WEB BASED MODEL OF A DIGITAL FAX DOCUMENT MANAGEMENT SYSTEM

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UUM 2009

WEB BASED MODEL OF A DIGITAL FAX DOCUMENT MANAGEMENT SYSTEM

A Project Paper submitted to the Graduate School in partial fulfillment of the requirements for the degree
Master of Science (Information Technology)
College of Arts and Science
Universiti Utara Malaysia

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MAY 2009

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ABSTRACT

The Government of Malaysia has encouraged the use of Information Technology application among the public and private sector to enable both sectors to compete and provide better facilities. Most brick and mortar or physically located organizations also seek alternatives for handling the document management. Nowadays, most of the information in the organization is stored in unstructured manner that require certain technique to be applied in order to retrieve the important and relevant information from a large scale of collected data. A digital document management system takes advantage of advanced document analysis and management techniques. In this study, a document from the fax machine that is a structured data is used in the system to digitalize the fax documents into the document management system.

ACKNOWLEDGEMENT

In the name of Allah the most Gracious and Merciful, alhamdullilah for the strength that had been given to completed and finished this research. The completion of this research is through relentless coorporation of several persons in giving the guidance.

The utmost appreciation goes to my supervisor, Profesor Madya Fadzilah Binti Siraj for her guidance, counsel and patience throughout the research project. Her knowledge, advice, critic, help, support, and understanding helped me in writing this research.

Special thanks and appreciation goes to Tuan Haji Wahab bin Jusoh who is the Assistant Director General of Biro Tatanegara Jabtan Perdana Menteri Putrajaya, for his willingness to corporate in contributing some insights for this research project.

Warmest thanks to all my family especially to my sister that motivated me and always there for me even in the hardest time. Also thanks to others that has been tolerant and patient in supporting me in my efforts to compete this research project.

Thank you for the companion.
May Allah bless all of us.
Thank you.

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CHAPTER ONE

INTRODUCTION

The information technology (IT) revolution has empowered organizations and every individual as a whole. However, the critical difference of leading-edge organizations that want to stay ahead in the new economy will be the ability to manage their content. Information is now spruced all over the organization in faxes, brochures, tenders, drawings, e-files and single greatest task is to keep all this data systematically organized and available at any time. When information is freed from the physical limitations of paper and converted into an electronic format, it becomes a valuable strategic resource.

Instead of stashing business-critical documents in file cabinets, voluminous physical and electronic data into information databases could be easily retrieved. It will making easily retrievable by users throughout the enterprise and also make them available instantly if such information could be stored digitally. It save hundreds of staff's man hours a month, searching for critical documents and eliminate vital information from damage, pilferage, theft, misplacement or loss. This helps users focus on getting their jobs done, rather than spending precious time looking for files and information.

Loosing of paper documents in folders or binders was the factors to create digital file. Low information density and lacks of computational power put paper as a poor storage device. It is not easy to distribute or back up bulky and heavy documents. Therefore, digitize paper documents and make the documents searchable will manage the digital version of documents with database and local search engine (Suzuki & Wobook, 2009).

To date, a digital document management system takes advantage of advanced document analysis techniques. It may provide automatic archiving of documents and retrieval without the need to navigate through a directory structure or specify a filename. Document comparison is facilitated by automatic retrieval of a previous version of a document. A digital copier alerts a user when a document to be copied already exists electronically within a database (Cullen *at el.*, 1999).

Biro Tatanegara (BTN) is a government agency started in 1974 under Program Belia and known as Unit Penyelidikan Belia, Kementerian Kebudayaan, Belia dan Sukan. In October 1981, Unit Penyelidikan Belia has been stated under Jabatan Perdana Menteri (JPM). The former headquarters of Unit Penyelidikan Belia was located at Jalan Kelantan, Kuala Lumpur. However, in Jun 1982, the name has changed to Biro Tatanegara, Jabatan Perdana Menteri and three branch offices are built in north zone, south zone and east zone in Malaysia. Since 1986, BTN state branches are built and until now there are 14 BTN branches in all state. On 6 September 1999, BTN headquarters had been moved to Aras 1, Blok B3, Kompleks Jabatan Perdana Menteri Pusat Pentadbiran Kerajaan Persekutuan, Putrajaya (Biro Tatanegara, 2005).

BTN is one of the government departments that used computer systems in managing their organization. Many business transactions that involved in this department use paper documents such as faxed documents that normally represent unalterable, legally binding transactions that are essential for business processes. To manage the high volume of inbound and outbound faxes that is part of normal business activities, therefore the proposed Web Based Model of a Digital Fax Document Management System which is a prototype of management tool is designed to manage all fax documents within an organization. This is to ensure that there is a single database of information accessible from a single interface. The proposed prototype is developed with an aim to improve organization's management in such a way that the time taken to process and dissemination of manual information is reduced through digitized information.

Description of Document Transformation

The illustration of data transformation is shown in Fig. 1. The manual documents is first converted into digital form using the scanner and stored in the office workstation where the document management system is installed. All the data and documents is then transferred after the client server and secured in the database storage through the document management system. From this database, data and documents can be search and retrieved using the proposed system.

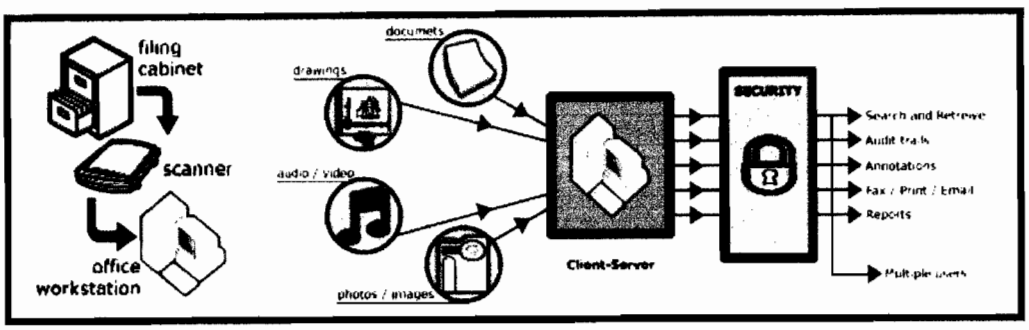

Fig. 1: Illustration of data transformation
(AmberSoft.Net, 2007)

Digital representations of pages that can be entered into the archives by copier scanning methods, (Fig. 2). The copier accesses the digital representations from remote archive servers or through standard scanning, fax scanning or computer generation of the page. The copier or computer sends a message to the archive server indicating that a new digital representation is being created and requested. The copier or computer may also provide the archive server and it allocates space for digital representation. This will generates the document including the location and transmits the document back to the copier or computer, receives and incorporates the document into digital representation of the page. It may affect the printing page with the documents and transmits a digital representation to the archive server. Appendix A provides a detailed implementation of Lopresti *et al.*, (1998) patent in United States Patent.

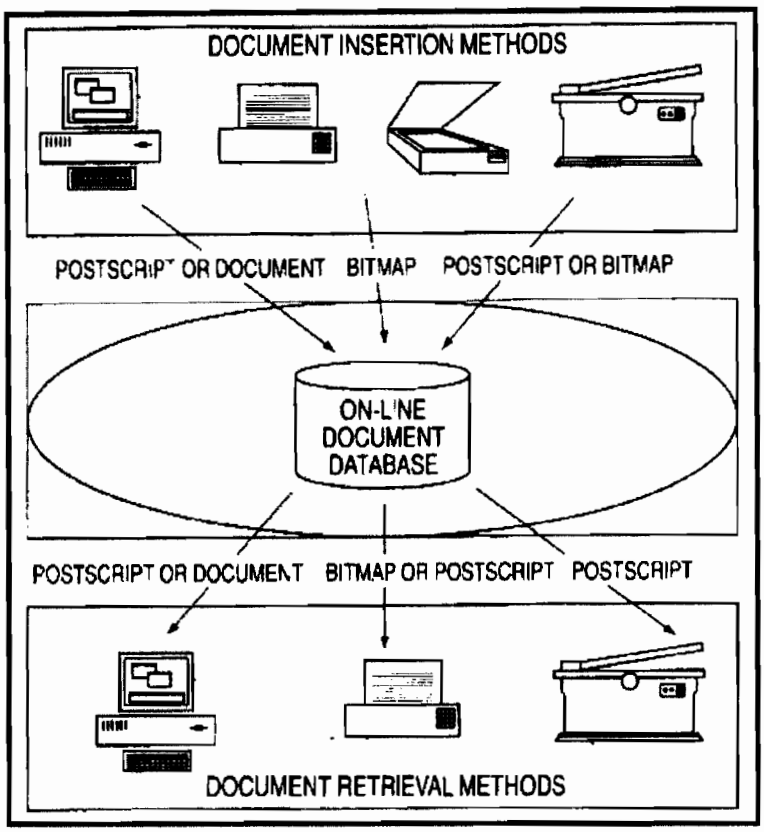

Fig. 2: Illustration of a comprehensive input, archiving and output system (Source: Lopresti et al., 1998)

Archive server is used as the storage location at which the digital representation will be stored and provide the location information for inclusion. The archive server stores the digital representations of each page and provides storage management and document management. Therefore, an overall network of perfect copiers, fax, computers and printers can be connected to an on-line database, archive server at which sufficient storage is available for all documents within the network. The on-line document will be adapted to provide storage management database and document management to the system.

Table 1: Fax Servers versus Fax Services - Pros and Cons
(Davidson Consulting Sturgis, MI, 2007)

	Fax Server	Fax Service	Server + Service
Pros	• Tight integration with local applications (Exchange, SAP, Oracle) • Control over in-house fax server • Higher customization capabilities • Mature technology, comfortable for late adopters	• Low up-front investment • Flexible cost varying with traffic • Unlimited capacity • No software to install or update • No hidden costs	• Tight integration with local applications (Exchange, SAP, Oracle) • Variable capacity of the service • Ensures service continuity (overflow and failover)
Cons	• Cost (software, hardware, hidden costs) • Fixed capacity • Requirement to manage hardware failure situations (expensive backup plans)	• Feeling of loss of control • Per-fax pricing may seem expensive for smaller volumes	• Cost of the server model (software, hardware, hidden costs) • Cost of the service model (when used for small volumes)

1.1 Problem Statement

No matter what the size or organization or industry is reliable, efficient and cost-effective, communication tools are essential for running a profitable and customer-service oriented business. While many organizations uses email, smart organizations still rely heavily on fax for their vital business communications. It remains the most universally accessible, reliable and secures method of document delivery available. Organizations that take faxing seriously today go beyond simple fax machines. They rely on a combination of fax server software and fax communication boards to facilitate fax delivery, receipt and management. This will reduce the waste of paper usage as while as space required to store the files of documents.

The proposed fax server solutions enable users to fax directly from desktop, email, Customer Relationship Management (CRM), Enterprise Resource Planning (ERP) and a host of other business applications. They provide the connectivity, performance and dependability essential for exchanging business communications. Besides, a disadvantage of current systems becomes apparent when there are phone line problems or the phone line at the remote destination is busy. Usually, fax machines or fax-equipped personal computers make repeated attempts which reduce productivity. This would burden the fax machine users of managing retries. Therefore, it is highly needed to design a digital fax document management system to support this fax server in managing the data and document through the organization management.

1.2 Research Objectives

The objectives are divided into main objective and specific objectives for this research. These objectives have been identified based on the problem statement which was stated in Section 1.1. These objectives are important for this project because facilitates motivation and direction during the development of the project.

1.2.1 Main objective:

- The aim of this study is to develop a prototype for Digital Fax Document Management System.

1.2.2 Specific objectives:

- To identify the system requirements of the application using a prototype.
- To design the architecture of the system.
- To evaluate a prototype based on the model designed.

1.3 Research Questions

This project intends to answer the following research questions.

1. What are the appropriate functions to manage the digital fax document?
2. How to design a prototype of a Digital Fax Document Management System?
3. How to implement the Digital Fax Document Management System?

1.4 Scope of the Study

BTN is one of the organizations that manage their administration with updated technology. This organization currently uses a web-based system among branches within every state in Malaysia. Therefore, this project focuses on fax document management from the manual fax machine to this digital fax document management system. The prototype of the software consists of faxing, administrating, searching and reporting functions. The platform to build the system will be web-based and the programming language will be PHP Hypertext Preprocessor (PHP), Dreamweaver MX and Apache Server (XAMPP Control Panel Application). The prototype will be proposed to BTN for accessing the management in managing their fax document.

1.5 Significance of the Research

The greatest challenge of the project is to create digital document management solution that is ready to be used without any complications. It will give:

- Time saving and increase productivity
  The most valuable asset of staff is free time to be utilized more productively in serving customers or efficiency in working. All information and data, documents and files required by every individual are available in the personal computer without spending their time looking for relevant documents.

- Reduces filling costs

  Typically, the law requires a business to save documents anywhere from seven years to a lifetime. The annual cost to store legacy documents can be reduced by storing at cheaper locations or in the case of some industries and eliminated completely. A digital document becomes easier to access than paper.

- Bringing out the best of staff

  It may not affect the organization with staff problems and also it will bring out the best from the staff or the organization. Besides, it will eliminate crippling and expensive human filing mistakes and may increased access to essential information.

- Improve access to information

  Groups of employees can share digital files more easily. Multiple copies can be sent to appropriate user via email and web-based information can be view by any staff with proper authentication.

The proposed study is expected to provide a document management system. Generally, this project serves as a prototype for the web based model of a digital fax document management system. Specifically, this prototype will be an application where it may provide more option to users in managing fax documents such as faxing, administrating, searching and reporting. In order to do this, a web based user friendly system that can be used by the organization officer or staffs is needed.

1.6 Summary

This chapter briefly presents an introduction to document management revolution, explaining the data transformation from filling to document management system which manipulates comprehensive input, archiving and output system that will be used in this project. From the problem identified in problem statement, the main objectives of this study is to develop a web based of a digital fax document management system using XAMPP control panel application that will implement the function of the prototype. The other main objectives are to help user to manage the fax documents in the system, to make storage of the fax documents and to retrieve the fax documents in a meaningful way. The related literature review for this study is presented in the Chapter 2. The methodology adapted in this study is presented in Chapter 3. The results of the study are discussed in Chapter 4. Finally, the conclusion and recommendation is presented in Chapter 5.

CHAPTER TWO

LITERATUR REVIEW

This chapter elaborates more on the research literature related to the subject of the study. The purpose is to get an overview about the research area and further understand the subject matter of research study. The research study is to propose a prototype of a Digital Fax Document Management System for local used in BTN Putrajaya. The proposed prototype should be in four functions which are faxing, viewing, searching and reporting. The literature is divided into three sections which are; the introduction of web-based model, digital fax performing digital document and the last section presents the proposed system architecture with digital document management system.

2.1 Introduction of Web-Based Model

A web-based model is a good choice for environmental document management because it can easily incorporate all of these diverse types of information. Documents can be posted for on-line viewing and printing, file transferring, searching, reporting, and can be accessed through a search engine. A web-based model is instantly available over an unlimited area. Furthermore, user-friendly interfaces can be developed to access the same core information for any number of user groups (Debora, 2006).

According to Cox (1997), Active Platform is the name given to Microsoft's component-based application development model for the Web. Active Platform is divided into three major sections which are:

a) Active Desktop - an ActiveX-enabled client architecture designed to house components and language-independent scripting environments.
b) Active Server - primarily intended to provide an execution environment for running business logic distributed across enterprise application servers.
c) ActiveX Technologies - the object-based underpinnings of all of the above - commonly referred to as The Component Object Model (COM).

Kim Wes (2001), with data access pages in Microsoft Access, create Web views of database can be created. When need to customize page beyond what the data access page designer allows, scripts can be added that perform sophisticated actions based on the data currently being shows, use transitions to create multimedia effects, or tap into the power of the Microsoft Office Spreadsheet, Chart, or PivotTable Web Components. However, there are differences between developing form- and report-based applications and developing Web-based applications.

Web-based model have several distinct advantages over stand-alone computer systems. In addition to the ease of information distribution and the ability to serve a widespread and diverse pool of users, there are also advantages in data protection, coordination with other company databases, and can provide ease of use, expandability, data integrity, and widespread data access. Packaged and custom systems are available. When initially selecting a system, involve the IT personnel to assure compatibility with existing computer system. Take advantage of the ability to start small and proceed at a comfortable place.

According to Baird *et al.* (2005), an internet-based or a web-based document management system (DMS) and method is provided where in access to the system and its services may be controlled through use of encrypted access tokens. The web-based DMS allows a fax or other electronic document to be stored in a compressed and encrypted format on an Internet-accessible server and accessed using previously known web server, downloaded in compressed format allowing for secure and speedy document response to

the user for review and organization, and then returned to the server for access by further users.

Table 2: Approaches and Features Comparison

(Source: Joshi J. B. D., 2001)

Approaches and features compared.	
Appraoch	**Features from Web Perspective**
DAC	• Ownership-based, flexible, most widely used, does not provide high degree of security, and hence ow assurance • Typed versions such as SPM, TAM, and DTAC are expressive but have little or no experience base • DTAC can handle dynamic changes and task-based control (better than RBAC) • Most cannot be used where classification levels are needed • Typed versions have tried to include classification levels
MAC	• Administration-based • Information flow control rules • High level of security, and hence high assurance, but less flexible
RBAC	• Policy-neutral/flexible • Principle of least privilege • Separation of duty • Easy administrative features • Able to express DAC, MAC, and user-specific policies using role hierarchy and constraints • Can be easily incorporated into current technologies • Good for multidomain environments when policies are expressed using role hierarchies and constraints
Access control Tasks/Workflow	• Task-oriented authorization paradigm • RBAC is highly beneficial for WFMS • TBAC is at an initial stage of development (no formalism yet) • A key component for success of transaction-intensive e-commerce, medical applications, and so forth
Hypertext-based authorizations	• Approach based on hypertext model or document characterization-infancy stage • Essential for providing formal base for the security of Web objects including links and nodes; access modes include browsing and viewing
Certificate-based	• Utilization of existing PKI facilities • Complements the host's access control model • Can use trust centers in the Web
Agents	• Adaptability and mobility • Mobile agents introduce new security issues • Can be considered a complementary system-building paradigm, rather than a model or mechanism for specific security implementation • May be useful in multidomain environments (for example, for policy negotiation)

2.2 Digital Fax performing Digital Document

The fax became a popular data transfer method in a very short time during the 80's. It spreads as fast as the Internet or mobile phones some years later, due to the network economics of this type of innovations, where its value to the individual users becomes bigger for each new user who joins the network. The fax was superior for handling offers, quick changes, and small scale graphics, but not good for large drawings and absolutely useless for reuse of the data in digital form at the receiving end (Bjork, 2001). Fax hardware plays a critical role in the sending and receiving of business documents.

According to Hunter *et al.* (2004), digital objects require constant and expensive maintenance because they depend on hardware, software, data, models and standards which are upgraded or replaced every few years. Accelerating rates of data collection and content creation and the increasing complexity of digital resources means that many organizations can no longer keep pace with the preservation needs of all of the data entrusted to them.

Hull *et al.*, (2007), through their research conclude a digital copier includes scanner that generates image data representing a document to be copied, an image processing unit that processes the image data to correct imaging errors introduced by the scan engine, a printers that copies the document responsive to the image data as processed by the image processing unit and an image data tap that relays the image data to a storage system for archiving.

According to Murphy, there are three ways in which companies can fax information today: First, stand-alone fax machines where, each individual fax machine has its own phone line that dials out its own fax number. These machines are easy to install, but cumulatively can be very expensive in large distributed organizations. Second, fax server which this is essentially an application-specific computer that can have several ports connected to dial phone lines for sending and receiving faxes. The fax server can take documents sent to and from an internal company network and convert these documents to

fax images for sending across fax lines. Third is Internet fax services. This method allows companies to send and receive faxes using their Internet connection as the medium for transmission rather than a separate phone line. In addition, the faxing is done as an outside service, so no infrastructure needs to be built or operated by the user in order to access these services.

According to Piersol *et al.* (2005), Fax represent a electronic devices and typically capable of receiving both paper-based and electronic fax document through a scanning interface that digitizes the document to an electronic format and receive through a modem interface. A modem interface function to modulate digital data for transmission across the publicly switched telephone network (PSTN) and demodulate data received over such a telephone network. Some fax devices known as internet fax devices are further capable of transmitting and receiving data over network.

Fax documents are stored as a received for subsequent retrieval by authorized users. Method are provided where in an authorized user system can associate attributes to individual pages of a fax or to a group of pages from different faxes. Fax documents may also be split into individual pages prior to storage for speedy document response to the user.

Gavan (1998), in connection with international fax transmission, fax line problem involve distances and lack of high quality connection to various place. It would be desirable if a fax transmission could be generated by a customer of network services. The network having the capability of storing the fax transmission and automatically complete it into intended destination. User of the fax machine is free from burden of managing retries. This kind of service gives advantage to user on transmitting faxes.

Organizational pervasiveness of fax documents which; there are variety of instances and departments where faxes are a central communications medium. They are a dominant force in sales and legal departments. This huge installed base of fax machines is a dominant force that requires intelligent fax technology to play a central role in document

management. Therefore, compliance and the challenges of fax documents such as security, process control, auditability and archiving need to systematize to meet compliance requirement for fax solution to support those efforts. A fax server solution is a higher level of document management for compliance where it will integrate with other IT system and captured and stored document digitally. Besides, it created inbound fax routing and integrated document management with searchable and improved auditing with security (Gies, 2005).

Henderson (2004), has conclude a research for Doctoral Consortium described that digital document management is the process of acquiring, storing, managing, retrieving and using digital documents whereby information overload is making document management increasingly difficult. Therefore, developing more usable software for digital document management is important to organize the digital documents with current software, facilities used and identify current document management software is adequate and inadequate. The connection of physical and digital documents by providing software level mechanisms for management paper documents and retrieval of digital documents through a single unified document management system will integrate the digital fax document management system.

The need for more efficient document management systems becomes increasingly urgent, as according to Liu and Stork (2000). They have conducted a survey to investigate the efficiency of using papers. Finding of the survey shows that large organizations lose one document every 12 seconds, 3% of all documents are incorrectly filed, 7.5% of documents are lost forever, disorganization in the workplace may cost executives up to six weeks of time per year and the average executive spends three hours per week hunting for mislabeled, misfiled or lost documents. Therefore, technologies improvement is need to digitalize all the paper documents in a document management system.

According to Serloco (2007), some organizations have incorporating their fax documents into a digital document management. It certainly a better alternative to storing paper faxes, not only allows each fax to become electronically and digitalize but also protects

the documents. With this, document can be send, receive and move into the document management system without additional effort. Besides, the system avoids the delays and delivering faxes document easy to multiple people and the document much more difficult to lose, ignore and delete. There are no more filling cabinets and it will improve security while taking the technology out of the equation directly drives down costs.

2.3 Digital Document Management System

Meier *et al.,* (1996), said that a document can be described simply as recorded information structured for human consumption or a document can be defined as information set pertaining to a topic, represented by a variety of symbols, stored and handled as a unit. A document is a snapshot of some information set that can be incorporated many complex information types; exist in multiple places across a network depend on other documents for information, change on the fly, have an intricate structure or complex data types such as full-motion video and voice annotations and be accessed and modified by many people simultaneously.

Documents which fit this definition can exist in many forms in an organization like contracts and agreements, reports, manuals and handbooks, business forms, correspondence, memos, news items and articles, drawings, blueprints, photographs, electronic mail and voice mail messages, video clips, presentation and computer printouts. Clearly these definitions include both traditional paper documents as well as electronic documents, even though the two have until now been managed in completely different ways. This broad definition of documents is an important first step in developing an integrated approach to document management. The next step is to classify the functions that documents serve in organizations (Meier *et al.,* 1996).

Seifried *et al.*, (2008), elaborate through their Proceedings of the Second International Conference on Tangible and Embedded Interaction (TEI'08); in a modern office environment the physical and digital document management systems remain largely disconnected. Even when digital and physical copies of the same or related documents

exist in both systems there is often no obvious manageable connection between it, and none of the advanced digital document management tools and techniques can be applied to their physical counterparts, for instance unlike the digital world where finding a document requires using a simple.

According to Gilheany (2001), digital documents are often digital versions of existing paper documents. Maintaining intellectual control over digital documents is just as important as maintaining intellectual control over paper documents, and is often overlooked by people skilled in the management, movement, and storage of digital data. Digital data has not had a meaning component, until the introduction of digital documents.

Gilheany mentioned in his article, to use a digital document, the exact format of the document's digital representation must be known, and every single one of the stored bits must be read perfectly from the storage medium. These two absolute requirements are mixed in with the operation of an organization's computing environment. The organization's computing environment is dependent on the function and evolution of the world wide computing environment. A records manager that is responsible for digital documents is also responsible for the effect that the document formats, storage media, and computing environment have on the ability to present the document to a user in a useful manner.

Management is the process of allocating an organization's inputs, including human, economic and information technology resources, by planning, organizing, directing and controlling the business operation for the purpose of producing good services desired by customers and the decisions can be made on the basis of facts and are more accurate and timely as a result to accomplish organizational objectives.

Management systems can be computer-based or manual system that transforms data into usefulness information to support the decision making process. Nowadays, with sophisticated technology, computerization is a must for an organization to be successful whereby management information systems are becoming more important to solve

business problems. This is because the need for an effective management information system is a primary concern to the business organization (Gilheany, 2001).

A document management system (DMS) is a computer system or set of computer programs that used to track and store electronic documents and images of paper documents. The term has some overlapping with the concepts of Content Management Systems and is often viewed as a component of Enterprise Content Management Systems and related to Digital Asset Management, Document imaging, Workflow systems and Records Management systems (Wikipedia, 2008).

A DMS is provided which organizes stores and retrieves documents according to properties attached to the documents. Applications which function based on hierarchical path names communicate to the DMS through a translator (LaMarca *et al.,* 2006). Current document management techniques do not acknowledge the continued use of paper. A document is specified for retrieval by navigation through a hierarchical directory structure and references to a file name (Cullen *et al.,* 1999).

Besides, a DMS is also a collection of integrated tools that convert paper documents into electronic form that can store, share, and use it in business. The right document management system helps to streamline everyday business processes, comply with industry and government regulations, and improve operational efficiencies across many areas of business (Hewlett-Packard Development Company, 2007). DMS use a combination of hardware, software, and business rules to support three major key elements of the document management process which are capture, manage, and share. Scanners can be used to create an electronic version of an existing paper document. Electronic files are also captured via personal computers and other digital media devices such as digital cameras. Once documents are in a consistent electronic format, store and manage just like any other data file. Server and storage equipment used to secure, store, and backup the digital records. To share the electronic files, any number of resources and tools can be used, including printing, email, file sharing, and more.

According to Yueh Tarng and Yuh Liu, a DMS is an information system embedded in a human social system. Throughout the process of computerizing a DMS, managers should be aware that information technology is part of the organizational culture. Technology must be accepted and accommodated by its users. Otherwise, users' dissatisfaction, suppliers' complaints, conflicting opinions and waste of scarce resources will continue to plague management.

Tani (2007), the DMS system according to claim a state to which the document stored in the folder may change next, information related to the device control corresponding to the state which are stored memory device retained by the digital multiple function peripheral and displayed on a Graphic User Interface (GUI) screen of a digital multiple function. The device control is any one of copying to another folder, movement to another folder, deletion, sending fax, sending to previously connected server, setting to unprintable, setting to not editable, encryption, composition or conversion of a file format form.

The benefits that a DMS provides such as a centralized repository for storing all documents, multiple versions of each document can be maintained, it forms a part of the front end, provides audit logs to track creation, modification and deletion of documents, access to documents can be restricted, paper documents can be scanned and stored in the repository, extensive indexing options, enabling easy and faster retrieval of documents and easy to share documents (Icreon, 2000).

Digital document management system (DDMS) are software applications that capture paper documents and a variety of electronic files while providing for the storage, retrieval, and security and archiving of these documents (Compulink Management Center, 2007). The process of digital document management begins with the conversion of documents into digitized images. These images can be easily organized and quickly retrieved, indexed and archived. When files are scanned a digital copy is stored on a system. Files can still be viewed, printed, shared and stored. Documents can be read and can performed actions depend on the level of security of the system.

Web-based document management enables small to medium sized businesses perform like large corporate ones. All business documents are stored in a centralized remote database fully protected from viruses, calamities, machine failures and unauthorized intruders. Organizations can manage, organize, upload and share any number and types of documents from virtually any computer using any web browser. It may centralize database for all documents and secured document transfers. Besides, it is easy to organize documents when of all documents (e-saletrack On-Demand CRM, 2005).

2.4 Conclusion

The greater availability and acceptance of document imaging technology, along with the rapidly-declining cost of computer systems, make a fax document management solution a prudent investment. According to Compulink Management Center, in an environment where increasing productivity, efficiency and profitability are crucial to long-term success, a document management solution is a business-essential aspect of day to day operations. It is a solution that cuts costs, reclaims storage space for revenue-generating activities, allows staff to redirect labor to more productive tasks and simplifies compliance with ever-changing regulations. On the cutting edge of the trends in communication technologies organizations are seeing more and more usage of digital faxing services that circumvent slower telephone lines and the machinery that use them, and instead send faxes as emails. This type of facsimile service can be both secure and highly efficient, provided that the electronic fax services utilize to protect the documents and information that are sent and received (Fax It Secure, 2005). A document management system should be flexible enough to adapt to organizational needs and address the needs of multiple departments. Document management solutions can work as effectively and the key is selecting the system that is the best fit for organization.

CHAPTER THREE

RESEARCH APPROACH AND METHODOLOGY

This chapter provides the research approach and research methodology for the findings of this research project. This chapter also provides details about the research methods that have been applied in this research projects. Information is defined as a collection of data. Data can be collected in variety of ways, in different settings, and from different sources. In order to collect data, the objective of research and the problem statement has been clearly defined in Chapter One. Data collections are based on primary and secondary data. Individual, focus groups, and respondents are specifically set up to ensure the opinions may be sought on the research issues from time to time. Collection of information from secondary data can be obtained from sources such as journals, articles, electronic form such as Internet sources, and books.

3.1 Research Model

Prototyping is the process of quickly putting together a working model (a prototype) in order to test various aspects of a design, illustrate ideas or features and gather early user feedback (Prototyping, 2008). Prototyping is often stated as an integral part of the system design process, where it is believed to reduce project risk and cost. Often one or more prototypes are made in a process of iterative and incremental development where each prototype is influenced by the performance of previous designs, in this way problem or any circumstances in design can be corrected. When the prototype is sufficiently refined

and meets the functionality, robustness manufacturability and other design goals, the product is ready for production (Prototyping, 2008).

Research model is the method used during this research project. The methodology used from the beginning of the project until the last phase of the project. There are traditional methods in developing a prototype of system or software, such as waterfall approach and SDLC (Software Development Life-Cycle). Advances of technology caused by demands for new system and software to develop. By using this traditional approach, there is lacking in many process for example; as according to the article in Wikipedia.com, clients may not be aware of exactly what requirements they want before they see a working prototype and can comment upon it; they may change their requirements constantly, and program designers and implementers may have little control over this.

In order for the system to be developed according to the time and requirement, another methodology will be implemented for this project, which is a System Development Life Cycle (SDLC). SDLC is also one of the software development processes on developing information systems. It is also known as Information Systems Development or Application Development. The SDLC that has been used for this project is Rapid Application Development (RAD). As according to Wikipedia.com it used by a systems analyst to develop an information system, including requirements, validation, training, and user ownership through investigation, analysis, design, implementation, and maintenance (System Development Life Cycle, 2008).

Throughout this research project, Rapid Application Development or RAD will be used as the methodology. According to Wikipedia.com, Rapid Application Development is a software development process developed initially by James Martin in 1991. Using this methodology, it is easy to develop dynamic Web based applications that use databases. Based on Gantthead.com there are eight phase of Rapid Application Development process, which are Plan Project, Activate Project, Control Project, Requirements Planning, User Design, Rapid Construction, Transition, and End Project.

To test the project, information technology acceptance model will be as measurement of the research project. Many of information system studies on adoption and usage of information technology are about the topic of individual evaluation of information technology and its related applications. In theoretical models about individual usability and attitudes, the most acceptable adoption theories are Technology Acceptance Model (TAM), Cognitive Fit, and Task Technology Fit (TTF). TAM has been proven robust in predicting user acceptance of IT, and has been applied widely in understanding the motivational issues in computer and software adoption, as well as usage of information systems (Chan & Teo, 2007).

According to CASEMaker Totem (2000), RAD compresses the step-by-step development of conventional methods into an iterative process. The RAD approach includes developing and refining the data models, process models, and prototype in parallel using an iterative process. User requirements are refined, a solution is designed, the solution is prototyped, the prototype is reviewed, user input is provided, and the process begins again. Fig. 3 shows RAD process in traditional development research model.

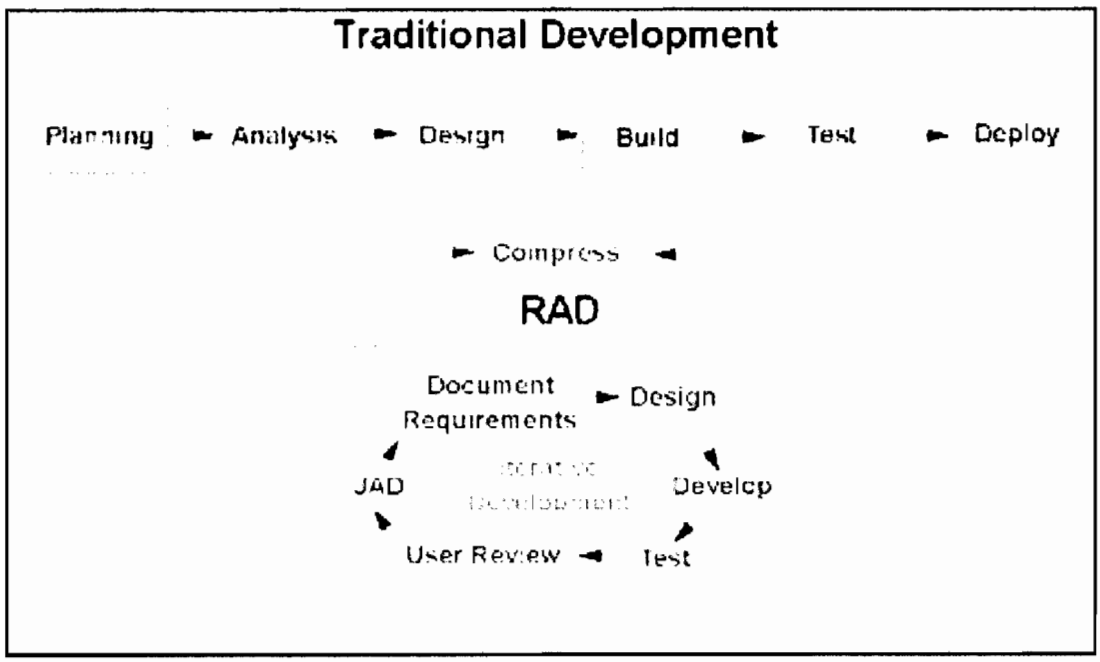

Fig. 3: RAD Process in Traditional Development Research Model

(CASEMaker Totem, 2000)

RAD has more advantages compared to other system development methodology. Speed and quality are the primary advantages of RAD. The first advantage of RAD is it increased speed. As the name suggests, RAD's primary advantage lies in an application's increased development speed and decreased time to delivery. The goal of delivering applications quickly is addressed through the use of Computer Aided Software Engineering or CASE tools, which focus on converting requirements to code as quickly as possible.

The second advantage is increased quality. It is a primary focus of the RAD methodology, but the term has a different meaning than is traditionally associated with Custom Application Development. Prior to RAD, and perhaps more intuitively, quality in development was both the degree to which an application conforms to specifications and a lack of defects once the application is delivered. According to RAD, quality is defined as both the degree to which a delivered application meets the needs of users as well as the degree to which a delivered system has low maintenance costs. RAD attempts to deliver on quality through the heavy involving of users in the analysis and particularly the design stages.

The third advantage is reduced scalability because RAD focuses on development of a prototype that is iteratively developed into a full system; the delivered solution may lack the scalability of a solution that was designed as a full application from the start.

The forth advantages is reduced features. Due to time boxing, where features are pushed off to later versions in favor of delivering an application in a short time frame, RAD may produce applications that are less full featured than traditionally developed applications. This concern should be addressed as soon as possible through clear communication with the client as to what will be delivered and when.

3.2 Research Model Used For the Research

In this research project, the research model that is used to conduct and guide the research is based on Rapid Application Development model. The concept of RAD is adopted, which considers on the eight phases involved namely the Plan Project, Active Project, Control Project, Requirements Planning, User Design, Rapid Construction, Transition, and End Project (CASEMaker Totem, 2000). Based on the objectives of the research project, all the eight variables of Rapid Application Development will be as guidelines to complete this research project. During the Construction phase of RAD, the activities such implemented design will be developed and tested. To measure the prototype of the project, user acceptance towards the system will be evaluate. Below are discussed all the variables or phases for further understanding about the model.

3.2.1 Plan Project

In this phase, all initial aspects of development are taken into consideration. Data and information are collected to be analyzed. This phase will produce the detailed project plan, project schedule, project organization, and resources. The project objectives and the problem statement are identified during this phase. This research project is to develop a prototype of a Digital Fax Document Management System. It also needs to obtain approval for the project and authorization to precede with the project activities. This research project proposal of document management system has been approved by authorized parties, and to complete the project, it will proceed to next phase which is to active the project plan.

3.2.2 Activate Project

The Activate Project stage acquires and develops the project resources. This includes the human resources, the skills, facilities, equipment, and support for the project. All the materials needed are being prepared during this phase. For

example, the software needed in project development, technology needed in preparing the documentation, and others.

3.2.3 Control Project

The goal of every project is to drive it to a successful and appropriate conclusion. If not controlled, the iterative nature of project work can lead to a false sense of progress and ever increasing levels of unnecessary detail.

3.2.4 Requirements Planning

The Requirements Planning is the first stage in the RAD methodology lifecycle. During this stage an outline of the system area and definition of the system scope are developed. The existing system will be study and analyze. Here the needs of Digital Fax Document Management System are been analyzed and the development will be in the four functions which are faxing, administration, searching and reporting.

Based on the design principles that have been suggested in the previous phase, a planning requirement of the system was built. The prototype of the system is developed in a web-based environment. Before developing the prototype of the system, the following software had been chosen as the development tools:

a) Microsoft Internet Browser – As a web browser to launch the prototype.

b) Macromedia Dreamweaver MX – the fundamental techniques enabling to create, design, edit, develop, and maintain the interface of the prototype to the latest web standards. The key new features; Cascading Style Sheets (CSS) to increase control over a web site, making it more accessible and easier to maintain; Dreamweaver's cross-browser validation feature, which ensures that no pages are using mark up, or CSS not supported in certain

browsers. Save time cropping, resizing and making minor changes to images with Dreamweaver's built-in Fireworks technology; copy and paste from Word and Excel documents directly into Dreamweaver while maintaining the appearance of Office documents; edit files and change code directly on remote File Transfer Protocol (FTP), (VTC, 2004).

c) XAMPP Control Panel Application - open source development by making it easier to write and distribute applications in a stable and standardized environment. AMPP - Apache, MySQL, PHP, and Perl have all been installed and configured as separate products. The trend of combining them into integrated middleware stacks promises to make open source development more competitive with J2EE application development, at least for low-end applications that has been use for this prototype, (IBM. 2004).

d) Microsoft Office Access 2007 – According to TOEFL 2008, Microsoft Access is an application used to create small and midsize computer desktop databases for the Microsoft Windows family of operating systems and as a database to keep all the information of the dam and other related information. It can also be used as a database server for a web-based application. It is also supported by ADO, ODBC, .NET Framework and XAMPP Control Panel Application.

e) Internet Information Services (IIS) 6.0 - Manages IIS, the web server for Internet and intranet web sites. Internet Information Services (IIS) 6.0 is a powerful Web server that provides a highly reliable, manageable, and scalable Web application infrastructure. It is a secure platform for building and deploying dynamic web-based system. It is compatible with PHP and allows the system to access the database.

f) WinFax PRO 10.03 – software that used of fax management capability to help user organize document and information in a better way. It is the leading fax management software for small businesses. Its high-quality faxes help you project a professional image to your clients and customers. When image clarity is vital, you can generate photo-quality faxes. You can even send or forward faxes via email to people who don t have fax hardware or software. It integrates smoothly with key business applications to simplify your management of client and customer interactions.

For this phase, there are a number of steps needed in order to fully analyzed and design the project. The first steps in planning on how to do this study and how to develop the system is by creating a Gantt chart. Gantt charts are a project planning tool that can be used to represent the timing of tasks required to complete a project. Gantt chart is use since is it easy to understand and the plan on all of the activities according to its proposed timeline. The Gantt chart of this project is shown in Appendix B.

The second step to identify the functional and nonfunctional requirements of this project. There will three types of priority which are mandatory requirement, desirable requirement and optional requirement. Mandatory is something that the system must do, desirable is something the system preferably should do and optional is something the system may do. The requirement id, requirement descriptions and the priority of the requirement in the functional requirement has been identified in this phase. Functional requirement is a requirement that had been implemented in the system. Non-functional requirement is a requirement that will not be implemented in the system, in other word, the requirements that happen outside the system which are related to the system in any ways.

After identifying the requirement; nonfunctional requirement or functional requirement, use case diagram has been designed. In use case, the most important parts are to identify the actor, the use case, the system boundary and also the relationship between actor and use cases. Basically use cases are requirements, primarily functional requirements that indicate what the system will do. Use case is a collection of related success or failure scenario that describes an actor using a system to support a goal (Larman, 2005). According to Larman, an actor is something with behavior, such as a person identified by role, computer system or organizations. Scenario is a specific sequence of actions and interactions between actors and the system, it is also called use case instance. It is one particular story of using a system, or one path through the use case. For this system, we have two types of user was identified that is the user and administrator.

After the use case had been identified, we have to specifically identify each of the use case. This will be done in use case specifications. Under use case specifications, there is severally information that will be identified in details.

3.2.5 User Design

User design is also known as the Functional Design Stage, this stage uses workshops to model the system's data and processes and to build a working prototype of critical system components. Project planning involves defining clear, discrete activities, and the work needed to complete each activity within a single project. There are various activities that must be performed during Functional Design Stage.

The User Design stage produces a detailed system area model, an outline system design, and a transition plan. The system is design by using the modeling language which is Edraw UML diagram. The design of the system is come out for use case diagram, class diagram and sequence diagram. Table 3 shows one of the processes in the system.

Table 3: Example of Process in the System

Input	Process	Output
- View document	- Choose preferred document	-Validation of preferred chosen
- User name - Address -Fax Number	- Save Data	-Identification confirmation
-Preferred document - Document Quantity	- Choose option - Document quantity	- Fax confirmation

A use case defines a goal-oriented set of interactions between external actors and the system under consideration. Actors are parties outside the system that interact with the system. An actor may be a class of users, roles users can play, or other systems. Cockburn (1997) distinguishes between primary and secondary actors. A primary actor is one having a goal requiring the assistance of the system. A secondary actor is one from which the system needs assistance.

A use case is initiated by a user with a particular goal in mind, and completes successfully when that goal is satisfied. It describes the sequence of interactions between actors and the system necessary to deliver the service that satisfies the goal. It also includes possible variants of this sequence, for example, alternative

sequences that may also satisfy the goal, as well as sequences that may lead to failure to complete the service because of exceptional behavior, error handling, and others. The system is treated as a "black box", and the interactions with system, including system responses, are as perceived from outside the system.

According to Hoffer *et al.*, (2002), project planning in information system project consists of ten activities. These activities are:

i) Describing project scope, alternatives, and feasibility.
ii) Dividing the project into manageable tasks.
iii) Estimating resources and creating a resource plan.
iv) Developing a preliminary schedule.
v) Developing a communication plan.
vi) Determining project standards and procedures.
vii) Identifying and assessing risk.
viii) Creating a preliminary budget.
ix) Developing a statement or work.
x) Setting a baseline project plan.

Since user design is important because it summarized up what the users' need from the system, therefore, it is important that an architecture design of the system is implemented first.

3.2.6 Rapid Construction

The design of the proposed system, initially described in the User Design stage, is completed in the Rapid Construction stage, and application software to implement that design is developed and tested. According to Nunamaker (1991), design specification is used as a blueprint for the implementation of the system. To test the prototype, it will be measure by acceptance from the user towards the system. Technology Acceptance Model (TAM) will be the methodology as guideline to evaluate during the testing activities in the construction phase.

According to Wikipedia.com (2008), The Technology Acceptance Model is an information systems theory that models how users come to accept and use a technology. It also state that the model suggested when users are presented with a new software package, a number of factors influence their decision about how and when they will use it. Figure 4 illustrate the core of TAM model (Davis *et al.*, 1989).

Perceived Usefulness (PU) is defined as the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context (Davis *et al.*, 1989). Perceived Ease of Use (PEOU) is defined as the degree to which a person believes that using a particular system would be free of effort (Davis *et al.*, 1989). Behavioral Intention (BI) is defined as a measure of the strength of one's intention to perform a specific behavior (Davis *et al.*, 1989). According to Davis *et al.*, (1989), PU and PEOU are hypothesized to jointly decide users' intention to accept an IT application. However, the effect of PEOU on PU is not part of this focus of research project.

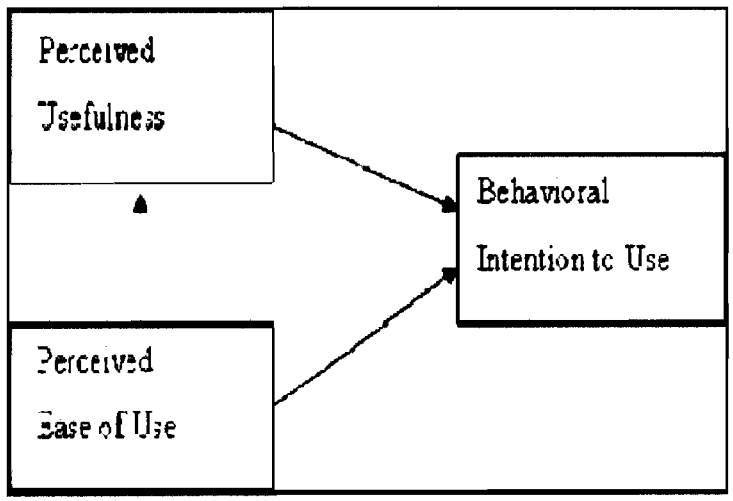

Fig. 4: Technology Acceptance Model (Davis *et al.*, 1989)

3.2.7 Transition

Transition is defined as a period during which newly developed procedures gradually replace or are interfaced with existing procedures. The execution of a Transition project obviously demands a thorough understanding of both the system to be installed and the systems to be replaced. A detailed knowledge of existing data structures and interfaces to other systems is also required.

3.2.8 End Project

The End stage brings the project to an orderly conclusion and retains its history for the benefit of subsequent projects. End Project tasks archive the project materials, report on the project's performance, turn over the project results to the owners, and release the project resources for use on other projects.

3.3 Research Approach

Data collections method can be in a variety of ways, in different settings, and from different resources. Data collection methods is include such interviews, questionnaires, observations, and others motivational technique such as projective tests. Data is collected based on primary sources and secondary sources. After collecting the data, the flow of the approach is to do analysis for the final findings or the expected outcome. Fig. 5 shows the diagram of the research approach on this research project.

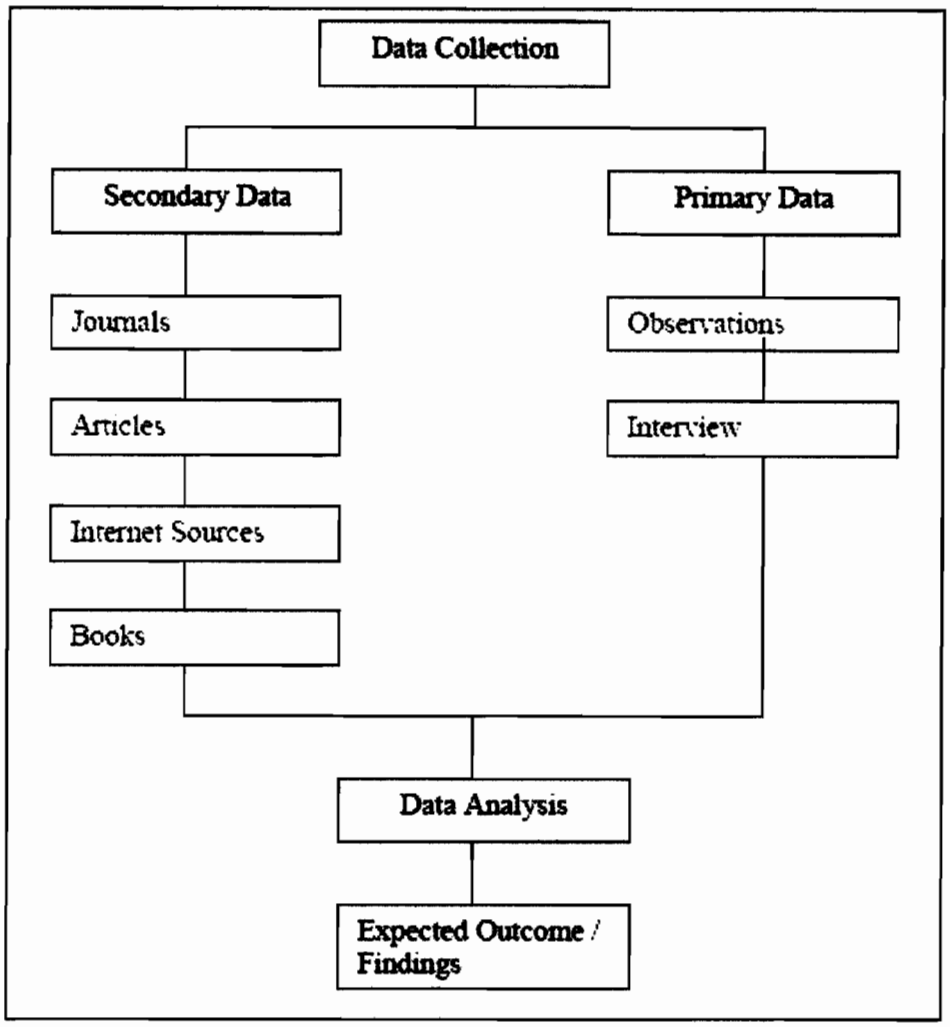

Fig. 5: The Process of Research Approach

3.3.1 Primary Data

Primary data is the collection of data that sources are getting from the first hand. In order to get primary data, firstly must choose the right method. They are several methods of primary data collection such as interview, questionnaire, observation, and others techniques. In this research projects, the best alternative is to do observation and conducted an interview. There are several types of interview, which is face-to-face interviews, telephone interviews, computer-assisted interviews, and through electronic media. The face-to-face interviews are conducted and takes place at Biro Tatanegara Putrajaya and the detail of respondents as follows:

Date: 22 February 2009

Place: Biro Tatanegara JPM Putrajaya

First Respondent's Name: Tuan Haji Wahab bin Jusoh

Position: Assistant Director General of Biro Tatanegara Putrajaya

Second Respondent's Name: Encik Khalid bin Ahmad

Position: Administration Assistant Officer of BTN
Administration Department

Third Respondent's Name: Cik Lina binti Jamain

Position: Assistant Administration of BTN IT Department

The interviews conducted are unstructured interview as the research approach is to make observation at the Biro Tatanegara Putrajaya. There are two methods of interviewing which are structured and unstructured interviews.

Structured interview is only can be conducted when it is known that the information is needed. The questions are likely to focus and factors that had surfaced during unstructured interviews and considered relevant to the problem statement. Unstructured interviews questions (Appendix C) are mostly that passing trough minds during the interview sessions. The question is related to the topics that are discussed for this research. The purpose of having unstructured interview is to get insight to some preliminary issues so that can formulate the better idea for getting information.

After the interviews process and the permission get from Assistant Director General of BTN Putrajaya, the process of collecting resources begun. The observations take place on two departments only because other department documents are private and confidential. The observation had done on the fax documents that retrieved and process through the fax machine as to study the

problem statement for conducting this research project. Observation form can be view in Appendix D.

Questionnaire will be use to conduct testing for the prototype. Almost one hundred (plus minus) fax users used and navigate the prototype. Questionnaire will be conducted; prototype is on the system server of the computer, so respondent only can navigate from the system. As for that, the ideal sample size for the respondent will be thirty respondents. The collection of data takes place at the BTN Putrajaya itself and other organizations that using fax to manage their documents. After distribute the questionnaire (Appendix E), it will be collected and analyze and the result will be show as mean value in next chapter.

3.3.2 Secondary Data

From the research approach, secondary data is collected from the sources such as journals, articles, internet sources, and books. Secondary data refer to the information gathered by someone other than conducting the current study. The literature review in Chapter Two is generally obtained from the secondary data. Resource from internet is generally obtained from the websites and online database library which provide journals, articles, and current issues. The advantages of secondary data are savings time and cost of acquiring information.

3.4 Research Design Chart

Research is an activity that contributes to the understanding of a phenomenon (Kuhn, 1996; Lakatos, 1978). All or part of the phenomenon may be created as opposed to naturally opposing. Theoretically, phenomenon is a set of behavior of some entity(ies) that is found interesting to the researcher. But in order to know the phenomenon, the researcher must first understand the knowledge that allows prediction of the behavior of some parts of phenomenon. Here, understanding and knowledge is the most important

elements for the researcher, so the set of activities a research community considers appropriate to the production of understanding are its research methods or techniques.

The second term is Design. According to Webster's Dictionary and Thesaurus, 1992, design is to invent and bring into being. Design deals with creating something new that does not exist in nature. The research design chart table which is tabulated in Table 4, explaining more on research questions, data sources, methods to be used and the measures or the deliverables.

Table 4: Research Design Chart

Research Questions	Data Sources	Methods	Measures / Deliverables
What are the appropriate functions to manage the digital fax document?	Primary Data	Observations	Prototype
How to design a prototype of a Digital Fax Document Management System?	Primary Data	Observations	Prototype
How to implement the Digital Fax Document Management System?	Primary Data and Secondary Data	Unstructured Interview and Observations	Prototype

3.5 Conclusion

This research project is conducted through the data collected from primary data and secondary data sources. The information gotten from primary data is through face-to-face unstructured interview, observation at the BTN Putrajaya, and observation for existing website. Information had been gotten from secondary data sources such as journals, articles, internet sources, and books. At this stage, the data is analyzed and the expected outcome for the deliverables is shown in Chapter Four which is the next chapter that will discuss more on the data analysis and findings.

CHAPTER FOUR

EXPECTED OUTCOME AND RESULTS

This chapter will elaborate more about analysis and findings which is the expected outcome for this research project and also the conclusion. The outcome is the proposed prototype that is developed based on the findings from data collection and based on the system design based on the methodology applied. Furthermore, the outcome is based on the research objectives and research question on what this research project is about.

4.1 Outcome 1: System Design

In this section will produce an outcome on system design. The system design is important as architecture before develop the prototype. The system design is illustrated by using modeling language. The appropriate modeling language that been used during completing this research project is Rational Rose. The system design will be illustrate using two diagrams which is use case diagram, and class diagram. The data get from primary data which is observation unstructured interviews. The observation been done throughout the BTN Putrajaya physically. The secondary data also been analyzed such as journals and articles on how the existing fax documents managed.

Fig. 6 illustrated the main use case diagram for the system design. The main use case diagram has two actors which are the staff and admin. Staff will act as the user of the system, who wishes to use the system and navigate the website while the administrator will use the system to maintain the system. The main use case or function of the system is to login, faxing, searching and reporting. Login will be done by the staff that uses the system while the admin will login to do the maintenance of the system.

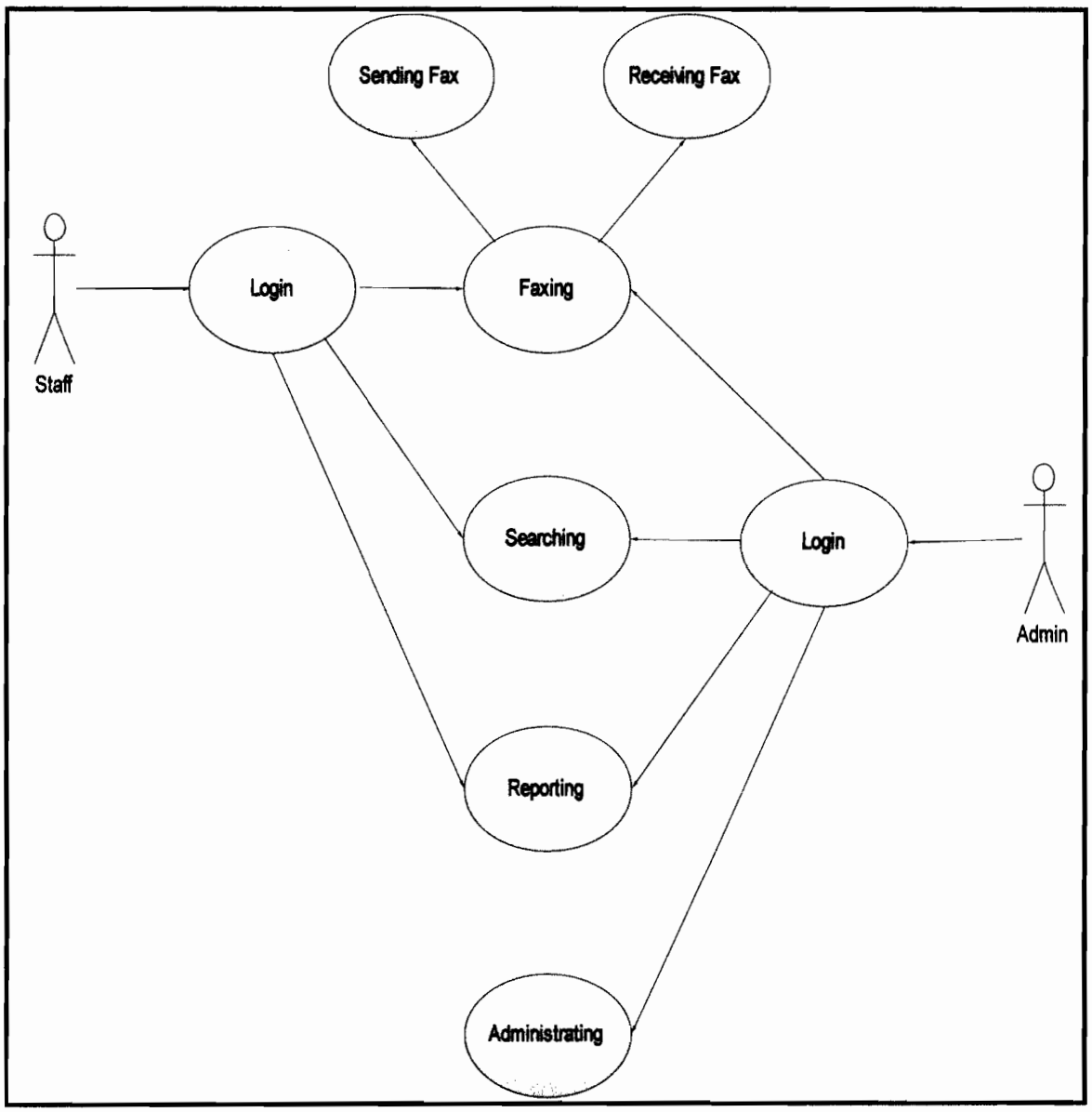

Fig. 6: Main Use Case Diagram

The main class diagram as illustrated in Figure 7 has seven (7) main objects which are staff, admin, login, faxing, searching, reporting and administrating. Faxing object divided to two which is sending fax and receiving fax. Staff and admin has relationship with login object. Object for staff has relationship with object login, faxing, searching and reporting, but not related with administrating object which just admin related to that object.

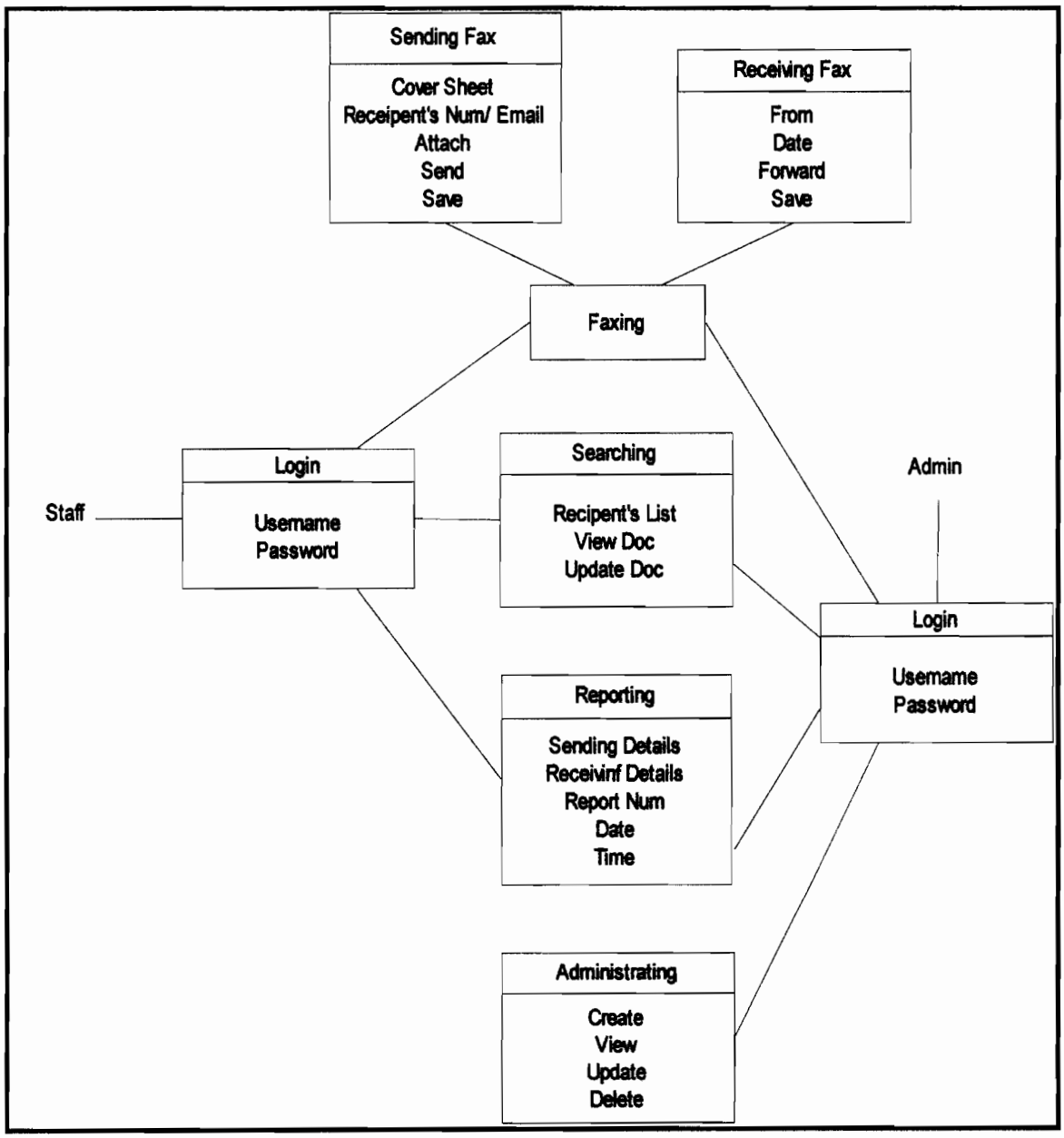

Fig. 7: Main Class Diagram

According to Hoffer *et al.*, (2002), sequence diagram depicts the interaction among objects during a certain period of time. Each sequence diagram shows the interaction related to the use case diagram since the pattern of interaction varies from one use to another. Fig. 8 illustrated a sequence diagram for the system. In the sequence diagram there are seven (7) functions which users can use in the system prototype. Users should need to Login the system before accessing the system. After that, users can view the inbox in the system and choose any functions that have in the system to manage their fax document. Besides, users can Add or Edit fax also can Search before view List of Search Result. Finally, users can Logout from the system after finished using it.

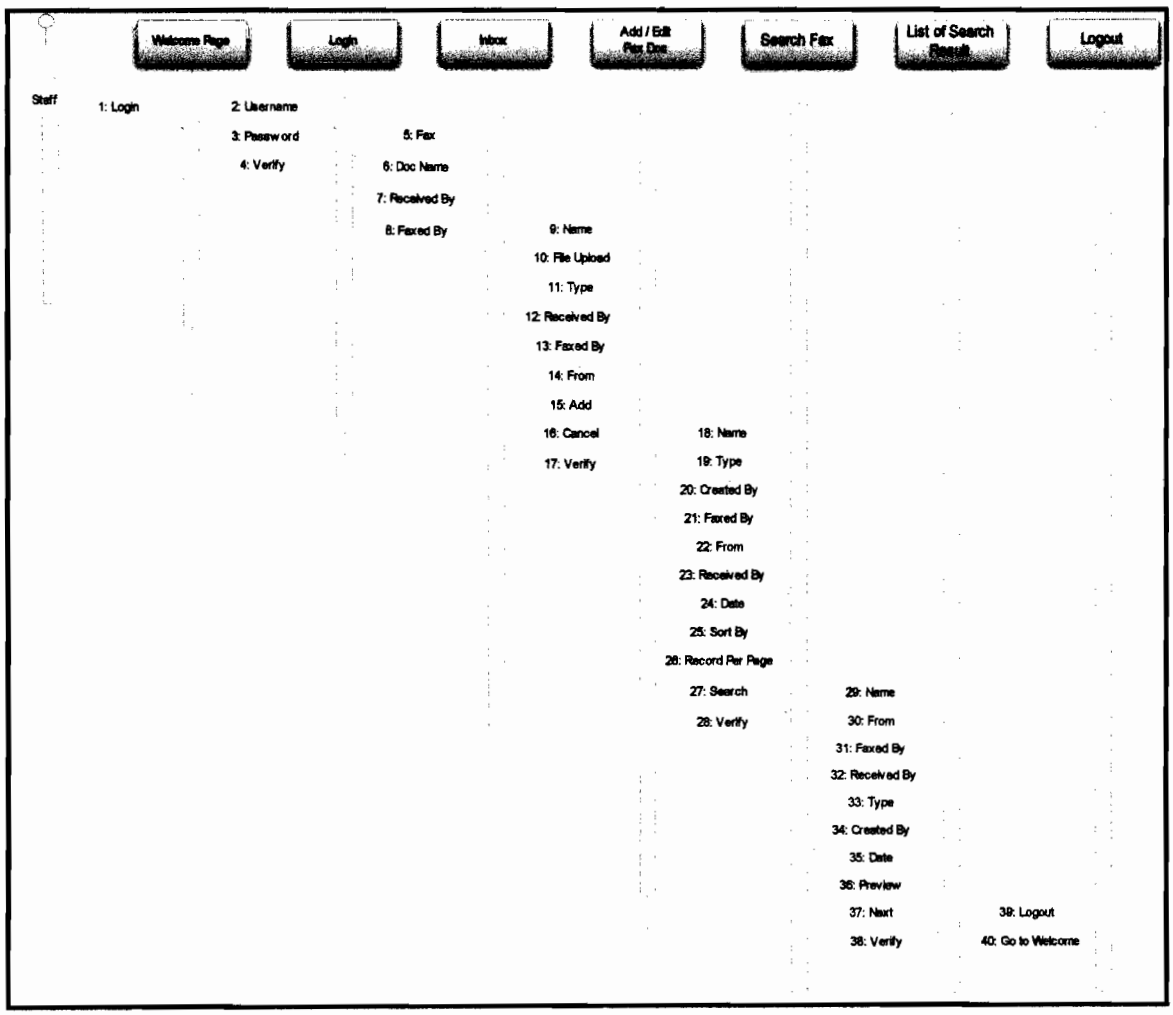

Fig. 8: Sequence Diagram

4.2 Outcome 2: Prototype for the Digital Fax Document Management System

In this section the outcome for prototype for the digital fax document management system prototype will be explained

.

Fig. 9 is the introduction page of the prototype. This page is just the introduction page and does not provide any informative content.

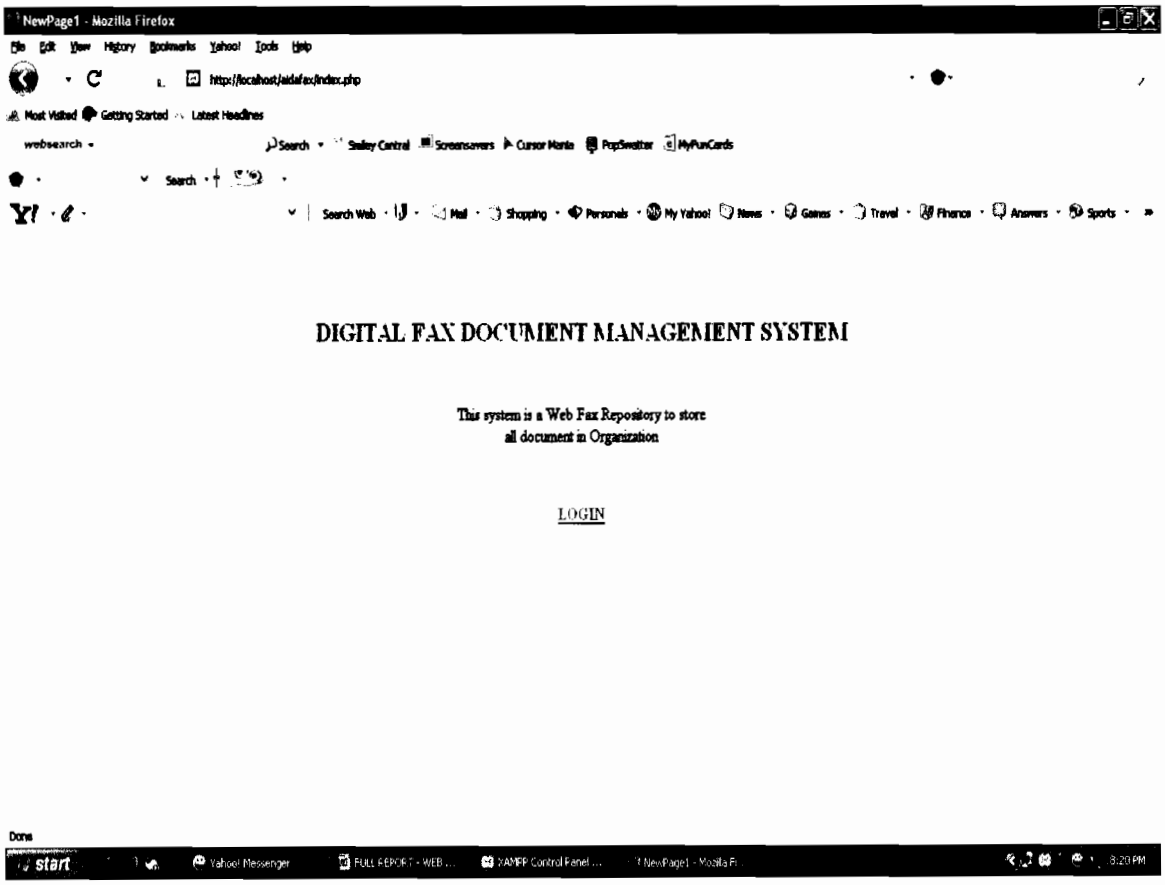

Fig. 9: Introduction Page

Fig. 10 is a login page. User needs to key in their username and password to login to this system. Login section needed to secure the document.

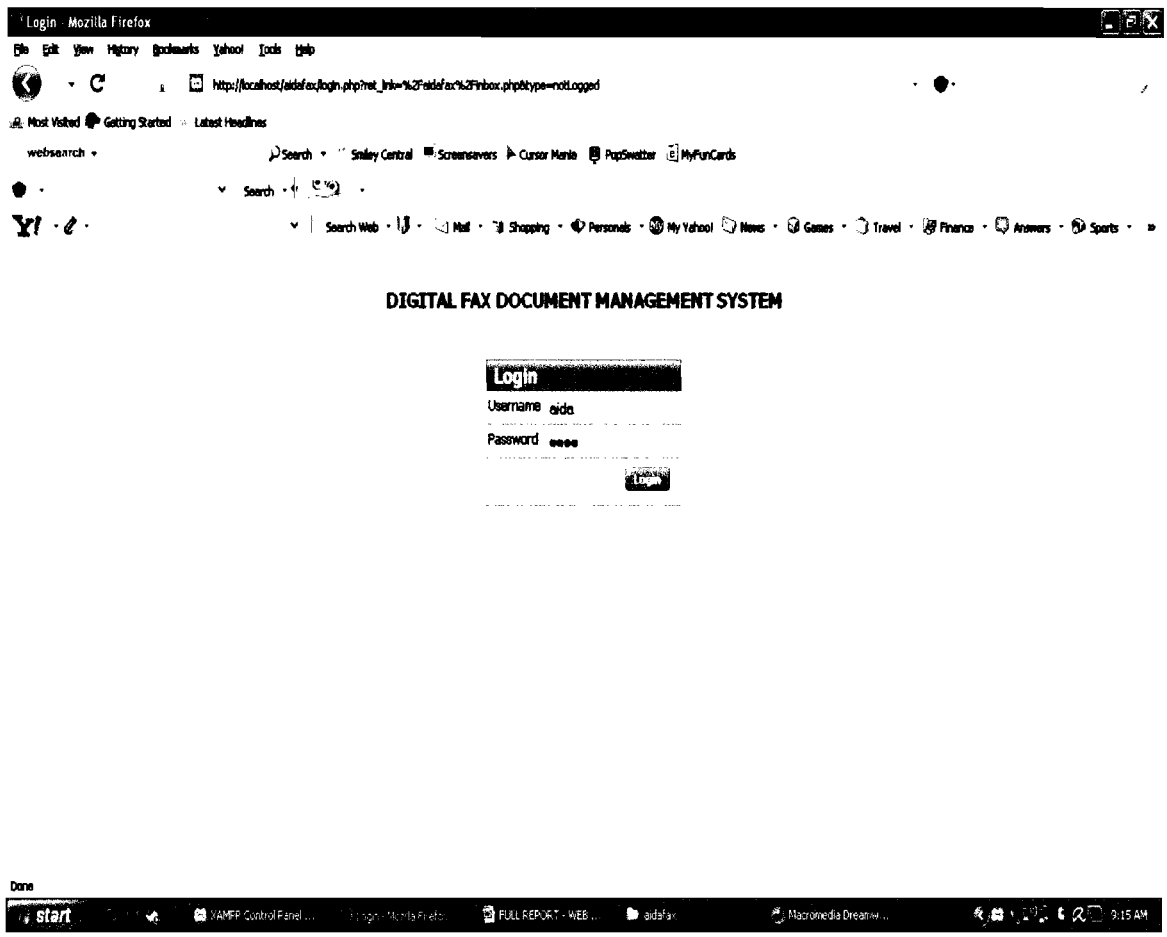

Fig. 10: Login Page

Fig. 11 is an inbox page. This page will view all the faxes record. Staffs can also click the link of "View All My Fax" to see the record of document in the system. Here, user can also create the document of fax and search for the document that have been saved.

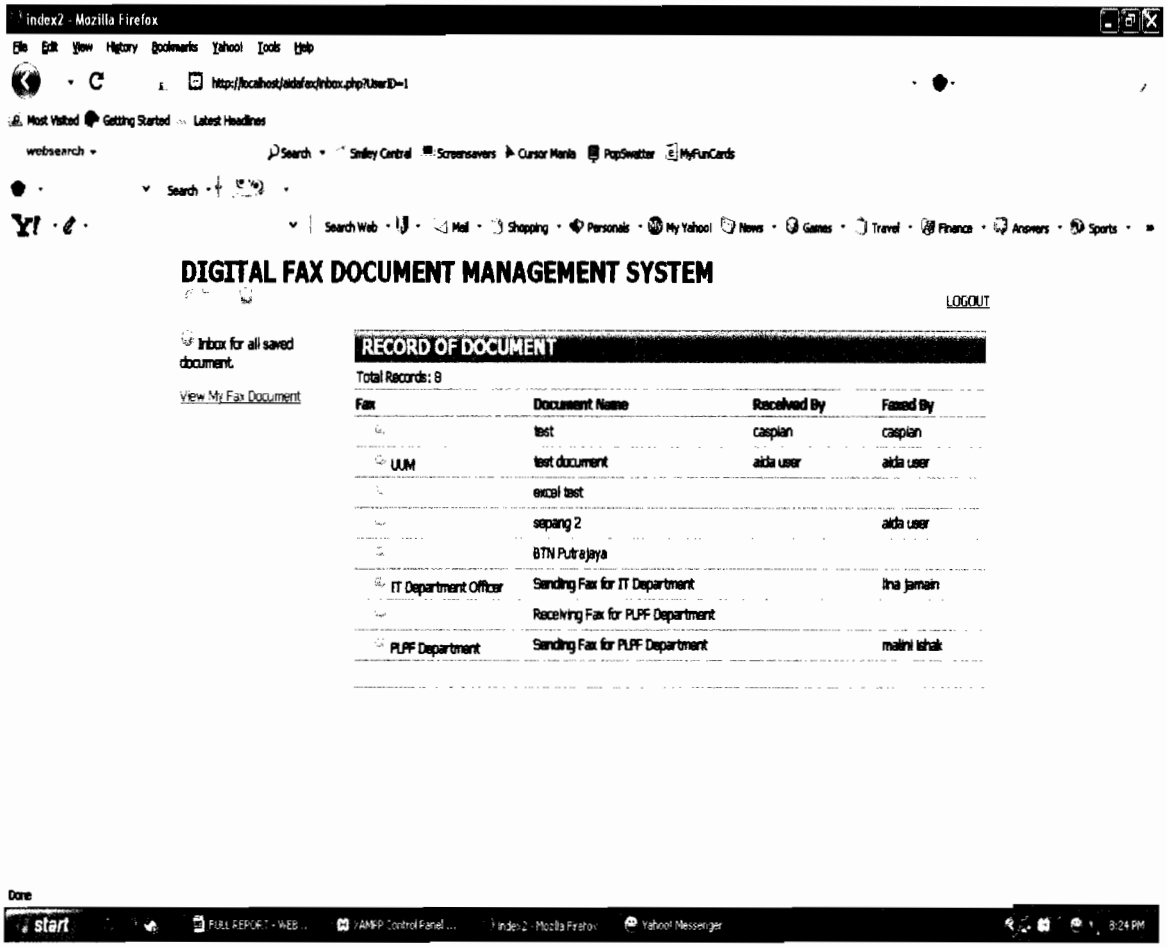

Fig. 11: Inbox Page

Fig. 12 is page about list of fax document. Besides, user can also directly fax any document that have been create and save in the system with click the fax icon after verifying the document. User can cancel the document if that is not the right one.

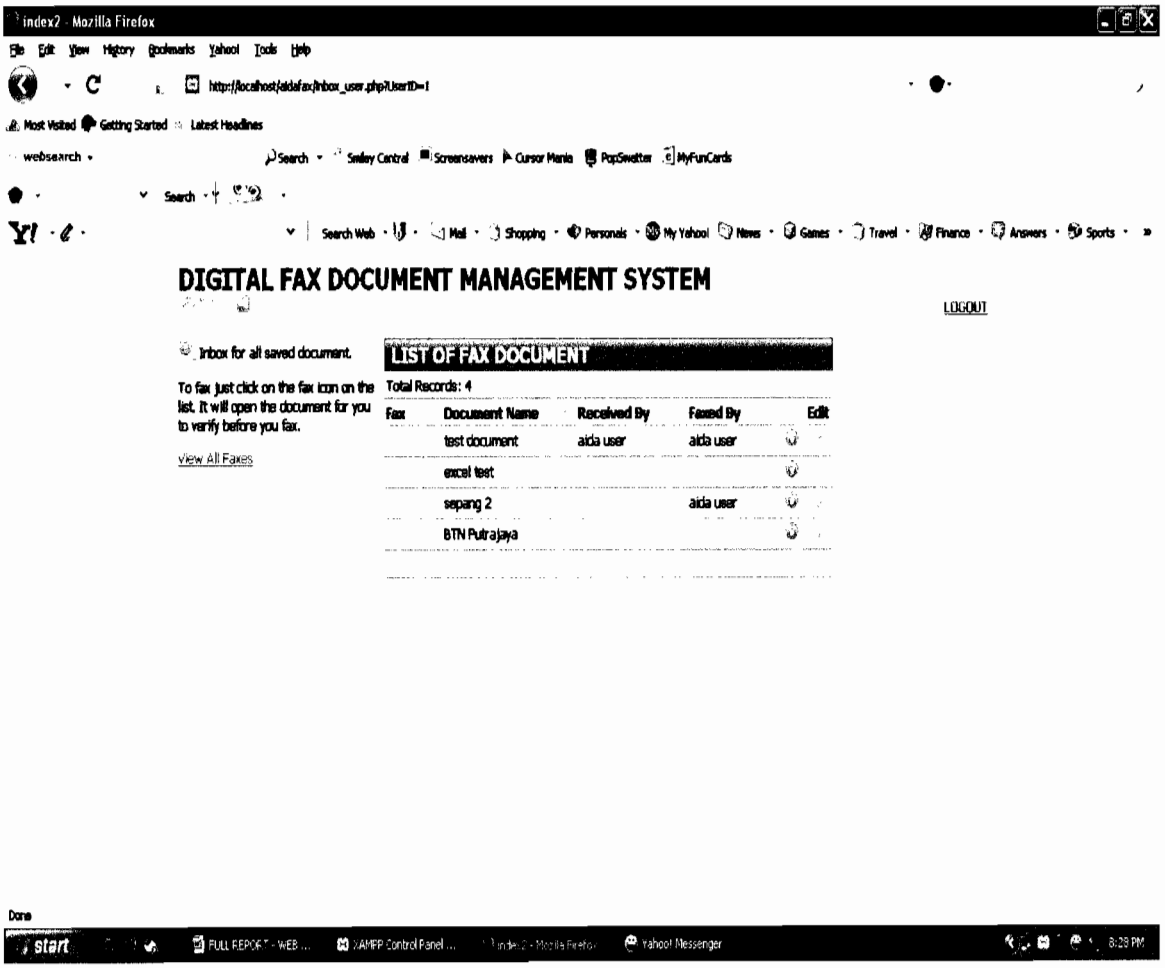

Fig. 12: List of Fax Document Page

Fig. 13 is a document information page where user can view the information on the document that has been stored in the system. The document information that have in the system are id, name, type, created by, faxed by, from, received by and date.

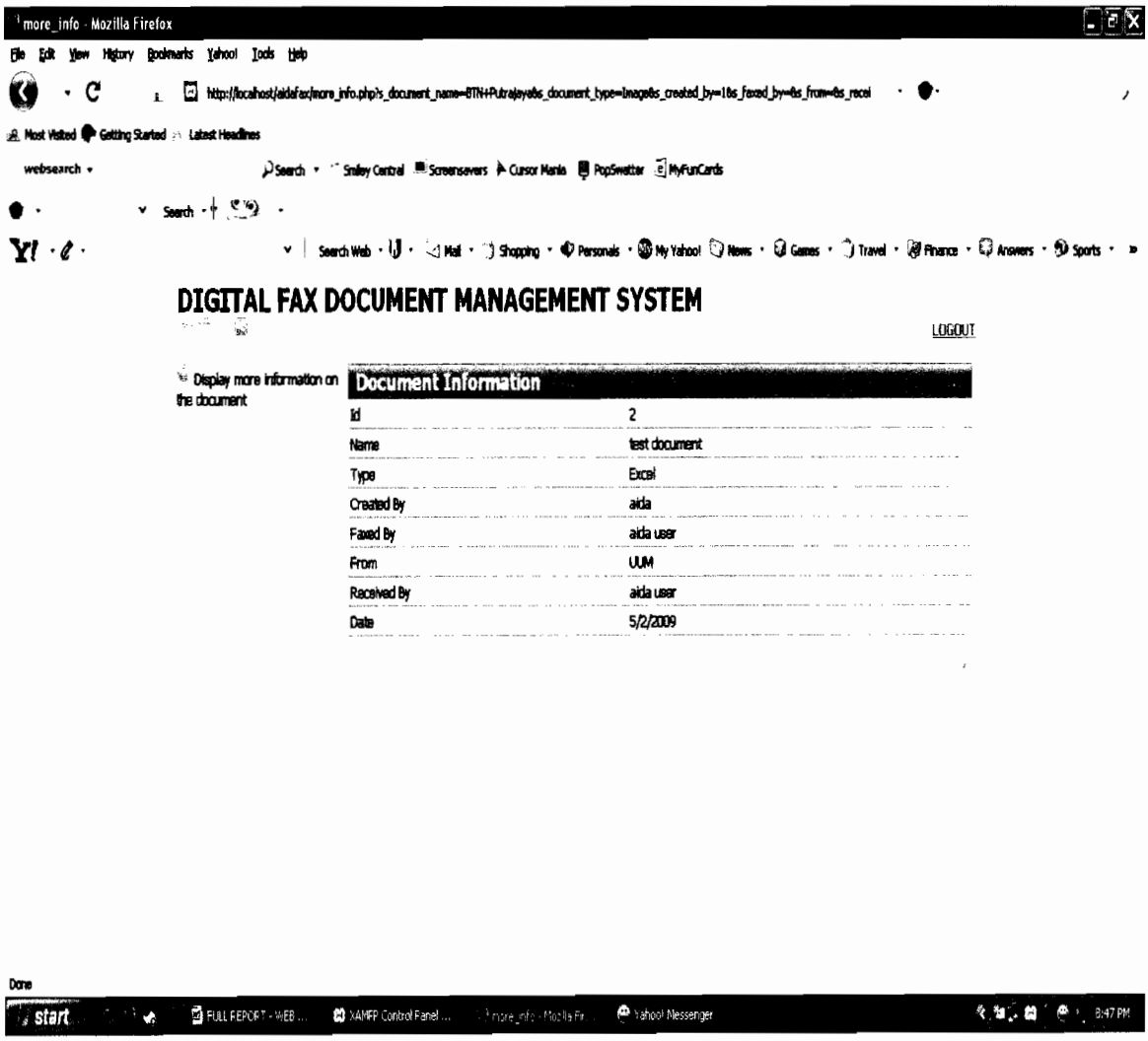

Fig. 13: Document Information Page

Fig. 14 is an add fax document page where user can upload files that need to be fax. Here, user can also create fax document and choose the type of fax document before sending the fax.

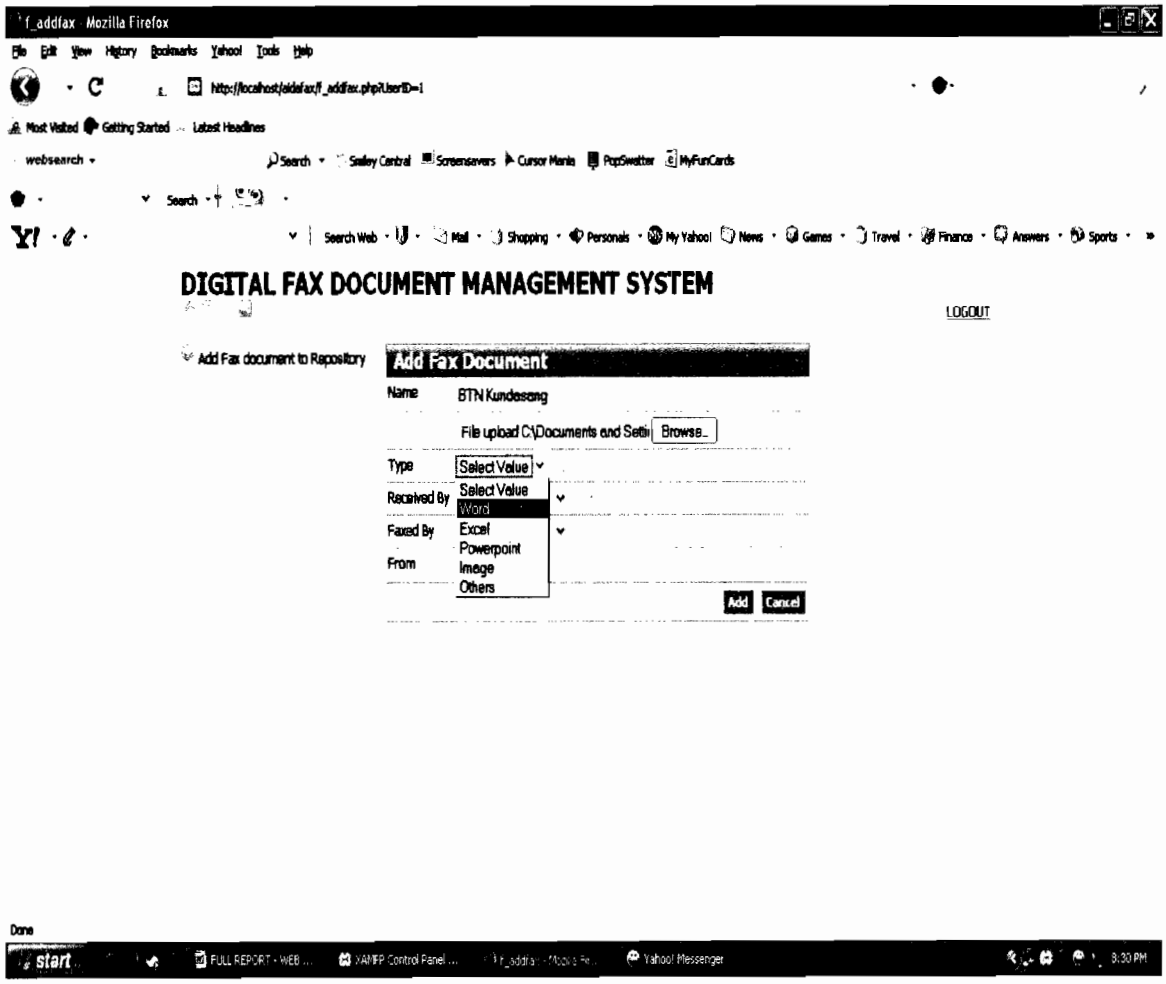

Fig. 14: Add Fax Document Page

Fig. 15 is a search features page where user can search for the document that has been stored in the system. User can see the list of search result after do the searching. Searching can be done by name, type, date, faxed by and received by. List of search result will be shows either there is any record according to searching that have been done by user.

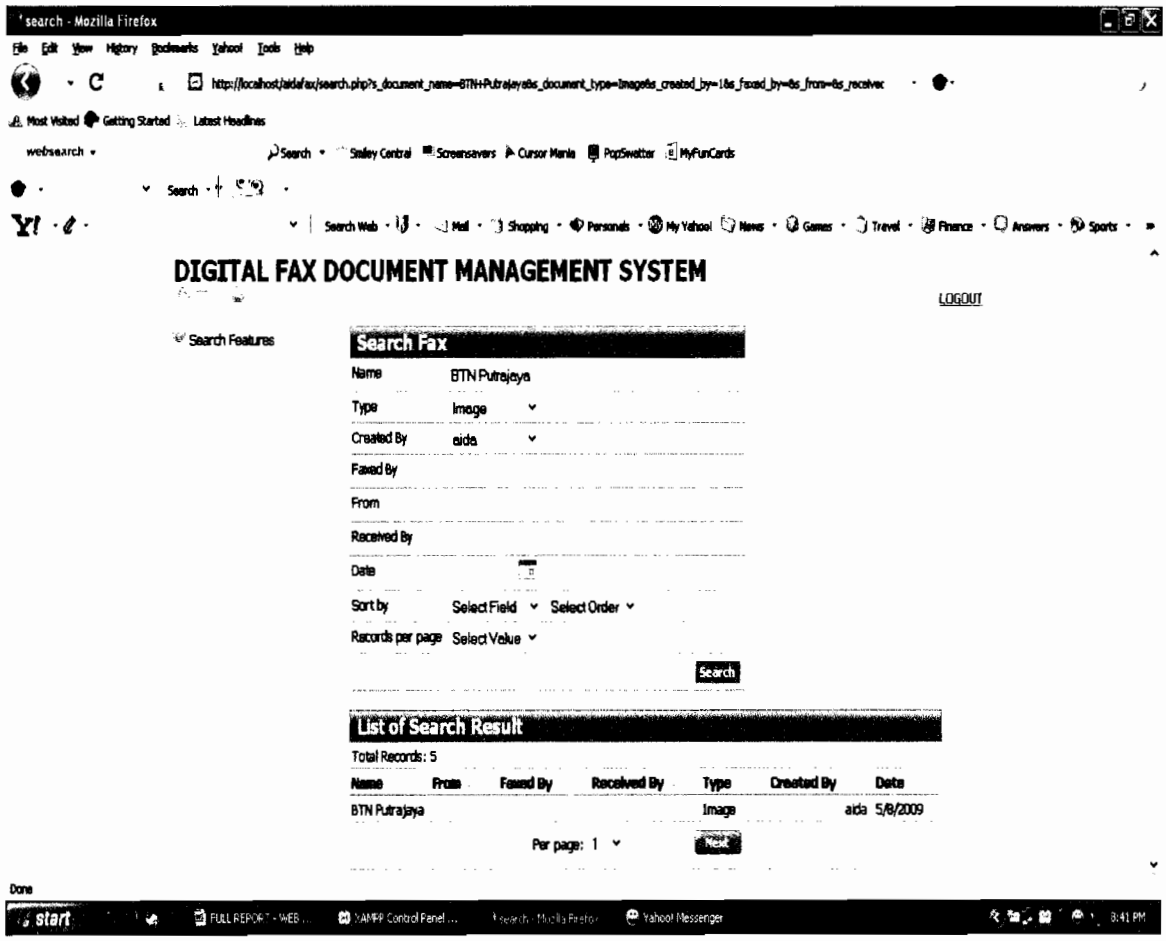

Fig. 15: Search Features Page

Fig. 16 is a logout page. If user logout from the system this page will appear. User can directly close the system or still can go back to the system by clicking the link to the system login.

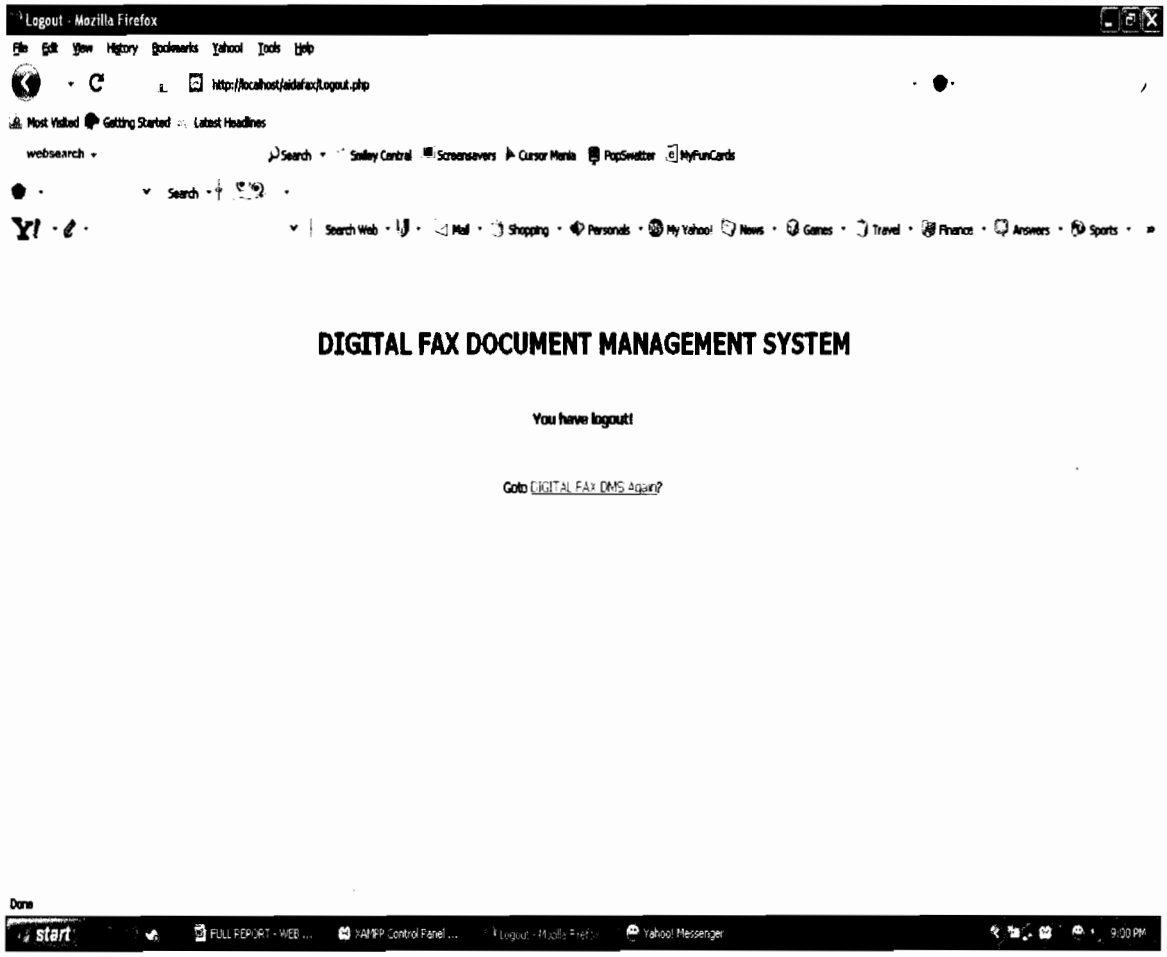

Fig. 16: Logout Page

Fig. 17 is an admin module page. Here, just administrator can access the system. Administrator will access into this page if need to add or delete user in using the system.

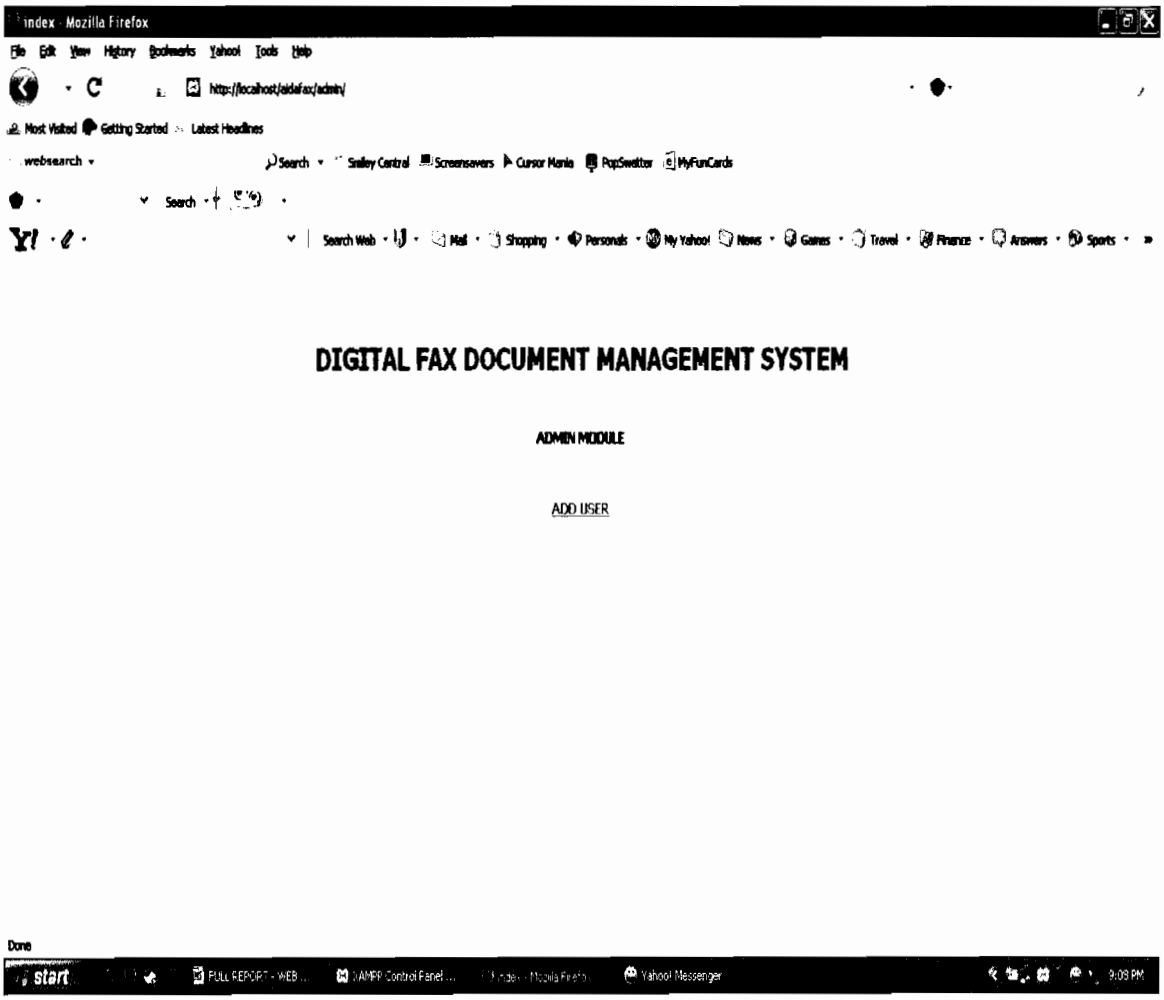

Fig. 17: Admin Module Page

Fig. 18 is an admin login page. Here, administrator needs to put login name as 'admin' and key in the right password to go to next page of the system.

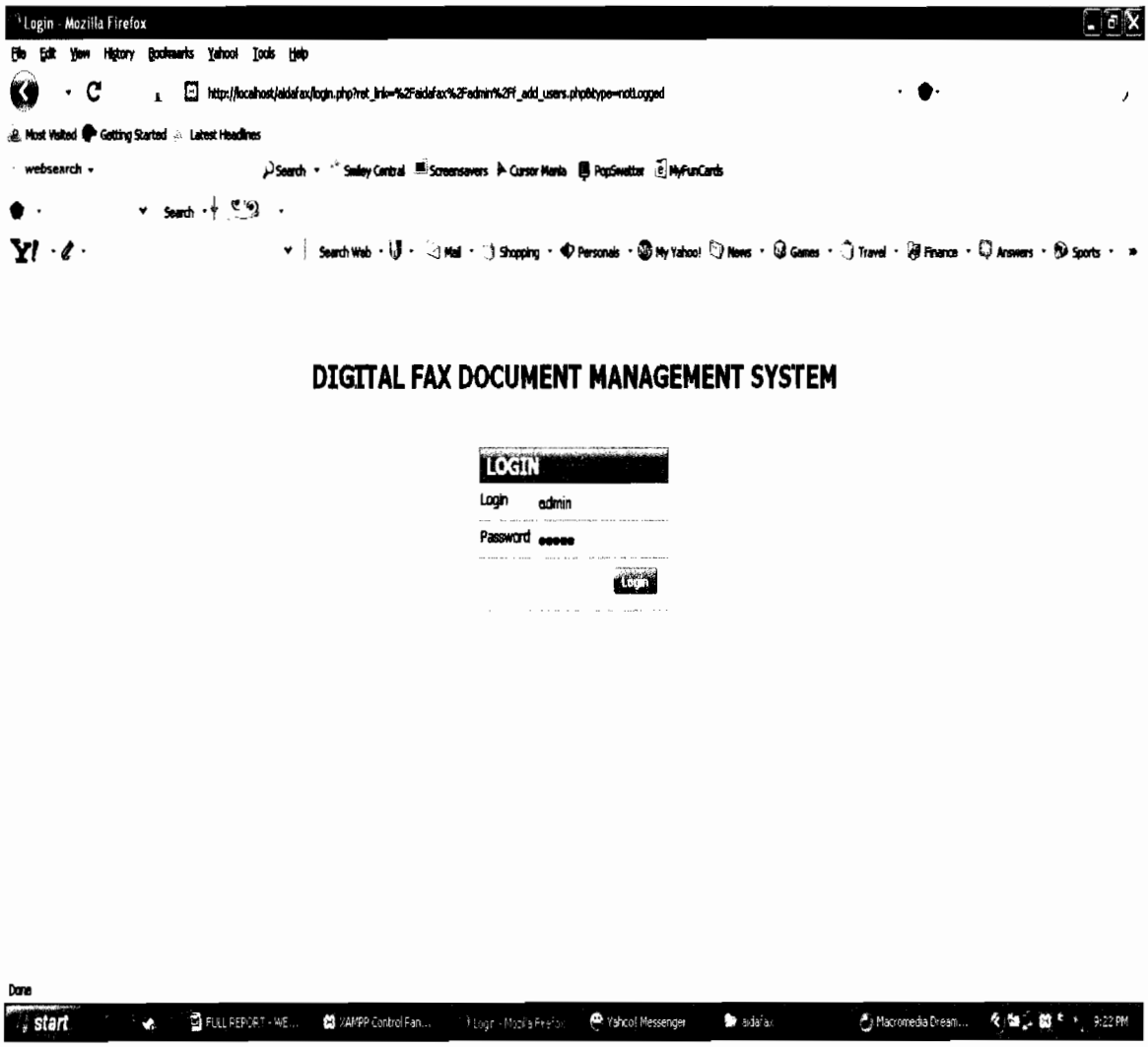

Fig. 18: Admin Login Page

Fig. 19 is an add and edit user page. At this page, administrator can add user that going to use and access this system. At the same time, administrator can view list of user that have in the same page.

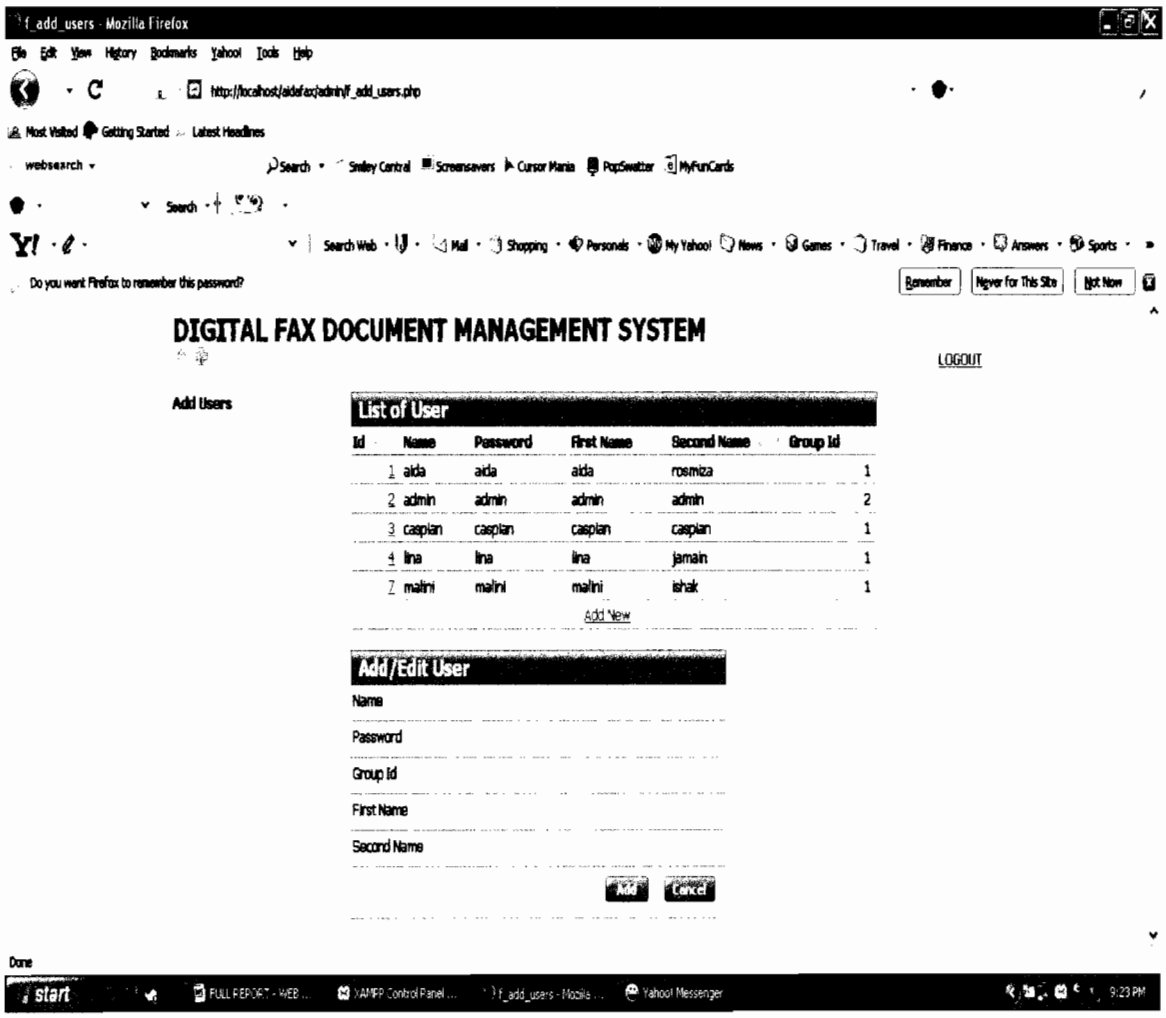

Fig. 19: Add and Edit User Page

Fig. 20 is a process (a) of sending document via WinFax Pro Message Manager. User must select the document that going to be send and select all the contact number of the receiver. Then, click 'Send'.

Fig. 20: Process (a) of Sending Document via WinFax Pro Message Manager

Fig. 21 is a process (b) of sending document via WinFax Pro Message Manager. After send the document to the receiver, all the details about sending fax is appear on the screen. Here, the fax server is connecting to the receiver fax machine.

Fig. 21: Process (b) of Sending Document via WinFax Pro Message Manager

Fig. 22 is a process (c) of sending document via WinFax Pro Message Manager. The document that wants to send is being process after the fax server is connecting to the receiver fax machine. The message will show either the fax in waiting mode, fax have been sent or fax is not sent.

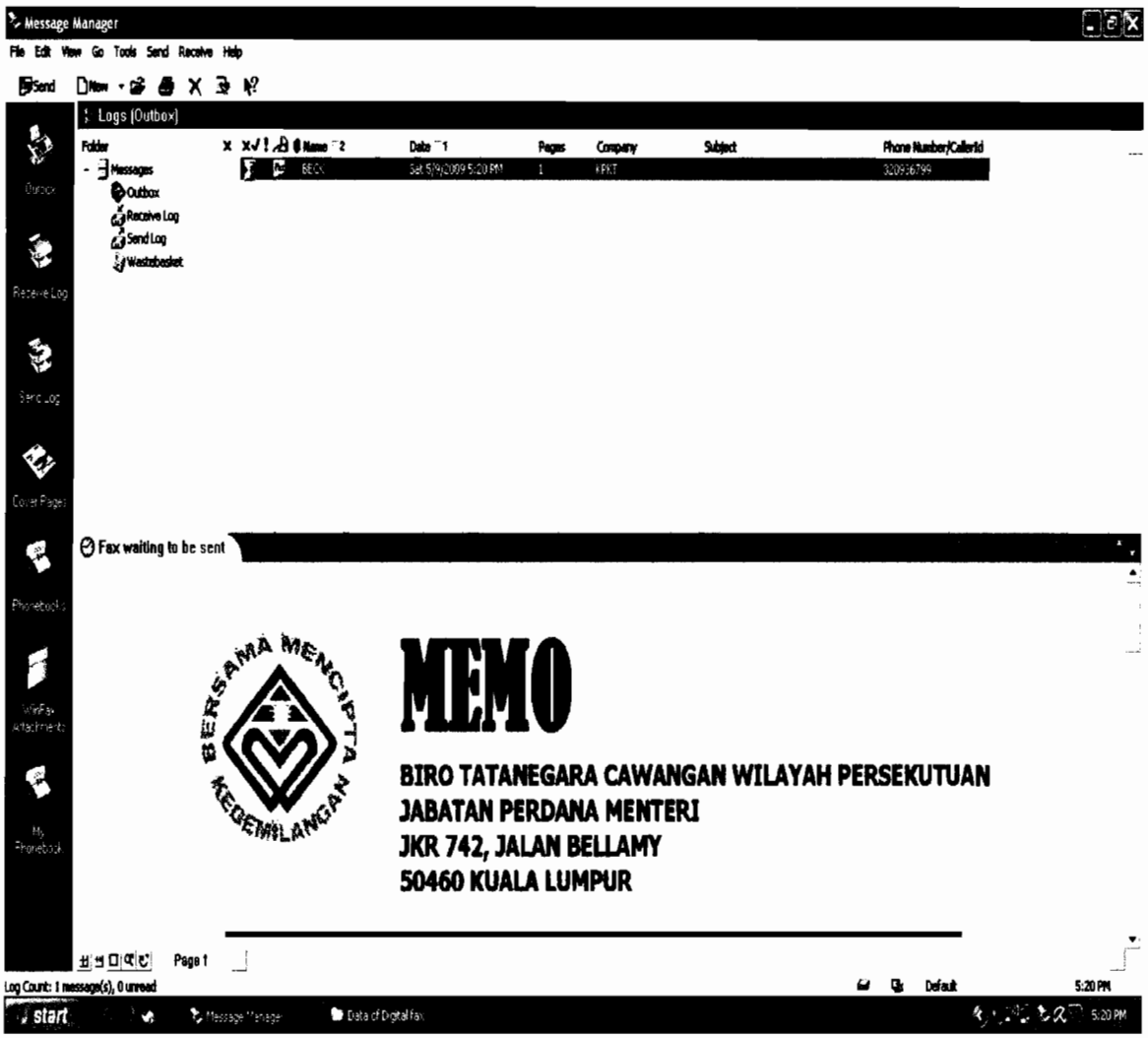

Fig. 22: Process (c) of Sending Document via WinFax Pro Message Manager

4.3 Outcome 3: Testing the Prototype

Software testing is any activity that had been done to the system aimed at evaluating an attribute or capability of a system and determining that it meets its required results. Although crucial to software quality and widely deployed by programmers and testers, software testing still remains an art, due to limited understanding of the principles of software (Hetzel, 1988). The difficulty in software testing comes from the complexity of software. User acceptance testing is the process whereby the actual user tests the system whether is fulfill the requirement and the needs of the user. Using questionnaire, that is another type of method to test the software, the functionality of the system and the interaction between the user and the system were tested.

The structured questionnaire was conducted to hundred respondents. The section of questionnaire (Appendix E) is divided into four main sections which is demographic, perceived usefulness, perceived ease of use, and behavioral intention. The outcome will be shows in mean value. The main focus research project in testing the digital fax prototype is perceived usefulness, perceived ease of use, and behavioral intention. This outcome will satisfied the last objective of this research project, which is test the prototype.

4.3.1 Perceived Usefulness

Question: Have you ever use a fax before on managing documents?

Result:

Table 5: Perceived Usefulness (1)

Variable	%
Yes	73.3
No	26.7

Conclusion: 73.3% of the respondents have experience used fax on managing documents.

Question: What is the first function that you used when using fax?

Result:

Table 6: Perceived Usefulness (2)

Variable	%
Faxing	67.7
Administrating	16.7
Searching	5.6
Reporting	10

Conclusion: 67.7% respondents used fax mode as the priority when navigating the digital fax prototype.

Question: Can you realize the different of the function when you use prototype of the fax system?

Result:

Table 7: Perceived Usefulness (3)

Variable	%
Yes	46.7
Not sure	33.3
I think so	13.3
No	6.7

Conclusion: 46.7% respondents realized about the different when use the prototype of the fax system.

Question: Do you think the function in the prototype is valuable while using the system?

Result:

Table 8: Perceived Usefulness (4)

Variable	%
Yes	76.7
No	23.3

Conclusion: 76.7% respondents think that the function in the prototype is valuable while using the system.

Question: Do you think the prototype is useful?

Result:

Table 9: Perceived Usefulness (5)

Variable	%
Yes	83.3
No	16.7

Conclusion: 83.3% respondents suggest that the prototype is useful.

4.3.2 Perceived Ease of Use

Question: What is your purpose to use fax?

Result:

Table 10: Perceived Ease of Use (1)

Variable	%
To give and get information instantly	43.3
To reduce time of work	6.6
Easy in managing document	30
Increase quality of document management	20

Conclusion: 43.3% respondents think purpose of the fax is to give and get information instantly.

Question: When using fax, it is easy to managing all the fax documents?

Result:

Table 11: Perceived Ease of Use (2)

Variable	%
a. Yes	46.7
b. Not sure	16.7
c. Difficult	20.4
d. I can't understand	16.2

Conclusion: 46.7% respondents think it is easy to manage all the fax documents when using fax.

Question: When navigating the prototype, is it easy to use the digital fax document management system in managing your fax documents?

Result:

Table 12: Perceived Ease of Use (3)

Variable	%
a. Yes	50
b. Not sure	20
c. Difficult	16.5
d. I can't understand	13.5

Conclusion: 50% respondents find it is easy to use of the digital fax document management system in managing your fax documents.

4.3.3 Behavioral Intention

Do the digital fax prototype provide the function that you wish it should have in managing the fax document in a system? Answer based on your experience using fax and navigating the prototype of digital fax document management system. Please rate between 1 until 5.

1 = Excellent

2 = Good

3 = Neutral

4 = Not good

5 = Poor

Result:

Table 13: Behavioral Intention

Variable	Fax Machine	Fax Ptototype
	%	%
Faxing		
a) Sending	3=33.3	2=40.0
b) Receiving	3=36.7	2=46.7
Your rate for this function	3=33.3	2=43.3
Administrating		
- Create	3=33.3	3=36.7
- Retrieve	4=46.7	2=46.7
- Update	4=46.7	2=40.0
- Delete	3=30.0	3=33.3
Your rate for this function	4=46.7	1=40.0
Searching		
- Recipient's List	3=33.3	2=36.7
- View Doc	4=26.7	2=46.7
- Update Doc	4=30.0	2=40.0
Your rate for this function	4=36.7	1=33.3
Reporting		
- Sending Details	3=36.7	2=33.3
- Receiving Details	3=36.7	2=30.0
- Report Num	3=33.3	2=30.0
Your rate for this function	3=33.3	2=33.3

Conclusion:

Faxing : 33.3% respondents rate as neutral for using the fax machine to sending and receiving fax documents. 43.3% of respondents rate as good for using the digital fax document management system in sending and receiving faxes.

Administrating : 46.7% respondents rate as not good for using the fax machine to manage the fax documents and 40% respondents rate as excellent for using the digital fax document management system in managing fax documents.

Searching : 36.7% respondents rate as not good for using the fax machine to search for the fax documents. 33.3% of respondents rate as excellent for using the digital fax document management system in searching all the faxes documents.

Reporting : 33.3% respondents rate as neutral for using the fax machine to do reporting for the fax documents. 33.3% of respondents rate as good for using the digital fax document management system in reporting all the faxes documents.

CHAPTER 5

CONCLUSION

In this chapter, the result obtained from the previous phases are presented and concluded. This chapter concludes the report by summarizing the overall results and achievement. There are also some discussions about the future works for this system.

5.1 Project's Summary

Here, it is concluded that the main objectives, that is to develop a prototype of web-based model of a digital fax document management system is achieved. In developing this prototype, a set of design principles that focused on functionalities and interface of the system have been suggested.

Based on these design principles and requirement, a prototype of the system called Web-Based Model of Digital Fax Document Management System has been developed using PHP. The system has several advantages that had been achieved. The advantages of the system are as follows:

i) For security purposes, only the user that is registered in the system can use this system. Only an authorized person who has the permission can use the system.

ii) The system is user friendly, in a sense that the user can easily understand the system although the user is a first time user. This is because the design is simple, attractive and do not have too many graphical items.

However, there are several limitations and problems that occurred in the Web-Based Model of Digital Fax Document Management System due to time constraints and the limitation of programming skills and language. These limitations and problems are listed below.

5.2 Problems and Limitations

There are several problems and limitations that occurred in this system. These problems and limitations in conducting this study are:

i) There are limited functions in this system. Only functions for sending and receiving fax are being highlighted. So in order to make the system more interesting and good, more useful functions should be included in the future.

ii) This project does not capture the overall design principles and requirements for developing the system, due to time constraints and most of all, because of the focus of the objectives that is the prototype of the system.

iii) The functions of system should be added more, by means that not only the basic function but the others in details such as scanning, file transferring and other functions.

5.3 Recommendation for Future Works

To solve and reduce the limitations and the problems with the existing system, there are several options that can be used. These options are:

i) There will be more and specific research on the existing system so that the limitation can be solved.

ii) The future works can be done according to what have been discussed in the previous section in full implementation.

iii) A new system that had been improved that will be used by other organizations so that only one system in used to manage the fax documents in Malaysia.

iv) Improved the functions so that other variety of function can be used in this system.

5.4 Conclusion

As the technological arise rapidly, it is necessary for organizations or individuals to upgrade their knowledge and usage of latest technology materials. By utilizing the system, BTN Putrajaya is able to obtain the real digitalize technique in managing fax documents in the document management system. Furthermore, other countries and large companies had developed interactive fax server and document management system which this could be opportunity for organizations to increase and improve their documents handling by provide more instantly and informative services.

For further study, research can be conducted to build a better framework of enhancement and implementing digital fax document management system for suitable usage. Another recommendation is to apply another interactive and more security technique in managing all documents. Further research also can study about the effectiveness of digital fax document management system to user around the world.

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APPENDIX A

US005754308A

United States Patent [19]

Lopresti et al.

[11] Patent Number: 5,754,308

[45] Date of Patent: May 19, 1998

[54] **SYSTEM AND METHOD FOR ARCHIVING DIGITAL VERSIONS OF DOCUMENTS AND FOR GENERATING QUALITY PRINTED DOCUMENTS THEREFROM**

[75] Inventors: **Daniel Lopresti**, Hopewell; **Jeffrey Esakov**, Hamilton Square; **Jianying Zhou**, Plainsboro, all of N.J.

[73] Assignee: **Panasonic Technologies, Inc.**, Princeton, N.J.

[21] Appl. No.: **495,187**

[22] Filed: **Jun. 27, 1995**

[51] **Int. Cl.**[6] H04N 1/00; H04N 1/40; G06K 9/20; G06F 17/00

[52] **U.S. Cl.** **358/403**; 358/401; 358/470; 358/444; 382/317; 235/375; 235/435

[58] **Field of Search** 358/401, 403, 358/404, 470, 444, 468; 382/181, 317; 235/375, 376, 435

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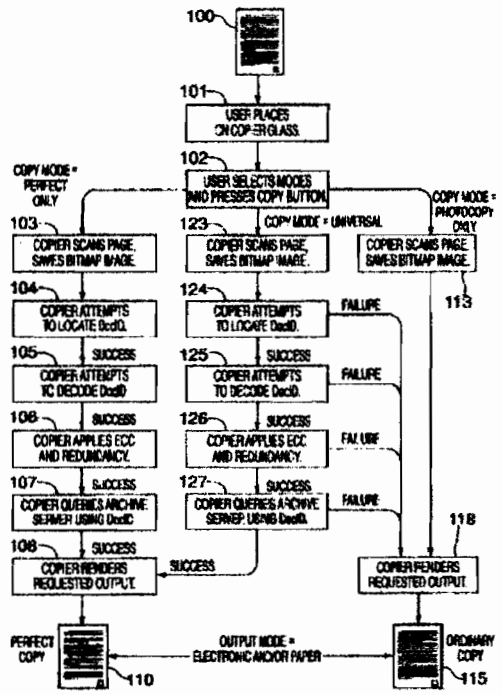
Primary Examiner—Edward L. Coles, Sr.
Assistant Examiner—Tia M. Harris
Attorney, Agent, or Firm—Amster, Rothstein & Ebenstein

[57] **ABSTRACT**

An inventive page encoding, printing, retrieval and archiving system and method wherein document information designators are encoded for pages. The designator includes information regarding the location of the digital representation of the page and optionally includes page generation and reproduction information. An enhanced copier or facsimile machine scans the printed designator and retrieves the stored digital representation of the page and outputs a "subsequent original" of the page. In the alternative, when the copier cannot directly access the digital representation of the page, the enhanced copier can decode the page generation and reproduction information found in the designator and apply the information to production of a high quality photocopy. The inventive equipment is additionally adapted to create digital representations of pages, create designators for the digital representations, store the digital representations along with the designators, and output printed versions of the pages including the designators.

34 Claims, 4 Drawing Sheets



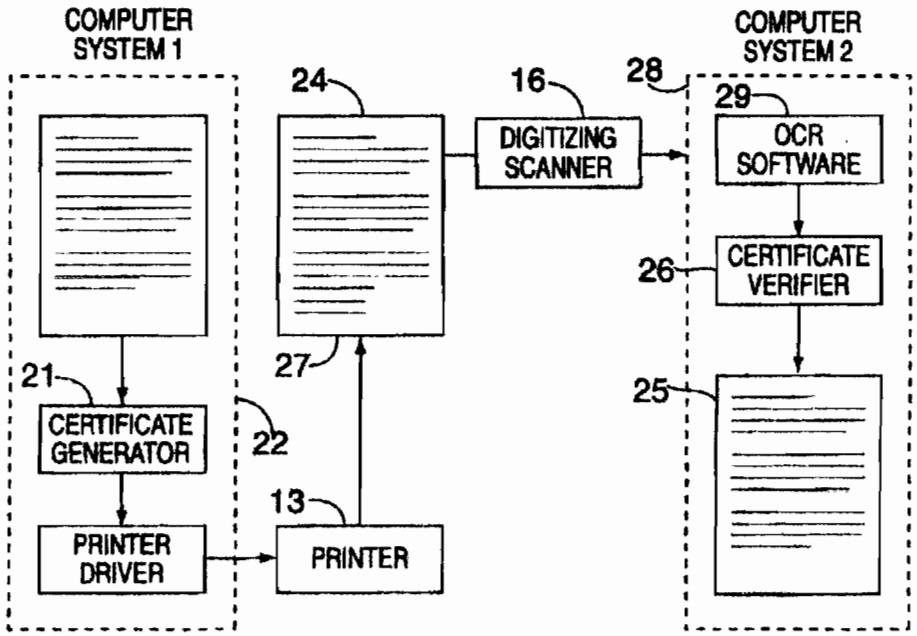


FIG. 1
(PRIOR ART)

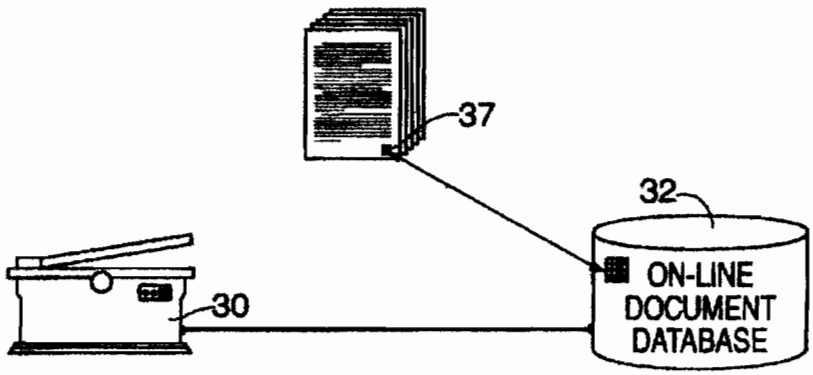


FIG. 2

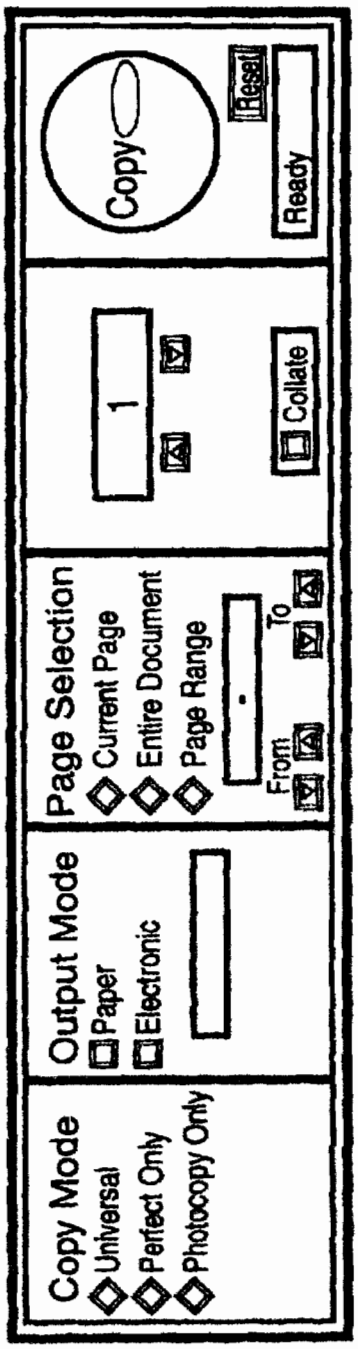

Copy Mode
Universal
Perfect Only
Photocopy Only
Output Mode
Paper
Electronic
Page Selection
Current Page
Entire Document
Page Range
From
To
1
Collate
Copy
Reset
Ready

FIG. 3

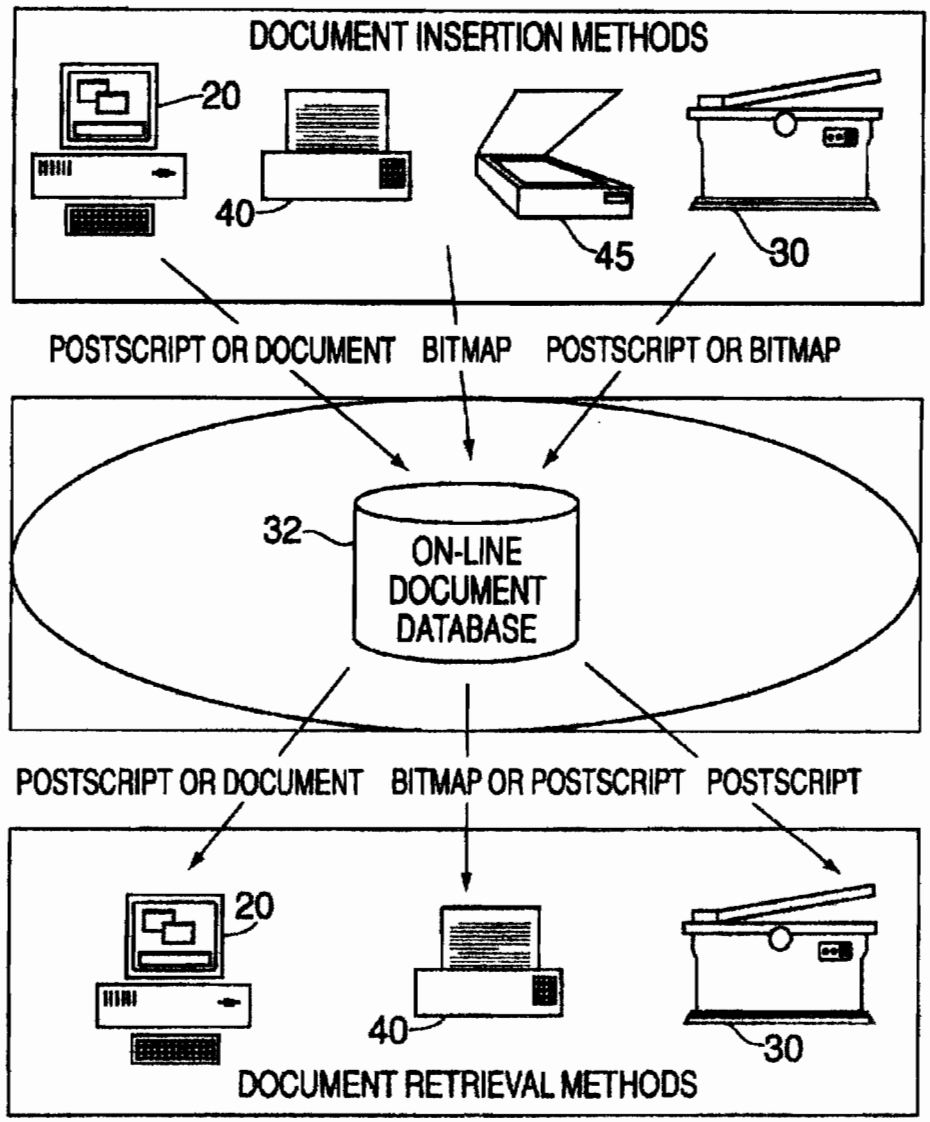

DOCUMENT INSERTION METHODS
20
40
45
30
POSTSCRIPT OR DOCUMENT
BITMAP
POSTSCRIPT OR BITMAP
32
ON-LINE DOCUMENT DATABASE
POSTSCRIPT OR DOCUMENT
BITMAP OR POSTSCRIPT
POSTSCRIPT
20
40
30
DOCUMENT RETRIEVAL METHODS

FIG. 4

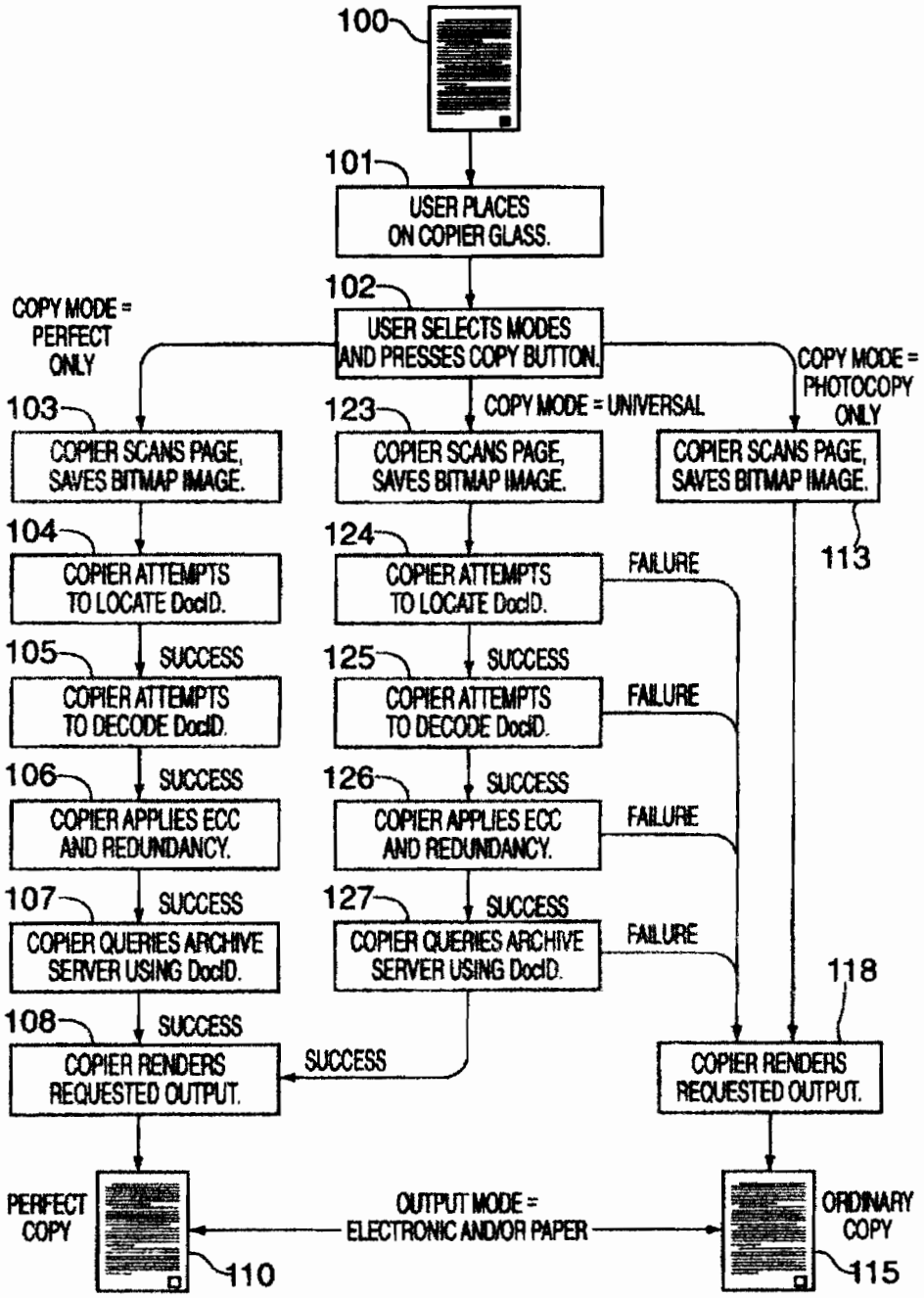

100
101
USER PLACES ON COPIER GLASS.
102
USER SELECTS MODES AND PRESSES COPY BUTTON.
COPY MODE = PERFECT ONLY
COPY MODE = UNIVERSAL
COPY MODE = PHOTOCOPY ONLY
103
COPIER SCANS PAGE, SAVES BITMAP IMAGE.
123
COPIER SCANS PAGE, SAVES BITMAP IMAGE.
COPIER SCANS PAGE, SAVES BITMAP IMAGE.
113
104
COPIER ATTEMPTS TO LOCATE DocID.
124
COPIER ATTEMPTS TO LOCATE DocID.
FAILURE
105
SUCCESS
COPIER ATTEMPTS TO DECODE DocID.
125
SUCCESS
COPIER ATTEMPTS TO DECODE DocID.
FAILURE
106
SUCCESS
COPIER APPLIES ECC AND REDUNDANCY.
126
SUCCESS
COPIER APPLIES ECC AND REDUNDANCY.
FAILURE
107
SUCCESS
COPIER QUERIES ARCHIVE SERVER USING DocID.
127
SUCCESS
COPIER QUERIES ARCHIVE SERVER USING DocID.
FAILURE
118
108
SUCCESS
COPIER RENDERS REQUESTED OUTPUT.
SUCCESS
COPIER RENDERS REQUESTED OUTPUT.
PERFECT COPY
OUTPUT MODE = ELECTRONIC AND/OR PAPER
ORDINARY COPY
110
115

FIG. 5

SYSTEM AND METHOD FOR ARCHIVING DIGITAL VERSIONS OF DOCUMENTS AND FOR GENERATING QUALITY PRINTED DOCUMENTS THEREFROM

FIELD OF THE INVENTION

The invention relates generally to the fields of on-line document generation, facsimile reproduction, document imaging, photocopying, and archiving. More specifically, it relates to the encoding of information in marks on printed documents to facilitate document archiving and reproduction either through on-line storage and retrieval of the document, scanning and reproduction of printed documents utilizing information encoded in marks printed thereon, or scanning and standard reproduction of printed documents to output either a paper or an electronic version of the document.

BACKGROUND OF THE INVENTION

The quality of document reproduction by photocopying has improved greatly in recent years but has, as an underlying defect, the inherent problem that, while an original document can be referred to as the "0th generation," all copies are first generation, at best. Degradation of copy quality is inevitable as copies are made from successive (i.e., first, second, third, etc.) generation copies wherein the cumulative degradation can ultimately result in an unrecognizable document. Ideally, one would like to produce an original-quality document each time reproduction of a printed document by photocopier or facsimile machine is desired.

Photocopying and facsimile transmission improvements have been realized in the technology as evidenced by Japanese Patent No. 05-041811 entitled "Reproduction Method of Color Image and Graphic Processing Device" and U.S. Pat. No. 4,549,219 entitled "Image Information Transmission System."

Another approach to document "reproduction" is to print out the document, provided that there is a digital version of the same resident in a computer, the computer is linked to a printer for outputting a printed version of the document, the user is permitted access to the document and knows how to access the computer-resident version of the document, the original application used to create the document is available, and the document hasn't been edited in the interim. Several Xerox patents, including U.S. Pat. No. 5,060,980 entitled "Form Utilizing Encoded Indications for Form Field Processing," have disclosed a basic scheme for accessing computer-resident version forms by providing a so-called "glyph" on the paper versions of the forms, which glyph represents an encoded pointer to the computer-resident version assuming access, application availability, etc. Once scanned by glyph scanning equipment linked to the computer, the computer uses the pointer information to facilitate processing of handwritten entries to fields on the form.

What is desirable is an enhanced photocopier and/or facsimile machine which can either retrieve and print a new original paper version of a computer-resident document, hereinafter referred to as a "subsequent original," or output a high quality reproduction of the document. It is additionally desirable that a user be able to automatically create and save an electronic version of a document in addition to being able to obtain a paper subsequent original of same. Ease of use of the copier is critical to the invention; and, ideally, all copiers in accordance with the invention will store and

retrieve documents in a universal page description language which is not application-specific.

It is, therefore, an objective of the present invention to provide copiers and facsimile machines (hereinafter referred to as "fax machines") capable of retrieving digital representations of stored documents and outputting subsequent originals of documents having inventive indicia printed thereon.

It is another objective of the invention that the above-described copiers and fax machines have the capability of alternatively providing high quality reproductions of documents by scanning and utilizing reproduction information encoded in the inventive indicia provided on the printed document.

It is yet another objective of the invention to provide a method for producing subsequent originals of printed documents having inventive indicia encoded thereon.

Another objective of the invention is to allow a user to automatically save a digital representation of a document, as a scanned bitmap or a page description file, including the inventive indicia encoded thereon or saving a pointer to a previously stored digital representation.

It is also an objective of the invention to provide an enhanced copier system for creating digital representations of scanned documents, said digital representations being appended with the inventive encoded indicia.

Yet another objective is to provide an enhanced copier system capable of preprocessing scanned or computer-resident documents for storage and of encoding inventive indicia therefor.

Still another objective of the invention is to provide printed indicia on an original printed document which has been preprocessed by a computer, said indicia encoding thereon at least document page identification and computer location identification and optionally including document generation information, and/or document reproduction information.

SUMMARY OF THE INVENTION

These and other objectives are realized by the inventive encoding, printing, and document production system and method whereby document information designators, called "DocIDs" are encoded for documents. Each document page has its own unique DocID which uniquely identifies the page, includes computer-resident document location information, and may optionally include document generation and reproduction information.

An enhanced copier scans the printed DocID and retrieves the stored digital representation of the document (e.g., an original wordprocessor source file, assuming that the copier is adapted to run the application which created the file; a bitmap; or a page description file) stored in the computer to which the copier has access and outputs a "subsequent original" of the document. In the alternative, when the copier cannot directly access the digital representation of the document, the enhanced copier can decode the document generation and reproduction information found in the DocID and apply the information to the production of a high quality copy of the printed document. By analogous adaptation, a facsimile machine can access stored source files, bitmaps, or page description files for outputting of subsequent originals. In the alternative, the enhanced fax machine can output enhanced high quality facsimile versions of scanned documents having DocIDs printed thereon. The inventive copier system is additionally equipped to image documents, create and store digital representations of pages, and create DocIDs for the pages.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a document recognition system in accordance with co-pending applications.

FIG. 2 provides a schematic illustration of a network defined by the enhanced copier and associated computer.

FIG. 3 illustrates a representative display panel for a perfect copier in accordance with the present invention.

FIG. 4 illustrates a comprehensive input, archiving, and outputting system in accordance with the present invention.

FIG. 5 illustrates a process flow representatively used by an enhanced photocopier in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As fully described in co-pending patent applications entitled "Certifiable Optical Character Recognition" (Ser. No. 07/958,938, filed Oct. 9, 1992, now abandoned, and Continuation Application Ser. No. 08/223,830, filed Apr. 6, 1994 now U.S. Pat. No. 5,625,721) and "Method and Apparatus For Providing Reproduction of Printed Documents Enhanced Optical Character Recognition" (Ser. No. 08/138,467, filed Oct. 15, 1993), the contents of which are explicitly incorporated by reference herein, information about the contents, layout, generation, and retrieval of a document can be encoded by a computer when initially generating the document or upon subsequent computer processing thereof. The encoded document information can then be provided via a document marker generated on the face of a printed version of the document. Advanced encoding and print resolution capabilities presently available can accommodate up to 30,000 bits of information in a single square inch of space, while a mere 100 bits of encoded information is more than sufficient to uniquely identify every atom in the known universe. Therefore, as taught by the above-referenced applications, one can theoretically encode the entire document contents, limited only by the amount of space on the document face that one is willing to sacrifice to the document marker. A marker scanner, in conjunction with or wholly separate from an optical page scanner, can locate and scan the marker and provide the information to an associated system equipped with the appropriate recognition and decoding software. The decoded information can then be used by the scanning system to create a new version of the document or to enhance the recognition, reproduction and error correction for the scanned document.

FIG. 1 provides an illustration of the representative enhanced optical character recognition system of the co-pending applications. It is assumed that the above-described system includes a first document generating or document processing computer **22** having document marker encoding software **21**, a printer **13** linked to the first computer and equipped to output the document marker **27** with the printed version of the document, a document scanner **16** adapted to scan the document marker, as well as, or separate from scanning of the characters on the document, a second computer **28** having recognition software **29** including software **26** for recognizing and decoding the document marker and for applying the decoded information in producing a second version of the document, and an optional printer (not shown) linked to the second computer for outputting a printed second version.

FIG. 2 illustrates the present inventive photocopier. In accordance with the present invention, the document marker scanning capability is incorporated into the photocopier, a so-called perfect copier. As previously mentioned, the invention is extendible to a facsimile machine as well. For ease of description, however, only the copier will be referred to throughout but will, except where otherwise distinguished, refer both to a copier and a fax machine. The perfect copier **30** scans and decodes the DocID located on the document to be reproduced. Although *it may* be useful to have a separate document DocID printed on the first page of an archived document to facilitate retrieval of an entire multipage document, it *is* intended that a separate page DocID, uniquely identifying each page, be located on each page of a multipage document.

Upon decoding of the information in the DocID, the DocID software in the perfect copier determines the appropriate process for generating a best available version of the page. The options for generating a best available version of a page include the following: (a) retrieving the file containing the digital representation of the computer-resident page (i.e., the source file, bitmap, or page description file) and outputting a subsequent original version thereof; (b) reproducing the contents of the page by optical character recognition based upon the information found in the decoded DocID; (c) enhanced photocopying of the page by utilizing photocopy parameters identified in the decoded DocID; or, (d) standard photocopying of the page. A perfect copier user *may* specify *the* copy *mode*, as will be discussed further below.

The perfect copier **30** operating in the first mode of retrieving the stored digital representation file for the page locates, scans, and decodes DocID **37** and then accesses the file containing the digital representation of the page by utilizing the decoded information from the DocID to transmit a retrieval request to the storage location, illustrated as archive server **32**, at which the file is stored. The retrieval request from a perfect copier includes an identifier uniquely assigned to the copier to establish access, an optional copier user ID, the copier's destination address, the decoded file location information, including the address of the archive server, and the file identification information. Archive server **32**, to which the perfect copier is linked, directly or via computer network, retrieves the designated file, from the location indicated by the decoded DocID information, and provides a digital transmission to the copier. The copier receives the digital representation and provides same for output of a subsequent original of the page. The subsequent original of the page is printed with its DocID to facilitate later copying of the page or accessing of the archived version thereof.

In the instance of a fax machine accessing the file having the stored digital representation of the page and sending a digital version of the page for outputting at a second receiving fax machine, the retrieval request identifies the requesting fax machine, the file location and identification information, and destination information for the second, receiving fax machine. As an alternative, the receiving fax machine can obtain a DocID from the sending fax machine or from the transmitted bitmap and thereafter request the digital representation of the page from the archive server.

In the second mode of operation, the copier operates in accordance with the previously-referenced co-pending patent applications by providing enhanced optical character recognition (OCR) based upon information from the decoded DocID. Assuming that the copier cannot access the archived version of the page, it will utilize the next best option for reproducing the page. Through a scan of the DocID, the machine first determines if OCR is necessary,

e.g., no scan would be required if the entire contents were encoded in the DocID. If not all of the contents can be reproduced simply by decoding the DocID, the encoded information will otherwise be used to accurately reproduce the page. Obviously, the foregoing second mode is a more costly and time-intensive mode of reproduction than simply photocopying the page. however, for archiving wherein subsequent document manipulation is anticipated, it may be desirable to OCR the page, and invoke DocID encoded error correction information as fully detailed in the aforementioned co-pending applications.

The third mode of operation for the perfect copier involves utilizing information encoded in the DocID to produce an enhanced, high quality photocopy of the page. Photocopying and facsimile reproduction parameters, such as exposure levels, paper size, and paper quality, may be automatically communicated to the perfect copier or perfect fax machine via the decoded DocID. Further detail may include an indication of whether the page contains any photographic (i.e., half-tone) images and whether the page contains any color images or text. Once again, this operating mode is one of the alternative copy modes based upon the assumption that the copier cannot access the digital representation of the page from its storage location, and/or assuming that the user does not require either a subsequent original or full OCR treatment for reproducing the page.

Finally, absent any DocID printed somewhere on the page to be reproduced, or absent the availability or need of implementing any of the aforementioned options when a DocID is available, the page may be reproduced in accordance with standard photocopying or fax reproduction technology.

Additional functionality which can be realized by implementing the present invention includes: output of an entire, multipage document based upon scanning of a document DocID or of a page DocID located on only one page of the document; output or replacement of missing pages from a document for which a document ID or any one page DocID is available; and, output of subsequent originals for torn or otherwise damaged pages and/or multipage documents. Redundancy of encoded information at various locations on a page can facilitate the latter reproduction scenario, wherein a single DocID location may have been torn away or obliterated.

A user may select the "Copy Mode" and "Output Mode" when utilizing the inventive copier 30. FIG. 3 provides a representative display panel 32 for a perfect copier. For the "Copy Mode," the user may select "Perfect Only," which option indicates that the user wishes to obtain a subsequent original of the page which has been placed on the glass of the copier. Unless the copier can find and decode a DocID for the page, the copier will not provide any output for the user. In addition, even if the copier locates and decodes a DocID for the page, if the copier cannot access the archive server, or other storage location at which a digital representation of the page resides, a subsequent original cannot be generated.

Access to an archive server can be strictly controlled by its owner (e.g., a publishing house, a library, a university, etc.) whereby only subscribers with verifiable access codes can request and receive transmissions of digital representations of pages which are resident thereon. Royalty collection for receipt of subsequent original pages and documents can readily be tracked and executed in such a subscriber-access system. In addition, a user-subscriber can not only obtain a subsequent original of a page or document, but may also access earlier or subsequent versions of a revised page or document, provided that the archive server cross-references its files and DocIDs in such a manner as to facilitate retrieval of related files, and assuming a functionality at the copier by which the user can communicate the desire to obtain the latest version of the page or document. Additional subpanels or screens of options can readily be provided at the perfect copier along with appropriate software to prompt a user with regard to alternative page and version selection, as is well within the purview of one having skill in the art.

Since a document DocID may be used for a multipage document in addition to each unique page DocID, the copier panel may additionally include the "Page Selection" display illustrated in FIG. 3. From the decoded DocID, the copier can obtain the document length and display the number of pages at the "Page Range" window. The user can then adjust the page range to indicate which pages are to be output. In this manner, a user can readily replace missing or damaged pages of a multipage document without having to reproduce the entire contents of the multipage document. Assuming that the archive server has linked successive versions of the stored page or pages of a document, another option can be communicated to the user for choosing one or more of the stored versions of the page or document, whereby the user can obtain an entire document history or simply obtain the most current information.

Assuming the "Perfect Only" copy mode has been selected and that the copier successfully accesses the archive server on which the digital representation of the page resides, the digital representation of the page is provided from the server to the copier. The copier then re-creates the page, be it a source file, bitmap, or page representation file, along with its DocID, as an analog version and prints the subsequent original including a printed DocID.

Of course, the user may opt for "Photocopy Only" mode to simply photocopy any page, thereby settling for a standard, next generation photocopy of the page, and necessarily avoiding any concerns of access and copyright royalties or subscription fees. Selection of the "Photocopy Only" mode will invoke standard photocopying procedures to obtain a next generation version of the page, in accordance with the prior art in the photocopying technology. Any DocID on the page being copied will, necessarily, be reproduced on the photocopy. However, the degeneration of quality and clarity may negatively impact the usefulness of the DocID for future retrieval. To counter balance the potential degradation, DocID's are provided with error correcting codes and redundancy encoding in order to maximize subsequent decoding thereof.

Finally, the "Universal Mode" can be chosen whereby the copier provides printed output of the page to be generated according to the best available method. If the page has a DocID and the copier can access the archive server or other storage location on which the digital representation is resident, a subsequent original will be output. If the page has no DocID, a photocopy will be made. In the Universal Mode, however, the copier can invoke the other two reproduction options discussed above, that of enhanced optical character recognition of the page, or that of enhanced photocopying of the page. Using information encoded in the DocID, the copier can optimize its output, even when it cannot access the storage location on which the digital representation of the page resides. The copier decodes the DocID to obtain copy parameters, page layout, etc., for use in reproducing the image on the page. Enhanced OCR could also be performed in accordance with the teachings of the aforementioned patent applications; although, as mentioned

above, the commercial applications of enhanced OCR at a copier are somewhat limited in light of the increased time and cost of performing OCR.

The user may also select the "Output Mode" to designate "Paper", "Electronic" or "Paper and Electronic" output. Clearly, selection of the "Paper" option indicates that the user wishes to obtain a hard copy of the page, whether a subsequent original, enhanced photocopy, or standard photocopy. The "Electronic" output option provides a user with the ability to electronically save a digital representation of the page which is provided at the imaging surface of the photocopier, scanner, fax machine, etc. If the user has chosen the "Perfect Only" copy mode and the "Electronic" output mode, the copier will obtain the previously stored digital representation of the page from the appropriate remote archive server and save that digital representation either at a local archive server, at a local computer associated with the copier, on a permanent storage location at the copier itself, or on a removable storage media associated with the copier. Saving, or archiving, the digital representation of the page additionally involves not only a step of obtaining a digital representation of the page, by either digitizing the page or retrieving a previously stored digital representation, but also the steps of physically reading that digital information to a storage location, and creating a DocID for the stored information. In the instance of a digital representation which had already been stored on and retrieved from another archive server, and is now to be stored locally, the new DocID may include a pointer to the original archive server, along with new information about its local storage location. In the alternative, what is stored locally may simply be the pointer to the archive server at which the digital representation is stored, thereby maximizing utilization of locally available storage.

Another mode by which a paper will be archived is by selection of "Photocopy Only" and "Electronic" mode. Rather than attempting to access an existing digital representation of the page, the copier will create and save a new digital representation. Such may be a particularly useful mode for saving pages which have been annotated by the user. The copier will save a bitmap of the page, as annotated, which bitmap includes the original content data, the original DocID (if one is present), and the added annotations. In effect, therefore, the copier acts as a flatbed scanner input device for the computer network. However, in storing the bitmap, the copier or the archive server will assign a new DocID to the newly stored digital representation. Since the "Photocopy Only" mode does not invoke the DocID decoding software, there will not be any cross-reference or linkage of any original and the newly cited digital representations of the paper. Clearly, however, the document management software at the archive server could be modified to decode and link DocIDs even without conducting the step of obtaining the "original" digital representation of the page from a remote storage location.

As illustrated in FIG. 4, digital representations of pages can be entered into the archives by the copier scanning method detailed above, the copier accessing of digital representations from remote archive servers, also discussed above, or through standard flatbed scanning, facsimile machine bitmap scanning, or computer generation of the page, wherein each of the scanning or inputting operations is followed by a two step archiving protocol. Assuming a "Paper and Electronic" output mode for a copier, and a corresponding "Print and Archive" output mode for a computer, the copier or computer sends a message to the archive server indicating that a new digital representation is being created and requesting a unique DocID for it. The copier or computer may also provide the archive server with OCR and ECC information for incorporation into the DocID, or such encoding may later be appended to the DocID at the copier or computer. The archive server allocates space for the digital representation, generates a new DocID including the location and transmits the DocID back to the copier or computer. The user's copier or computer receives the DocID and incorporates the DocID into the digital representation of the page. The copier or computer then effects printing of the page, including the DocID and simultaneously transmits a digital representation of the page to the archive server.

In a network of devices, the DocID creation software could be provided to each of the input devices, however, the archive server must identify the storage location at which the digital representation will be stored and provide the location information for inclusion in the DocID. The DocID may also include identification of the person who generated the page, input location, input parameters, indicia for identifying the page, a page count for multipage documents, archive destination information, and cyclic redundancy check (CRC) and error correcting codes (ECC). As an alternative to the server generating a new DocID for each new page, the server may issue a "bank" of DocID's which the user's computer or copier may assign to created pages as needed. In issuing a "bank" of DocIDs, the archive server commits certain storage locations for the subsequently-transmitted digital representations, more realistically, for pointers to the ultimate storage locations of the later-saved digital representations. The archive server stores the digital representations of each page according to its DocID and provides storage management, document management, security, and accounting functions relative to the pages.

Although the manner in which the page is archived is not critical to the retrieval thereof, several archiving options involve saving the page from a scan at the inventive perfect copier or perfect facsimile machine. Software can be installed at the copier or fax machine to scan and digitize the relevant page for transmission to a storage location, to append a DocID to the digital representation, and to transmit the digital representation (e.g., bitmap file or page description files) with the DocID to a storage location at an associated computer and/or archive server. When the output mode is "Electronic," DocID creation can be done after transmission of the digital representation to the computer and/or archive server.

A computer at which a page is generated, may be adapted to include not only the familiar "Store" or "Save" feature but also a specific "Archive" function or "Print and Archive" function by which the storage location and other relevant page information are encoded in a DocID which is both saved with the digital representation and output whenever a subsequent original of the page is printed or whenever the file is provided to an associated component or user. Page bitmaps can be created and archived by fax machines, document scanners, and copiers adapted in accordance with the present invention. The bitmap, the DocID, or both which are created when scanning can be saved locally (i.e., at the scanning component) if sufficient local storage is available; can be stored on some form of removable media (e.g., a writable optical disc or floppy disc), or, can be provided for storage at the remote location. As noted above, the DocID can be created at the remote storage location rather than at the scanning or copying location.

Ideally, an overall network of perfect copiers, perfect fax machines, computers, and printers can be connected to an

on-line document database, the archive server 32 of FIG. 2, at which sufficient storage is available for all documents within the network. Multiple networked archive servers and on-line document databases, perhaps distributed geographically throughout the world, may be connected to perfect copiers via one or more computer networks. The on-line document database will be adapted to provide storage management (e.g., compression and attendant functionality for maximizing storage and facilitating access to stored documents); document management including, for example, page choice and version control; security for verifying user ID's thereby permitting access to stored documents only to designated users; and accounting to monitor copyright royalties and any other page access and reproduction fees as may appropriately be incorporated into the archive network management system.

FIG. 5 illustrates a representative process flow for use by the "perfect copier". At step 101 the user places page 100 on the glass of the copier. At step 102, the user selects the "Copy Mode". For purposes of this description, selection of one or another of the output modes does not affect the process flow until the last step. In the "Perfect Only" copy mode, the copier scans the page and saves the bitmap image at step 103 and, at step 104 attempts to locate the DocID. Since the "Perfect Only" mode does not have a default mode, the process flow will stop if no DocID is located in step 104. If step 104 is successful, the DocID is decoded at step 105, and any ECC and redundancy checks found in the DocID are applied at 106. Assuming successful processing at steps 105 and 106, the copier contacts the archive server, at step 107, to retrieve the digital representation of the page. Upon successful receipt of the digital representation from the archive server, the copier generates the requested output at step 108. As discussed above, generation of the requested output may be either archiving the digital representation and a DocID therefore, or generating a paper comprising the page.

If the "Photocopy Only" mode has been selected, the copier also begins by scanning the page and saving a bitmap image thereof at step 113. The copier subsequently generates the requested output by either archiving the scanned bitmap or reproducing the scanned bitmap on paper at step 118. The "ordinary copy" 115, i.e. a next generation version of the paper will be generated in the "Paper" output mode.

For the "Universal Mode", the copier scans the page and saves the bitmap at step 123. Thereafter, the copier attempts to follow the process flow for the "Perfect" copy mode. Steps 124–127 include locating, decoding, applying error correction and redundancy checks to the DocID and accessing the archive server. If any one of the steps is unsuccessful, the copier defaults to outputting the scanned bitmap at 118, in either the "Paper" or "Electronic" output mode.

While the invention has been described with reference to a preferred embodiment, it is to be understood that various different modifications are possible and are contemplated as being within the spirit and scope of the invention, as set forth in the appended claims.

What is claimed is:

1. A system for producing a high quality paper version of a page provided to an image generating portion thereof, said system comprising:

scanning means for scanning said page to locate encoded indicia on said page;

means for decoding encoded indicia located on said page to ascertain an address at which a stored digital representation of said page can be accessed;

means for accessing said stored digital representation of said page with said address; and

means for outputting a paper version of said page from said accessed stored digital representation or by photocopying said page when no encoded indicia are located thereon.

2. The system of claim 1 wherein said means for scanning further comprises means for generating a digital representation of said page.

3. The system of claim 2 further comprising means for encoding indicia about said generated digital representation of said page.

4. The system of claim 3 further comprising means for saving said generated digital representation of said page and said indicia.

5. The system of claim 4 wherein said means for saving said generated digital representation of said page and said indicia comprises at least one storage location and at least one means for cataloging said indicia for subsequent access thereto.

6. The system of claim 3 further comprising means for providing said generated digital representation of said page and said indicia for storage in at least one remote storage location.

7. The system of claim 1 further comprising means for applying said decoded indicia to enhance outputting of said paper version.

8. The system of claim 1 wherein said means for scanning comprises means for performing optical character recognition on said page and further comprising means for applying said decoded indicia to enhance said optical character recognition.

9. The system of claim 1 wherein said at least one storage location comprises a remote storage facility wherein said means for accessing said stored digital representation of said page comprises:

means for establishing communication with a remote storage facility;

means for assembling at least one request packet including at least address and page identifying information for transmission to said remote storage facility;

means for transmitting said at least one request packet to said remote storage facility; and

means for receiving said at least one stored digital representation of said page.

10. The system of claim 1 wherein said means for outputting a paper version comprises means for converting said accessed digital representation to an analog version of said page.

11. A facsimile system for communicating at least the content data of a page, provided thereto said page optionally having encoded indicia containing an address at which a stored digital representation of said page can be accessed, said system comprising:

scanning means for scanning said page;

means for recognizing said encoded indicia on said scanned page, when present;

means for decoding said encoded indicia recognized on said scanned page to ascertain said address;

means for accessing said stored digital representation using said address; and

means for receiving said stored digital representation.

12. The facsimile system of claim 11 further comprising digitizing means for digitizing the content data of said scanned page to create a digitized representation if no encoded indicia are recognized.

13. The facsimile system of claim 12 further comprising means for transmitting one of said stored digital representation or said digitized representation of said page.

14. The facsimile system of claim 11 further comprising at least one storage location including a remote storage entity and wherein said means for accessing said stored digital representation comprises:

means for establishing communication with said remote storage entity at which said digital representation is stored;

means for assembling at least one request packet including at least said address and page identifying information from said decoded indicia; and for transmitting said at least one request packet to said remote storage entity.

15. The facsimile system of claim 12 further comprising means for encoding indicia about said digitized representation of said page.

16. The facsimile system of claim 13 further comprising means for archiving said digitized representation of said page and said indicia.

17. The facsimile system of claim 14 wherein said means for archiving said digitized representation of said page and said indicia comprises at least one storage location at said facsimile machine and at least one means for cataloging said indicia for subsequent access thereto.

18. The facsimile system of claim 13 further comprising means for providing said digitized representation of said page and said indicia for storage in at least one remote storage location.

19. The facsimile system of claim 11 further comprising:

means for receiving at least one digital transmission comprising at least content data from at least one remote facsimile machine;

means for converting the content data of said at least one digital transmission to analog data; and

means for outputting said analog data as a paper version of said page.

20. The facsimile system of claim 19 wherein said scanning means and said decoding means are adapted to scan received digital transmissions to identify encoded indicia and to decode encoded indicia identified therein.

21. The facsimile system of claim 18 further comprising means for applying said decoded indicia to enhance outputting of said paper version of said page.

22. The facsimile system of claim 11 wherein said means for scanning comprises means for performing optical character recognition on said page and further comprising means for applying said decoded indicia to enhance said optical character recognition.

23. The system of claim 1 wherein said digital representation of said page includes page description data having source data and formatting instructions for formatting said source data, and

said means for outputting applies said formatting instructions to output said paper version in accordance therewith.

24. The system of claim 1 wherein said digital representation of said page includes source data, and

said means for outputting outputs said paper version in accordance with said source data.

25. The system of claim 1 further comprising means for accessing related information relating to said scanned page with said address.

26. The system of claim 25 wherein said related information includes document information identifying a document associated with said scanned page and said means for outputting is adapted to output one or more pages of said document identified by said related information.

27. The system of claim 26 wherein said means for outputting is adapted to output one or more pages of said document identified by said related information and selected in response to selection input to said photocopying system.

28. The system of claim 25 wherein said related information includes document version information relating to one or more document versions associated with the content data of said scanned page and said means for outputting is adapted to output at least one page contained in said one or more document versions identified by said related information.

29. The system of claim 28 wherein said means for outputting is adapted to output at least one page of a document version identified by said related information and selected in response to selection input to said photocopying system.

30. The system of claim 11 when said means for accessing accesses related information relating to said scanned page with said address, and said means for receiving is adapted to receive said accessed information.

31. The system of claim 30 wherein said related information includes document information identifying a document associated with said scanned page and said means for accessing is adapted to access one or more pages of said document identified by said related information.

32. The system of claim 31 wherein said means for accessing is adapted to access one or more pages of said document identified by said related information and selected in response to user selection input to said system.

33. The system of claim 30 wherein said related information includes document version information identifying one or more document versions associated with the content data of said scanned page and said means for accessing is adapted to access at least one page contained in said one or more document versions identified by said related information.

34. The system of claim 33 wherein said means for accessing is adapted to access at least one page of a document version identified by said related information and selected in response to a selection input to said system.

* * * * *

APPENDIX B

Week Activities	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Planning	●	●	●													
Analysis / Literature Review	●	●	●	●	●	●	●	●	●	●	●	●	●			
Design Prototype				●	●	●	●	●								
Develop Prototype					●	●	●	●	●	●						
Test Prototype											●	●				
Review Prototype													●	●	●	
Documentation														●	●	●

APPENDIX C

Web Based Model of a Digital Fax Document Management System

Master of Science (Information Technology)
College of Arts and Sciences
Universiti Utara Malaysia

UNSTRUCTURED QUESTIONAIRE

By: Aida Rosmiza Binti Shuib
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(This unstructured interview session is conducted to get an idea and analysis of management view of the fax document management.)

1. What is your comment of the usage of fax machine?

   _____
   _____
   _____

2. From your opinion, do you think the fax document from/through the fax machine must be stored in a system?

   _____
   _____
   _____

3. Is there any suggestion for storing the fax document in a document management system?

   _____
   _____
   _____

4. If you don't mind, is there any problem when managing the fax document storing?

   _____
   _____
   _____

5. From your opinion, do you think it is valuable to have a digital fax document management system?

   _____
   _____
   _____

6. What do you think of the idea to develop a prototype of a digital fax document management system?

   _____
   _____
   _____

7. Comments and ideas?

   _____
   _____
   _____
   _____
   _____

APPENDIX D

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OBSERVATION
By: Aida Rosmiza Binti Shuib
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Observation Table

TYPES OF PROTOTYPE FUNCTION		CONDITION			NOTES
• Good • Neutral • Not Satisfied		EXCELLENT	NEUTRAL	NOT SATISFIED	
Faxing • Sending Fax • Receiving Fax					
Administrating					
Searching					
Reporting					

APPENDIX E

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QUESTIONAIRE – EXTERNAL USER
By: Aida Rosmiza Binti Shuib
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PLEASE TICK (√) AT APPROPRIATE BOX
User must be a person that use fax or even once and navigate the prototype of digital fax document management in order to complete this questionaire that lead to the testing purpose.

A.DEMOGRAPHIC

1. Gender
   a. Male ☐
   b. Female ☐

2. Age
   a. 18 - 25 years ☐
   b. 26 – 35 ☐
   c. 36 – 45 ☐
   d. > 46 ☐

3. Race
   a. Malay ☐
   b. Chinese ☐
   c. Indian ☐
   Others (specify) _____

4. Job
   a. Government Sector ☐
   b. Private Sector ☐
   c. Professional ☐
   d. Own Work ☐
   Others (specify) _____

B. PERCIEVED USEFULNESS (PU)

The prospective user's subjective probability that using a fax on managing documents.

5. Have you ever use a fax before on managing documents?
   a. Yes ☐
   b. No ☐

6. What is the first function that you used when using fax?
   a. faxing ☐
   b. administrating ☐
   c. searching ☐
   d. reporting ☐

7. Can you realize the different of the function when you use prototype of the fax system?
   a. Yes
   b. Not sure
   c. I think so
   d. No

8. Do you the the function in the prototype is valuable while using the system?
   a. Yes
   b. No

9. Do you think the prototype is useful?
   a. Yes
   b. No

C. PERCEIVED EASY OF USE (PEOU)

10. What is your purpose to use fax?
    a. To give and get information instantly
    b. To reduce time of work
    c. Easy in managing document
    d. Increase quality of document management
    Others (specify) _____
    _____

11. When using fax, it is easy to managing all the fax documents ?
    a. Yes
    b. Not sure
    c. Difficult
    d. I can't understand

12. When navigating the prototype, is it easy to use the digital fax document management system in managing youe fax documents?
    a. Yes
    b. Not sure
    c. Difficult
    d. I can't understand

D. BEHAVIORAL INTENTION (BI)

13. Do the digital fax prototype provide the function that you wish it should have in managing the fax document in a system? Aswer based on your experience using fax and navigating the prototype of digital fax document management system.
Please rate between 1 until 5.

1 = Excellent
2 = Good
3 = Neutral
4 = Not good
5 = Poor

Item	Fax machine	Fax Prototype
a. Faxing - Sending Fax . Cover Sheet . Recipent's Num/ Email . Attach . Send . Save - Receiving Fax . From . Date . Forward . Save		
b. Administrating - Create - Retrive - Update - Delete		
c. Searching - Recipent's List - View Doc - Update Doc		
d. Reporting - Sendind Details - Receiving Details - Report Num - Date - Time		