar according to location of use, neighbouring entities, accessible devices and changes of these attributes stated above. There are four categories of context-aware

applications. Those four are represented as two orthogonal axes with two points each: fetching information vs. giving commands, and manual vs. automatic actions [7]. The four categories are proximate selection, automatic contextual reconfiguration, contextual information and commands and context-triggered actions. The ones that are discussed are only proximate selection and automatic contextual reconfiguration.

2.3.1 Proximate Selection

Proximate selection is the manual fetching of context-aware information about input or output devices, non-physical objects and services, or locations. User interface issues of how to emphasize information based on degree of proximity exist [7]. Proximate selection is a user interface technique where the located-objects that are nearby are emphasized or otherwise made easier to choose [8]. Proximate selection involves entering two variables which are the "locus" and the "selection." For the study for this project, the user interfaces that automatically default the locus to the user's current location.

There are at least three kinds of located-objects that are interesting to select using proximate selection technique. The first is computer input and output devices that require co-location for use which includes printers, displays, speakers, facsimiles and video cameras. The second kind is the set of objects that you are already interacting with, and which need to be addressed by a software process. This includes people in the same room to whom you would like to "beam" a document. The third kind is the set of places one wants to find out about: restaurants, night clubs, gas stations, and stores, or more generically, exits and entrances. The one that will be under development for this project is the third kind of located-objects.

Location information can be used to weight the choices exhibits and sections that are nearby. It can be shown that proximate selection dialogs for exhibits and sections are as follows: the name of the exhibit, the location and the distance from the user and also the next section of exhibits. One interface issue is how to navigate dialogs that contain this additional location information.

Another factor that proximate selection interfaces must take into account is bandwidth requirements. Presenting information that changes, either due to the user moving or the contents of the dialog changing for instance like people moving will cause update to the network traffic. One approach is to view location information with more or less precision based on the situation [8].

User interfaces for proximate selection pose some challenges. Map imagery may provide a good User interface metaphor [8]. Since proximate selection may occur on a mobile host, the user interface techniques developed must take into account device capabilities such as screen real-estate and communication bandwidth.

2.3.2 Automatic Contextual Reconfiguration

This is the automatic selection of information or altering components based on context. For example, a white-board application may bring up new or existing pages when a person enters a new room, or an operating system may decide to spin down a disk when AC power is disconnected [7].

Reconfiguration is the process of adding new components, removing existing components or altering the connections between components. Typical components and connections are servers and their communication channels to clients. However reconfigurable components may also include loadable device drivers, program modules

and hardware elements. In the case of context-aware systems, the appealing aspect is how context of use might bring about different system configurations and what these adaptations are.

Systems that reconfigure based on context are subject to the same problems faced by reconfigurable systems in general. If the context is changing rapidly it may be distracting to the user or impractical to adapt to every change. Also, certain adaptations may confuse users, mainly if the context is incorrectly reported, if the user is unaware of what context an application considers relevant, or if the context changes during use.

2.4 Push Technology

There are also other technologies used in LBS these days. For example, LBS using pull-based and push-based concept. These technologies are associated to the information being portrayed at the client side of the system. When information is portrayed to the user at the mobile devices of the users it can be automatically sent to the users or users subscribe for further details of the information.

As for this section, the discussion on push technology will be stated. Push technology means data distribution technology in which selected data is automatically delivered into the user's computer or mobile device at prescribed intervals or based on some event that occurs.

There are a few advantages of push technology that can be discussed for the implementation of this project. Those advantages are:

- The push technology can reduce the burden of acquiring data for tasks where occasional, time-critical data must receive immediate attention.
- The push technology can reduce the burden of acquiring data for tasks in which there is a large information flow.
- Able to target users with more precision, focusing on those who are more likely to benefit from their products or services.

CHAPTER 3
METHODOLOGY

3.1 Procedure Identification

In this section, discussion regarding the methodology used for this project will be made. Iterative Development is used to develop this project. Since this project may require change of requirements from time to time during the development, there is a need to support process iteration where parts of the processes are repeated as system requirements evolve [14]. For the development of this project, Rapid Application Development (RAD) will be used considering the time frame given is quite short. This development method was chosen based on categories that indicate the suitability of adopting this development method. The RAD category suits best with this project would be Iterative Development.

In this section, discussion will be about the planning, analysis, design and implementation phase. Planning phase includes planning the development of the project such as its scope, feasibility and time frame while analysis phase includes information gathering and information analysis. The design phase will be discussing about the layout of the project and the architecture that is intended for use for this project. Lastly, the implementation phase tells about the description of this Cooperative Gallery using Push Technology via Bluetooth project. In this implementation phase also details on the functions of this project will be discussed.

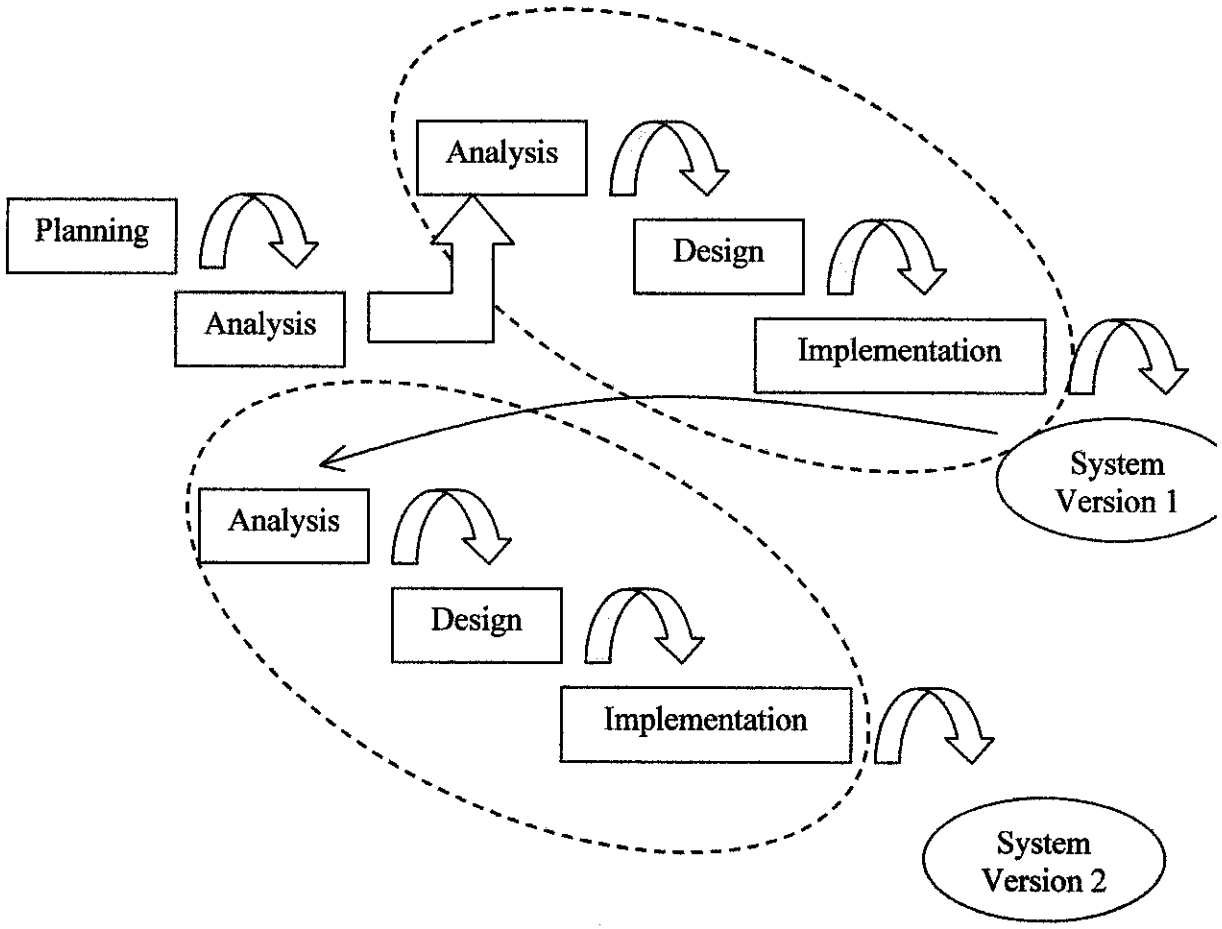

Figure 3: Iterative Development Methodology

Figure 3 above shows the Iterative Development methodology that has been applied in completing this project. The iterative methodology breaks the overall system into a series of versions that are developed sequentially. The analysis phase identifies the overall concept; information gathering and information analysis then categorizes the requirement into a series of versions. The most important requirements are collected into the first version of the system. The analysis phase then leads into design and implementation, but only with the set of requirements identified for version 1.

The vital idea behind iterative enhancement is to develop a software system incrementally, allowing developer to take advantage of what was being learned during the development earlier, incremental, deliverable versions of the system. Key steps in the process were to start with a simple implementation of a division of the software requirements and iteratively improve the developing sequence of versions until the full system is implemented. At each iteration phase, design modifications are made and new functional capabilities are added. These steps of iteration are being practiced in developing this project. To go into details on each phases of this methodology, descriptions regarding the activities done in each phases are about to be discussed below.

3.1.1 Planning phase

For the planning phase, a project schedule is planned along with the supervisor in order to commit to this project. The project schedule is planned in order to ensure that the reports that need to be submitted in partial fulfillment for this course meet the submission date. Planning also includes describing the major areas of research, determining the scope of studies, problem statement and the proposed solution towards the problem. Literature review, journals and thesis have been reviewed for further supporting of the research. During this phase is also to ensure that each development of this project is going according to plan and its time frame.

3.1.2 Analysis Phase

For Analysis phase, the plan is to gather as much information as possible on various parts of project, let it be the technical information or just feedback from people who are interested in this project. For this phase there will be two sub sections involved which are Information Gathering and Information Analysis. The information gathering and

analysis will be done in the form of giving out questionnaires to students for them to answer. The responds from the questionnaires will then be tallied and tabulated and will be included in the Results and Discussions section.

3.1.2.1 Information Gathering

In order to start gathering information, there are a few ways that need to be considered. First is the requirement analysis followed by requirement specification and lastly requirement validation. Requirement analysis is the practice of obtaining the system requirements through observation of existing research projects, task analysis and others. Requirement specification is translating the information gathered during the analysis into a set of requirements document. The last phase, requirement validation is to check the requirements for practicality, consistency and comprehensiveness. By practicing these three techniques stated, the process of gathering information will be complete.

In gathering information, the method applied is by using Questionnaires. A questionnaire is a numerical survey handed out in paper form usually to a specific demographic to collect information to provide better service or goods. Questionnaires are a precious tool for studying the attitudes, interest, desires, and priorities held by an interest group. By creating a questionnaire and collecting responses, a profile of a group can be drawn and perhaps perform analysis to understand the source of those responses. The survey findings can then support fact-based continuous improvement projects towards the goal of enduring competitive benefit.

For this project, decisions have been made to construct a questionnaire to be distributed out to people in order to gather information from people regarding this project. The purpose of the survey being made is to determine the acceptance and effects of implementation of this project within the UTP campus area.

In developing the questionnaire, the goal is to ask the specific group of interest questions regarding the implementation of this project and how it will affect this group of people. As for this project, the target audience or group of interest would be the students in UTP. The questionnaire that will be given out to the students would be in a form of Online Survey. With the help of Online Survey, it could somehow ease up the work of tabulating the responds from students. Furthermore, students of UTP are often attached to their computers and are always spending time on the Internet, so the decision on constructing an Online Survey would be appropriate and accessible by all. After receiving feedback from students from the questionnaire, the analyzing the data part will be taken into consideration.

3.1.2.2 Information Analysis

After the information has been gathered through the questionnaires, the data are then collected and analyzed. The steps to analyzing the information are:

- Monitor response rate

  It will be important to monitor the response rate regularly; in case of there are any plans for follow-up in order to complete the project.

- Review and edit survey returns

  It is very important to evaluate and edit survey returns before expecting tabulating them into the computer. To ensure the data is precise, review each return, clarify unclear responses and correct inaccurate respondent rewrites and marginal notes.

- Enter data

  The way of entering data can be in the form of spreadsheet, database, and statistical software.

- Analyze response

  Once response from respondents is entered, the data will then be analyzed to measure how well did the respondents react to the questionnaire.

- Generate and display findings

  When data provided by respondents has been entered and processed, findings can be generated and displayed in ways that facilitate interpretation. For comprehensive answer, ranked lists, tables, and cross-tabulations will be accommodating. Charts and diagrams may also be obliging.

- Draw conclusions

  Depiction of conclusions about survey findings concerns translating what they mean for the issues at hand and making practical recommendations about how to address those issues.

The information gathered and analyzed will then be included in the Results and Discussion chapter.

3.1.3 Design Phase

For the design phase, this is the part where the layout of this project is laid out. Furthermore, the architecture of this system is planned. The system has been tested on two mobile phones, which one of them acts as the master and another as the slave. The system is implemented in a client-server configuration. The master acts as a Server providing information to the slave which acts as a Client. The Server will automatically send the location information to the Client once a Client arrives upon a specific section of the UTP Gallery.

3.1.4 Implementation Phase

In the implementation phase would be the part where this project is finally implemented. Cooperative Gallery using Push Technology via Bluetooth is a system that emphasizes on locating the sections of a gallery using Push Technology. This project is to assist visitors to guide their way through the UTP Gallery.

As stated in section 3.1.3, the implementation of this project is done by using Push-based concept since the Server will automatically send information to the respective Client. The functions of Server and Client stated in section 3.1.3 will be developed and implemented during this phase. The push-based concept will be applied to this project.

3.2 Tools Required

3.2.1 Software

The software used in order to develop this project is:

- Java Wireless Toolkit by Sun Microsystems with Java API Bluetooth Wireless Technology (JAWBT)

3.2.2 Hardware

The hardware used for developing the system is:

- Mobile phones with Bluetooth Capability
- Laptops with Bluetooth Capability

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Analysis Phase

From the replies gathered from the questionnaire distributed to students, the data collected are then interpreted into charts and graphs for better understanding. There are 20 students who answered the questionnaire and all of the 20 students responded overwhelmingly. The questionnaires that have been distributed to the students have been attached in the Appendix section.

4.2.1 Results

Below is the elucidation of each of the 10 questions provided in the questionnaire. The Results from the respondents from the questionnaire given is graphed and analyzed using graphs and charts as the representation.

Question 1 : Gender

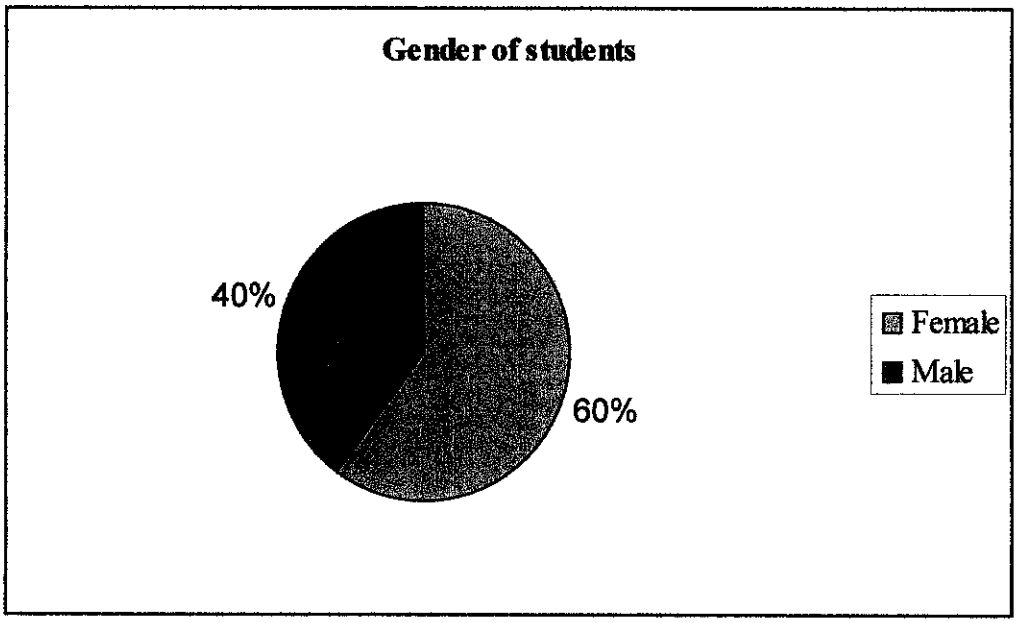

Figure 4: Gender of Students

Most of the students who answered the questionnaires are female students. 60% out of all of the students are female students.

Question 2 : Which programme are you enrolled in?

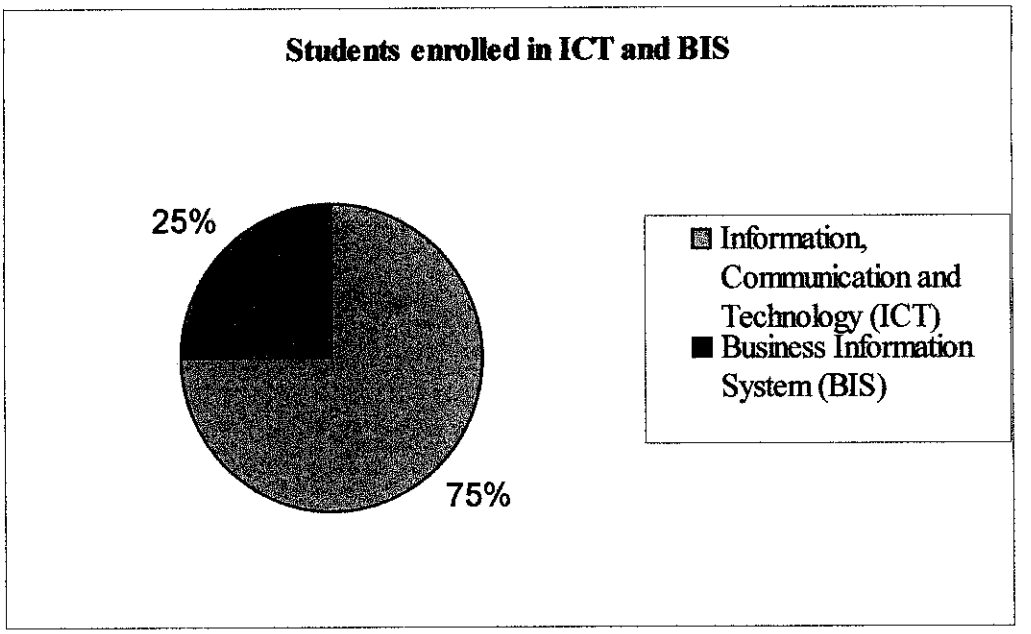

Figure 5: Percentage of Students Enrolled in ICT and BIS

With the percentage of 75% of students who responded to the questionnaire, it shows that most of the students who answered the questions are students enlisted in Information Communication Technology (ICT) programme.

Question 3 : Do you own any Bluetooth enabled phone?

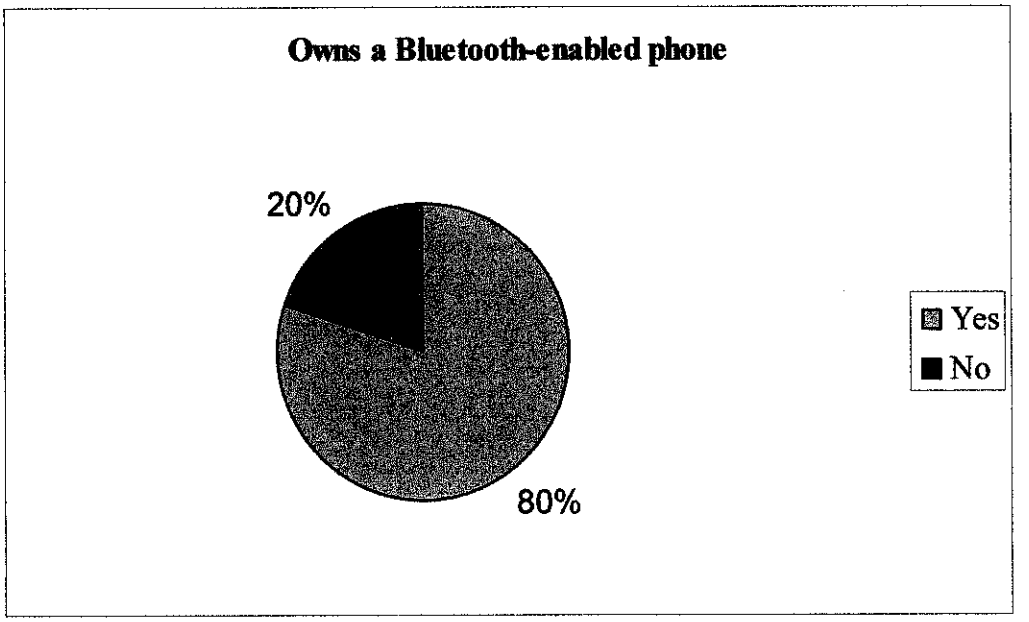

Figure 6: Percentage of students that owns a Bluetooth enabled phones

The pie charts represent the percentage of students owning a Bluetooth enabled mobile phones. Since the current markets nowadays are selling Bluetooth enabled mobile phones widely throughout the country, the percentage of students owning one is high. Only 20% of students do not own a Bluetooth enabled mobile phones.

Question 4 : How often do you use Bluetooth?

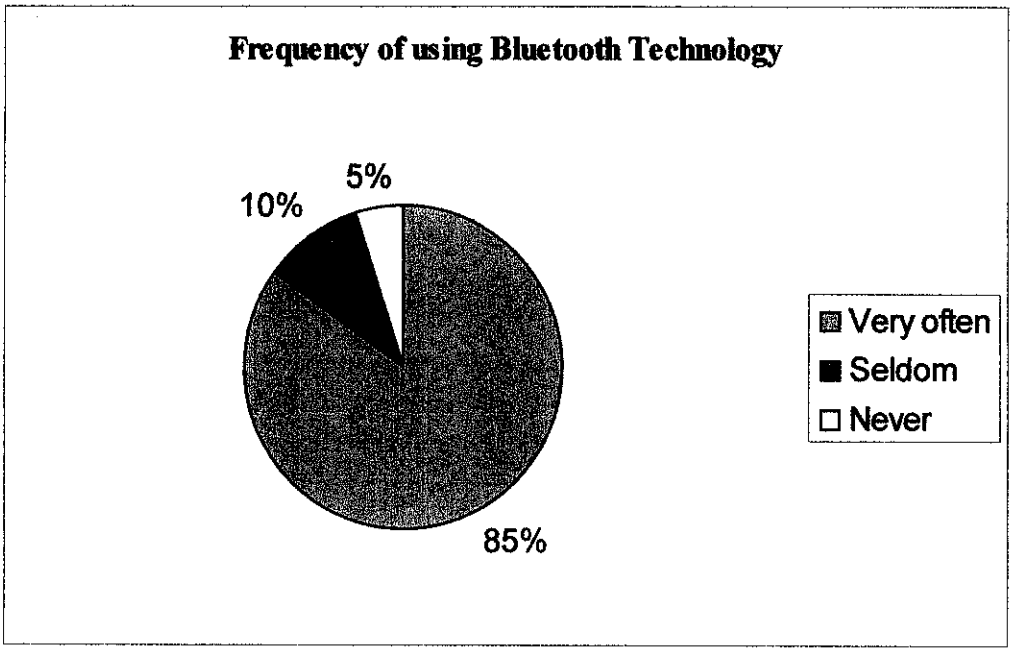

Figure 7: Number of students who often engage themselves in using Bluetooth

This pie chart shows that 85% of the students use Bluetooth technology through their mobile phones very often. Due to the new technology advancement in sending data via Bluetooth, this causes students too to engage themselves in using the technology. The examples of data transmission using Bluetooth nowadays is sending pictures, ringtones and other data via Bluetooth. While other 10% of students seldom use this technology and only 5% percent of students never use the technology due to the fact that they do not own a Bluetooth enabled mobile phone.

Question 5 : How do you rate the Bluetooth technology?

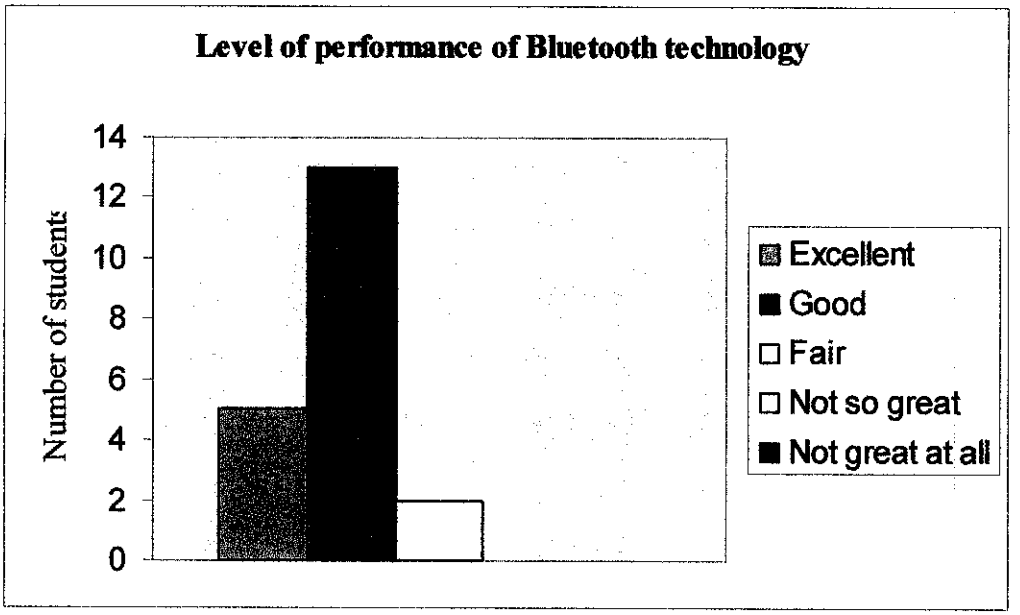

Figure 8: Level of Performance of Bluetooth Technology to students

Based on the bar chart above, 13 students rate excellent for the level of performance of the Bluetooth technology. This proves that 65% of the students agree that Bluetooth gives high impact on the usage of the technology. Only 10% of students claimed that the technology is not great at all.

Question 6 : Have you been to the University Technology Petronas Gallery?

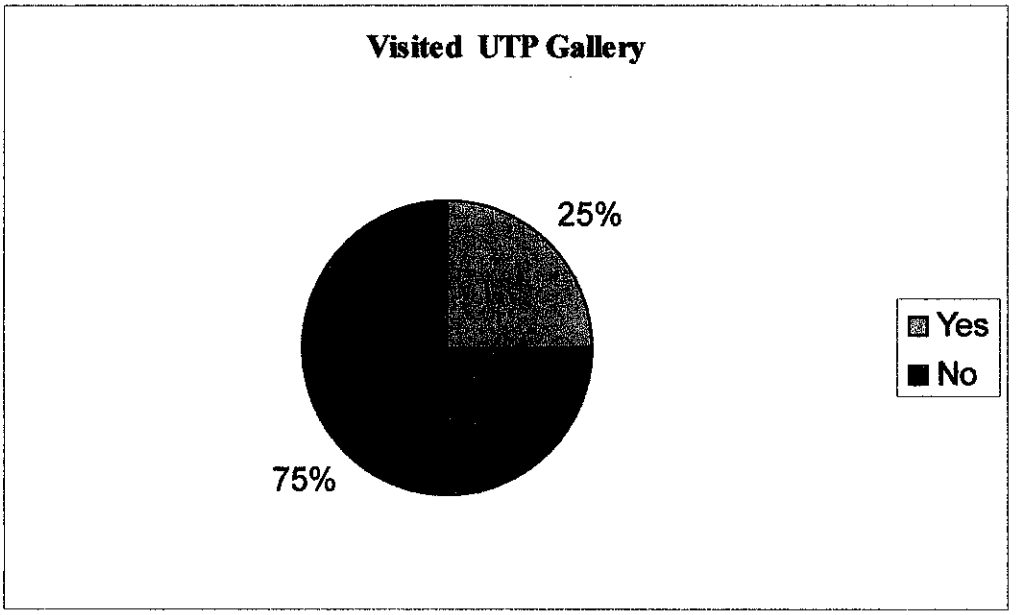

Figure 9: Percentage of students visited to the UTP Gallery

Based on the pie chart above, only 25% of students responded that they have been to the Universiti Teknologi PETRONAS Gallery. This shows a very small amount of number of visitors. With this respond, a new approach needs to be implemented to the gallery in order to promote more visitors to visit the gallery.

Question 7: How do you find the presentation of the information there?

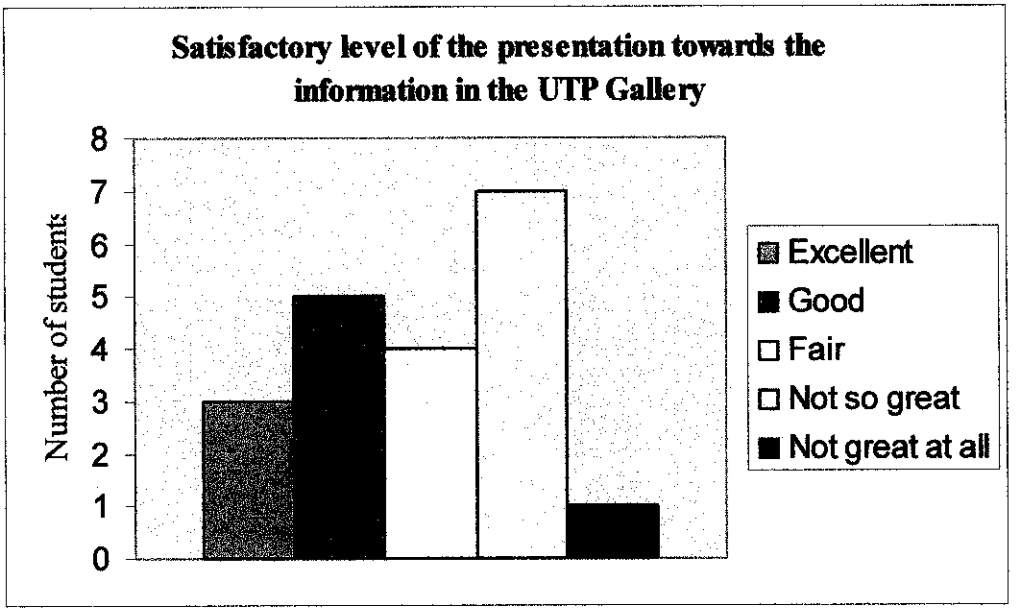

Figure 10: Satisfactory Level of the presentation towards the information in UTP Gallery

Based on the bar chart above, the highest number of students responded that the information was "not so great". This may be the reason that not many visitors visited the UTP Gallery. The information presented need to be more accessible to be viewed by the visitors.

Question 8 : Do you think the Universiti Teknologi PETRONAS Gallery need to propose a new approach of presenting the current information in the gallery?

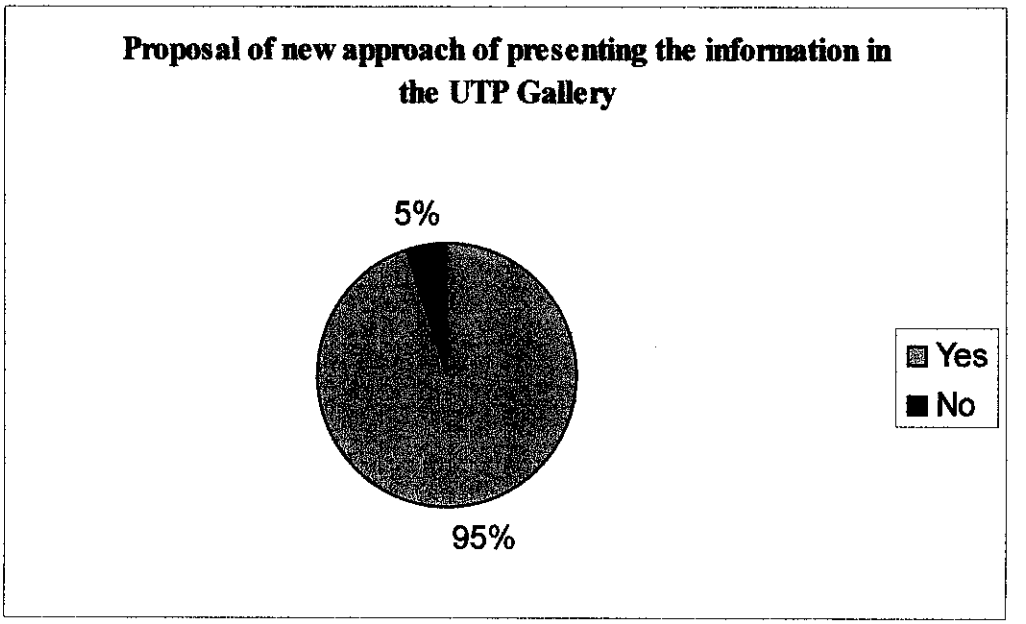

Figure 11: Percentage showing how the proposal of the new approach of presenting the information in the UTP Gallery is agreed by the students

Since the UTP Gallery is portraying the conventional way of presenting its exhibits and its information, this question arises to question the students whether they would want a new approach in venturing inside the gallery. From the responds from the questionnaires, 5% of students who do not want a new approach being implemented to the UTP Gallery while other 95% of the students are eager for a new approach of exploring to the Gallery.

Question 9 : Are you interested with a new technology that enables you to detect the section of the Universiti Teknologi PETRONAS Gallery using your Bluetooth enabled mobile phone?

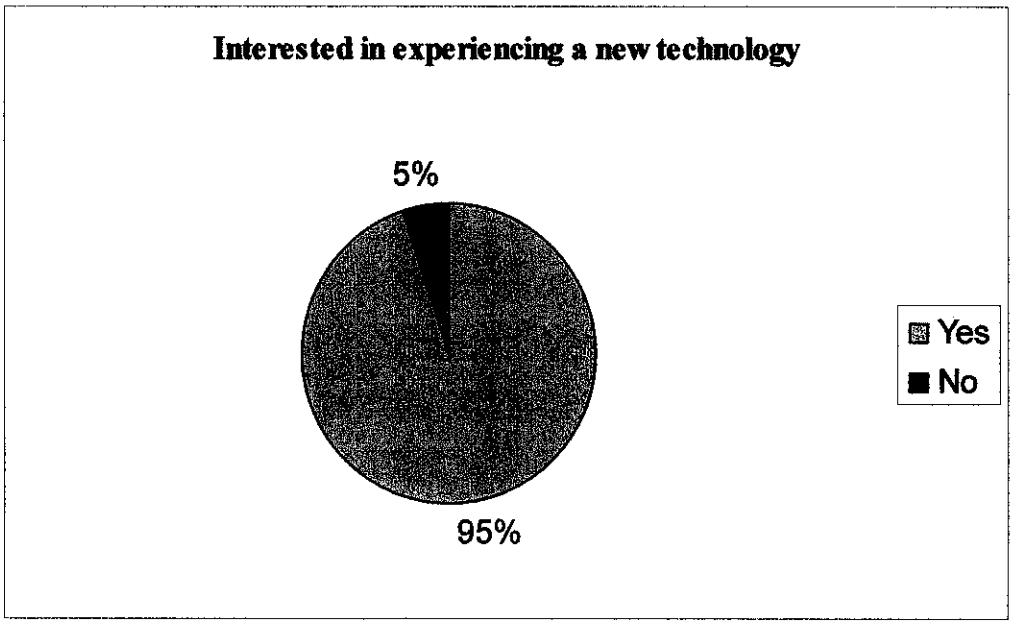

Figure 12: Percentage of students who are interested with a new technology of detecting location around the UTP Gallery using Bluetooth enabled mobile phone

Based on the pie chart in Figure 13, 95% of the 20 students who answered the questionnaire are interested in experiencing a new technology to venture around the UTP Gallery using their Bluetooth enabled mobile phones. Meanwhile the other 5% of students are not interested is due to the fact of the unavailability of owning a Bluetooth enabled mobile phone.

Question 10 : Will the implementation of the new system helps to promote more visitors to visit the Universiti Teknologi PETRONAS Gallery?

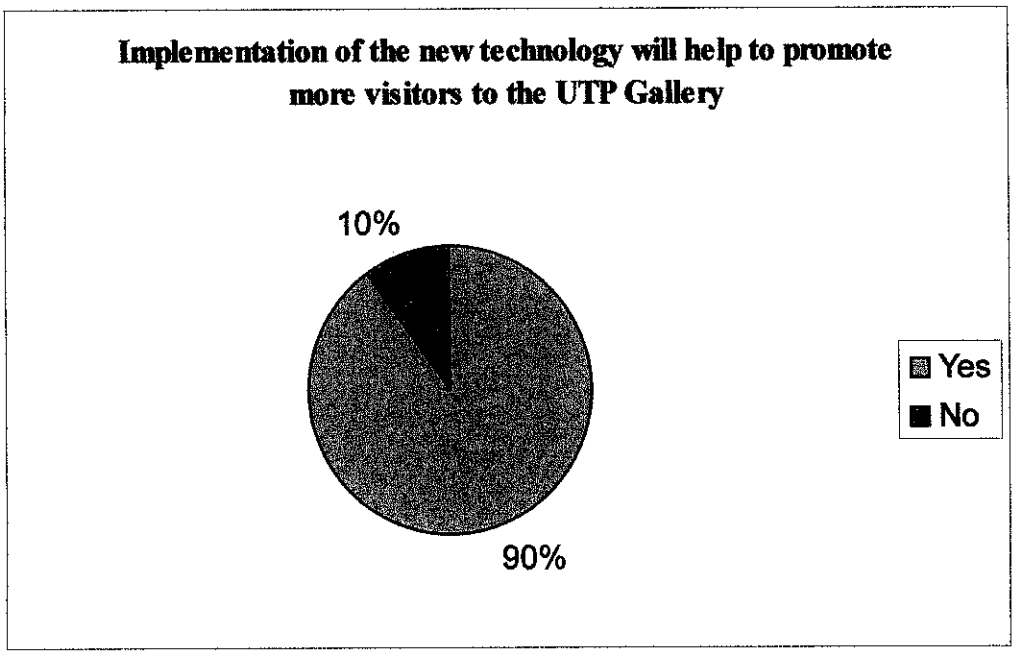

Figure 13: Percentage of students who wanted new technology implementation in order to promote visitors to the UTP Gallery

As for the reason of promoting UTP Gallery to be visited by many more students, 90% of students agree that with the new technological advancement in mobility around the Gallery could certainly increase the amount of visitors to the Gallery. While the other 10% of students disagree that this new advancement could affect the amount of visitors to the UTP Gallery.

4.2 Design Phase

As for the design phase that has been explained in Section 3.1.3, the design of the Client-Server configuration will be implemented.

4.2.1 Results

For the results of the design phase stated in Section 3.1.3, the outcome from the methodology that has been laid out is that to derive a system architecture regarding the Client-Server configuration of this system. The figure of the system architecture is shown below.

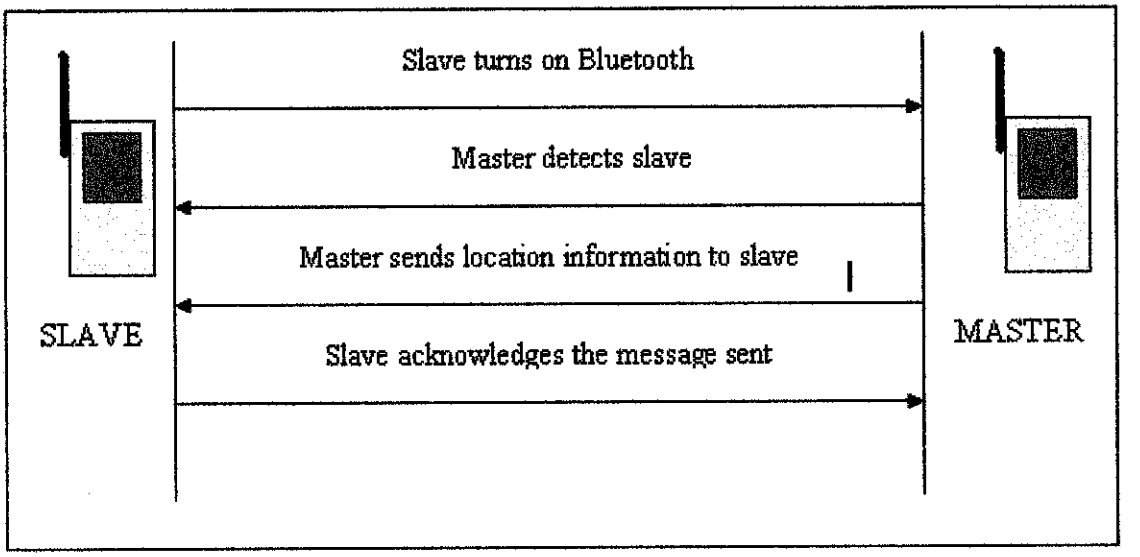

Figure 14: System Architecture

Both the server and client can be on any mobile phones, as long as it has Bluetooth service and can install java application as Java Wireless Toolkit is used to implement this system.

4.3 Implementation Phase

For the implementation phase, this is the part where the system architecture will be implemented into the system. Details of the system architecture and the functions will be stated in the Results section, 4.3.1.

4.3.1 Results

The main components and operation sequence of the system are referred to the system architecture that is presented in Section 4.2.1:

1. Slave turns on Bluetooth capability for available server within its range.
2. Master detects Slave's availability.
3. Once Master has detected Slave, Master sends information regarding the section Slave is currently at to the Slave.
4. Slave acknowledges the message received and proceeds to the next section of the Gallery.

Both the server and client can be any mobile phones, as long as it has Bluetooth service and can install java application. To employ this system, user need to download the java application into the mobile phone, install it and it is ready to use.

In this review, the application is stored inside a laptop. It is transferred to the mobile phones using Bluetooth connection.

This project allows location of user to be transferred from one phone to another. It is intended to be run on two or more phones with one of them that act as a server and the other phone acts as a client retrieving the information from the server.

From the design phase that has been stated earlier arise the implementation of the design of the system layout. The screen shots of the system that have been implemented will be included here in this particular section.

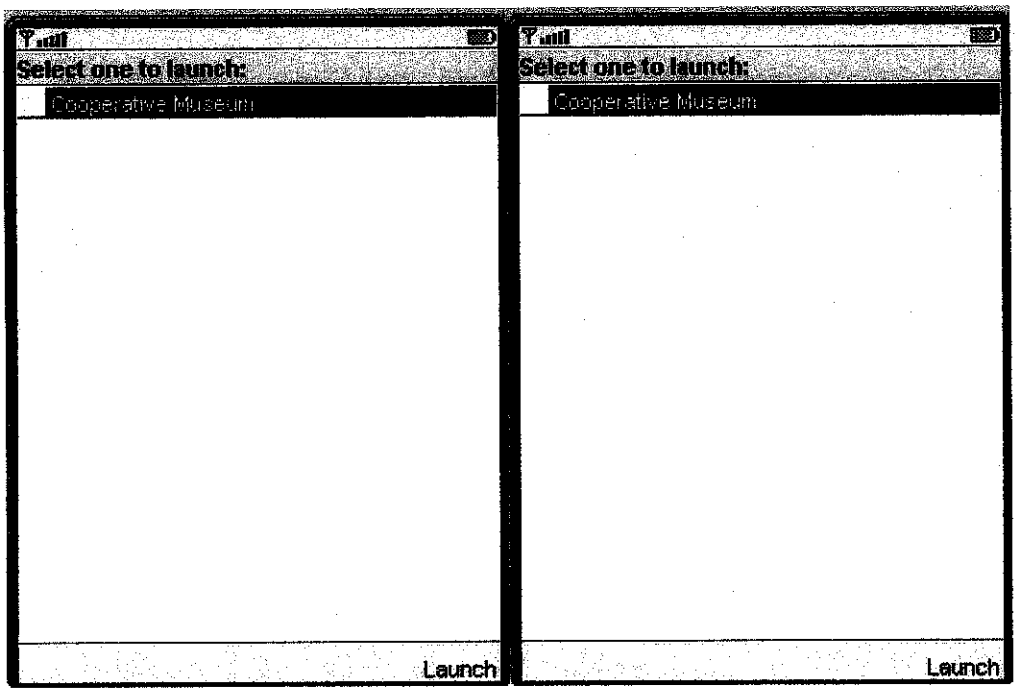

Figure 15: System configuration on Server and Client Side

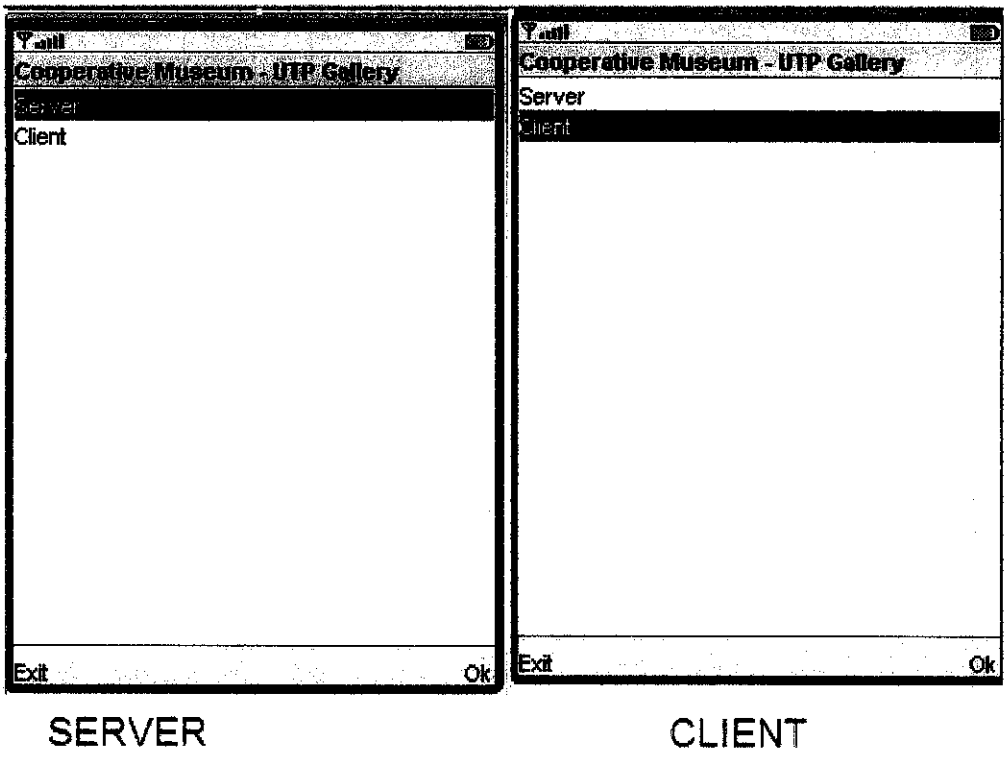

Figure 16: Selection for being a Server or Client by User

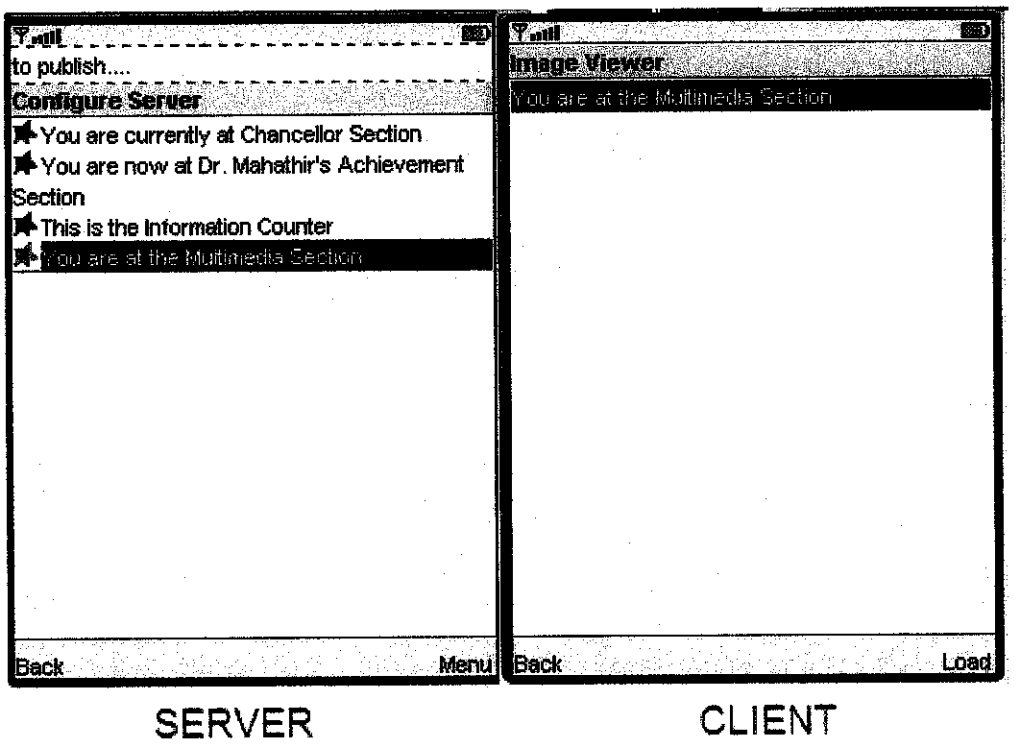

Figure 17: Configuration of Server when Client is at the Current Location

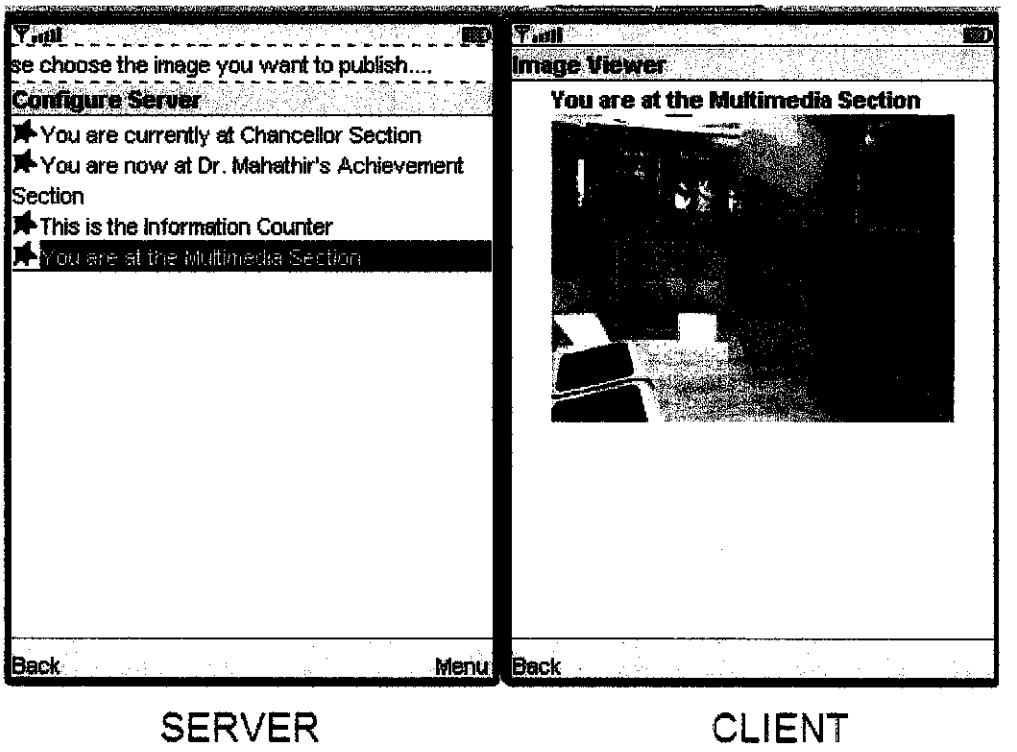

Figure 18: Location Information on the Client Side

CHAPTER 5
CONCLUSION AND RECOMMENDATIONS

The "Cooperative Gallery using Push-Based Technology via Bluetooth" that has been developed is similar to the location detection system where user can detect the exact location that they are currently are now. The only difference is that the scope has been narrowed down to implementing the system indoors such as the UTP Gallery as a start before implementing it to a real museum. In order to meet the objectives of this project, studies have been made and the implementation of the project will be integrated with wireless technology. This project operates on a mobile phone with Bluetooth capabilities. In turn to instigate the system, a few points need to be pondered. Those points are the usage of push-based concept for the system, the performance of the hardware used to implement the system and also the features of the system which is the accuracy of the location information displayed when this system is being used. Therefore, it has become clear that, the implementation or development of this system requires a lot of study based on the points stated. Plans have been made to improve the research for this project in order to get it done perfectly by doing in depth coverage about the parameters involved in creating the system. However, there are some difficulties that have been faced in order to complete this system. With the implementation of this project, it can be concluded that a location based system using Bluetooth technology has been implemented in this project. Therefore it can be alleged that the objectives that have been stated earlier for this project have been met.

5.1 Future Work

Due to the time constraint, this project is not able to be implemented on the mobile phone itself but it will be represented using an emulator to demonstrate how this project works. This issue can be overcome if given more time to work on. So, the implementation of this project on real mobile phones will be considered as the future enhancement for this project.

However, a widespread and longer user study will be needed to provide real assessment of the acceptance of the implementation of this Cooperative Gallery project. Furthermore, a larger scale operation would require a systematic validation of the specification for this project.

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APPENDIX

Final Year Project Survey

This survey is to obtain feedback from respondents regarding my Final Year Project which would be the implementation of a system using Bluetooth Technology.

---

der

- Male
- Female

---

ich programme are you enrolled in?

- Information & Communication Technology (ICT)
- Business Information Systems (BIS)

---

you own any Bluetooth enabled phone?

- Yes
- No

---

v often do you use Bluetooth?

- Very Often
- Seldom
- Never

/ do you rate the Bluetooth technology?

- Excellent
- Good
- Fair
- Not so great
- Not great at all

'e you been to the Universiti Teknologi PETRONAS's Gallery?

- Yes
- No

---

v do you find the presentation of information here?

- Excellent
- Good
- Fair
- Not so great
- Not great at all

---

you think the Universiti Teknologi PETRONAS need to propose a new approach of presenting the current ıtion in the gallery?

- Yes
- No