



UNIVERSITI PUTRA MALAYSIA

**PERSONAL DIGITAL ASSISTANT (PDA) BASED CLIENT/SERVER DATA
COLLECTION SYSTEM**

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**PERSONAL DIGITAL ASSISTANT (PDA) BASED CLIENT/SERVER DATA
COLLECTION SYSTEM**

By

NAGALETCHUMI BALASUBRAMANIAM

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Partial Fulfilment of the Requirements for the Degree of Master of Science**

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DATA COLLECTION SYSTEM**

By

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Nowadays, in the competitive world, mobility plays an important role in the business and daily lives. Personal Digital Assistant (PDA) is one of the most actively developing areas in computer systems technology. PDAs start replacing PCs especially where PCs and Internet/Network technology do not reach. PDAs are being used to access, monitor, and control database management system of organizations. This work investigates the issues involved in designing and developing a PDA based client/server data collection system for an inventory control of a hypermarket. This thesis also provides a comprehensive discussion on the software and hardware aspects of the data collection system. Personal Digital Assistant (PDA) module is used as a base unit in this research. Application software has been developed for the PDA and PC. Interfacing the software provides the system to function in a client server environment. The performance of the system in terms of memory usage by the PDA and synchronization time has



been studied, as these are important parameters from user point of view. Further integration of PDA with wireless technologies and other peripheral devices are discussed as future work of the research.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**SISTEM PENGUMPULAN DATA BERASASKAN KONSEP
PELANGGAN/PELAYAN**

Oleh

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Kini, keupayaan mudah alih memainkan peranan yang penting dalam dunia perniagaan dan kehidupan seharian. Pembantu Peribadi Digital (PDA) merupakan bidang yang membangun pesat dalam arena teknologi sistem perkomputeran. PDA mula menggantikan keperluan komputer, di mana komputer, Internet and sistem rangkaian tidak didapati. Penggunaan PDA kian menyerlah dalam sistem pengurusan data/maklumat organisasi. PDA digunakan sebagai alat untuk menyimpan dan mengawal pengurusan data organisasi. Kajian ini bertujuan untuk mereka bentuk rangka kerja dalam membangunkan sistem pengumpulan data berasaskan konsep pelanggan/pelayan. Sistem ini telah diaplikasikan untuk mengumpul data inventori di sebuah pusat perniagaan. Kajian ini juga akan membincangkan secara terperinci tentang keperluan perkakasan dan perisian untuk membangunkan sistem ini. Kajian ini berasaskan PDA sebagai modul utama. Perisian telah direkabentuk untuk keperluan pengumpulan data pada PDA

dan untuk keperluan penyimpanan data pada komputer. Integrasi kedua-dua komponen ini membolehkan sistem berfungsi berasaskan konsep pelanggan/pelayar. Kemampuan sistem yang direkabentuk dikaji dari aspek penggunaan ingatan pada PDA dan juga masa yang diperlukan untuk mensegerak data dari PDA ke komputer memandangkan ia merupakan parameter yang penting pada sudut pengguna. Sistem pengumpulan data ini boleh dipelopori untuk keperluan lain dengan penggunaan konsep dan teknologi yang sama. Penggunaan teknologi wayarles dan penggabungan perkakasan lain ke sistem turut dibincangkan untuk keperluan masa hadapan.



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I certify that an Examination Committee met on _____to conduct final examination of Nagaletchumi Balasubramaniam on her Master of Science thesis entitled “Personal Digital Assistant (PDA) Based Client/Server Data Collection System ” in accordance with Universiti Pertanian Malaysia (higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I here declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

NAGALETCHUMI BALASUBRAMANIAM

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LIST OF ABBREVIATIONS

API	Application Programming Interface
CAPI	Cryptographic Application Programming Interface
CGI	Common Gateway Interface
DAO	Data Access Object
DBMS	Database Management System
ECG	Electrocardiogram
EEPROM	Electrically Erasable and Programmable read Only Memory
GNU	GNU's not Unix
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communication
GUI	Graphical User Interface
HTTP	Hypertext Transfer Protocol
IrDA	Infrared Data Association
IrMC	Infrared Mobile Communication
JDBC	Java Database Connectivity
JVM	Java Virtual Machine
LAN	Local Area Network
LCD	Liquid Crystal Display
MIPS	Multipurpose without Interlocked Pipeline
ODBC	Open Database Connectivity



OLE	Object Linking and Embedding
PDA	Personal Digital Assistant
PKI	Public Key Infrastructure
RAM	Random Access Memory
RMI	Remote Method Invocation
ROM	Read Only Memory
RTOS	Real Time Operating System
SSL	Secure Sockets Layer
SQL	Structured Query Language
TCP/IP	Transmission Control Protocol/Internet Protocol
USB	Universal Serial Bus
VM	Virtual Machine
WAP	Wireless Application Protocol
WIM	Wireless Identification Module
WML	Wireless Markup Language
WTLS	Wireless Transport Layer Security
WWW	World Wide Web
XML	Extensible Markup Language



CHAPTER 1

INTRODUCTION

1.1 General Overview

The ever-fast innovation and diversification of development in the computer systems and mobile technology have brought significant impacts to our daily lives. One of the most active areas of computer system development today is Personal Digital Assistant or PDA.

PDA is replacing PC especially where PC and Internet/Network Technologies do not reach. This is true as today's world demand the necessity of miniaturization and its thirst to execute the latest technology is escalating.

Mobile and wireless devices such as cellular phones, pager, and PDAs are widely used to get information. People want to send and get information freely, that is, at anytime any locations. So it is practical for people to have a handheld computer in a pocket rather than a desktop or laptop and to have access to information whenever and wherever they need it.



The characteristics and advantages of a PDA have been exploited for well-beings of mankind. PDA based systems are used in government sectors such as education, healthcare, rural development, transport system, social marketing, and agriculture. On the other hand, PDA based systems are used in private sectors such as pharmaceuticals, healthcare, wholesale, retail, distribution, telecom, communications, banking, and insurance.

PDA based systems are used vastly due to its benefits and the device characteristics. The device attracts the end users by being user friendly and providing portable technology. The electronic data collection systems develop based on PDA are an effective reach system, while eliminating redundancy of data, paperwork, and swift in implementation of various management activities.

1.2 Personal Digital Assistant (PDA)

PDAs have recently become a popular organizing and planning tool as they serve the function of cumbersome pen-and-paper day timers, address books, and to do lists in a compact, user-friendly electronic format. PDAs are not bigger than an average sized calculator. There are wide varieties of PDAs available for both business and personal market. Some PDAs also support other functions, such as video playback and voice recording.



PDA is a portable device that can receive, manipulate, and send information. With the functions the device can provide, it increases the flexibility for users. Furthermore, it has large range of applications on it. These applications can be manipulated to increase the productivity and mobility of business, ease our livings and others. Moreover PDAs are compatible with a variety of operating systems and has low maintenance cost. Generally PDA encompasses most of the flexibility and power of a laptop and personal computer but in a pocket-sized form.

PDAs do not develop their full potential unless they are connected to applications and services through the Internet. There are a number of ways how a PDA can be connected to the desktop data. They are direct serial connection which most of the current users are familiar with, dial-up connection, and network connection.

Wireless technology gives an important breakthrough for PDA users and software development organizations to develop applications and services based on PDAs. Several wireless protocols for PDA already exist and most are evolving rapidly.



1.3 Electronic Data Collection System

Data collection technology has taken giant leaps forward over the last 30 to 40 years. Earlier days, pencil and paper approach were widely used but today, numerous devices and options are available for gathering data. The optimal choice depends on several factors, including the complexity of the task, the speed, accuracy, and documentation required. Data collection systems range from the simple to the complex, with a range of performance and functionality.

Electronic data collections become popular as it provides several advantages over the conventional data collection methods. Elimination of clipboards, paper maps, handwritten worksheets, and the collection of more data in less time are a few basic advantages over the conventional paper based data collection methods.

Other advantages includes the elimination of data re-entry, branching, real-time error checking, an integrated Global Positioning System (GPS) interface, and enhanced data integrity. Collecting data using pen and paper eliminates the task of transferring data into electronic format. Post-processing of data into electronic media often involves manual data entry, which susceptible to error. This process is often time-intensive and costly.



Furthermore, electronic data collection is an efficient and effective mean of collecting data. The capabilities of this system are only limited by the ability of the mind to find new applications for the technology.

1.4 Problem Statement

Nowadays, mobility has become an important factor in determining the productivity and enhancement of a business. On the other hand, PDA, are no longer seen as an executive toy but an important business and consumer tool. The features of the device, which is small, portable and light, increase the flexibility for the users. Moreover, PDA can be used as a powerful electronic data collection device. With that, PDA based handheld system is proliferated across many areas both in the government and non-government sectors.

As the business world is getting more and more complicated, many governmental and non-government organizations are facing problem in data management system. Data management system ranks from data collection, monitoring, and analysis as well. A flexible, electronic and mobile data collection system is needed to overcome the obstacles in today's competitive business world. The system must be able to receive, manipulate, and send data to the main server to be updated and allow the end users to exchange data among them.



PDA is a flexible, electronic, and mobile device. It is also capable of acting as a temporary storage of data. It minimizes the time and effort spent in the conventional method. Integration of the handheld system into the current heterogeneous system will provide a significant competitive advantage to forward-thinking organizations by extending the functionality of mission-critical applications to internal users wherever and whenever they need it. The return in both financial term and in organizational efficiency and effectiveness is compelling.

Even though, many systems exist for PDAs, systems designed to work in an integrated client/server environment will serve better the need of the users, (Carroll, 2001). Developing a data collection system which has the ability to link the data collected on PDA (client) to a central database (server) will provide the users of the system with unlimited advantages. Data synchronized from PDAs to terminals at different locations could be linked to the central database and any data updated on the central database could be distributed to the terminals and to the PDAs through the future synchronization.

This was the main motivation of this research, developing a data collection system in client/server environment. The system will offer the users an unlimited advantages and the system can be expanded to any other applications.