E-Fibroid Patient Tracking System

by

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Dissertation submitted in partial fulfilment of
the requirement for the
Bachelor of Technology (Hons)
(Information System)

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
Information System Programme
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In partial fulfilment of the requirement for the
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(INFORMATION SYSTEM)

Approved by,

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that original work contain herein have not to be undertaken or done by specified sources or person.

NOORAZIAH BT ABD KARIM

ABSTRACT

The objectives of e-Fibroid Patient Tracking System is to allow information on fibroid patients' to be generated, updated, archived, routed and used for decision making and strategic information analysis with the combined benefits of smart card to support mobility in a pocket coupled with the ubiquitous access which presents a new paradigm for medical information access system. Smart card with the local processing capabilities facilitates the development of active programs that are designed to effectively and accurately manage complex fibroid patient's medical record. Essentially, the patient's information is augmented with active programs residing within the smart card to provide rich services such as record management facilities, security and authentication, and clinical alert system. The intended users are the administrative, doctors, specialists, hospital, clinics and fibroid patients'. The main interest arises on the solutions of providing mobility of medical data or records and preventing the increasing cost, redundancy of treatment and the most importantly obtaining necessary medication for fibroid patients. It provides better security against the misuse of patient data by implementing security mechanisms. The scope of study will covers the literature review on the effect of Multimodal Interfaces and Smart Card in Medical Application. Meanwhile, the methodologies used in the development of the system will follows four process which are planning, analysis, design and implementation. Performance and robustness, together with ease of use, which provides available, accessible and manageable information on fibroid, are likely essential elements in the final system.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

A fibroid is the most common tumor found in the pelvis. Such a tumor develops most often between the ages of 35 and 45 years, seldom before age 20. In most of these women, the fibroids are small and asymptomatic. In fact, women frequently do not know that they have a fibroid even though fibroid tumors are common. No one is really sure how or why they develop, or why fibroids occur again and again in one woman and not at all in another [28]. Fibroid patients' will have variety symptoms including abdominal swelling, excessive bleeding during menstruation, bladder compression, pelvic pain and cramping. The decision to actively treat fibroids can only be made on an individual basis. The doctor may decide to treat fibroids if they start growing rapidly, cause serious pain or discomfort, or may interfere with the patients' ability to become pregnant.

1.2 OVERVIEW

All information regarding one's health that consists of past medical record information is crucial for everyone [45, 46]. These include information of diagnoses, medications, allergies, surgeries, infections, and other type of data in medical area. Currently, most of this information is stored in a chart unique to the caregiver such as clinic or hospital resulting in scattered pieces of information of the heath history that are often unrecoverable and irreconcilable [36].

Basically at the hospital, fibroid patients' information was used and can be accessed, monitored, and maintained by the doctor or caregiver only. Due to this situation, the patient and other caregiver has limited access this medical information. The mobility of these data is limited. As societies are moving from a paternalistic healthcare system where the patient relies completely on the authoritarian role of the doctor to a system of open partnership between healthcare providers and patients, health information should be accessed, monitored, and maintained by patients [41]. This means that patients may maintain their own health record on medications, dietary notes, exercise notes or minor infections and it is also means that they may want to obtain a copy of their medical record when available and have it explained. Further, the patients or their family may want to maintain and understand the fibroid records that might need to be access to make healthcare decisions.

Currently, most caregivers used ordinary manual way to manage and keep the medical information of a patient. This introduces a lot of problem to the caregiver. Among the problems is limited space for storing patients' information, slow processing of data, and difficulty in managing all the records or data [37]. The reliability and security of data also a big problem introduce by this manual implementation. An intruder can easily access the information as the records are kept in a chart or medical book that does not implement any security features to maintain the reliability of data.

1.3 PROBLEM STATEMENT

1.3.1 Problem Identification

Several problems have been identified with the current manual processes, which support the need for computerization. The problems are:

a) Immobility of Patients' Medical Records

Currently, all medical records are kept within a specific caregiver. This causes a problem for a patient to move from one place to another. Come to worst, for those patients that need regular or consistent treatment, they will face a big problem as they mobile because they do not have previous medical records for reference for the next treatment.

b) Difficulty in Managing Patients' Medical Records

The manual implementation of managing all this information is ineffective. This is due to several reasons such as human error. This manual process also uses a lot of paper that is ineffective in term of economy and management.

c) Slow Processing

Currently, the caregiver's staffs are doing all the processes or tasks of searching, inserting or updating of patient's information. This manual process takes a long period of time as it is done using human capability [40].

1.3.2 Significant of the Project

This system enhances and improves the management of patient information in a caregiver such as clinic or hospital. Through this system, all the activities that are previously handled by manual processes is transformed into a computerized system that provide friendly, efficient, reliable, secure and simpler implementation. This system also helps patient and caregiver to access, maintain, update and monitor all these medical information in a more efficient way. An identity card that consists of personal and medical information that helps doctors and patient to identify medical treatment that is provided to each patient. And it is mobile.

1.4 OBJECTIVES & SCOPE OF PROJECT

1.4.1 Objectives

The objectives of this system are:

a) To study the concept of Multimodal Interfaces in enhancing a system's effectiveness.

b) To develop a centralize system that coordinates patients' data and information.

c) Decreasing time to access and process of information.

d) To improve decision-making process.

1.4.2 Project Scope

The system is a centralized system. The application and the database are hosted in each of the care center that intends to implement it. It is a small application that helps a care center to manage and coordinate its patients' crucial information.

1.5 RELEVANCE & FEASIBILITY OF THE PROJECT

1.5.1 Relevancy of the Project

This project is relevant as societies are moving from a paternalistic healthcare system where the patient relies completely on the authoritarian role of the doctor to a system of open partnership between healthcare providers and patients. The system allows easy access, monitor, maintain of medical records between healthcare providers and patients.

1.5.2 Feasibility of the Project

Initial feasibility of the project can be evaluated through economic, technical, operational, and schedule factors:

a) Economic Feasibility

This system supports feasibility in term of economic by increasing effectiveness and productivity of current process with less time needed. With this system, the management of patient information will be more efficient. Less time is needed to do jobs, compared with the current existing procedure. The system also speeds up the decision making process between doctors and patients and reduce the probability of redundant treatment for a patient.

From the hardware perspective, not much additional hardware is needed; the cost of the system hardware is projected as affordable. On the software side, only a database is needed.

b) Technical Feasibility

This system can be implemented practically using available technology and expertise. Smart card and its reader are available in the market. The skills and information to develop a smart card application is available in the Internet and other sources of information.

c) Operational Feasibility

Operational feasibility can be evaluated using the Performance, Economy and Efficiency.

- Performance

The system provides minimum effort in managing the patient information. Through computerization of the manual process, the throughput of the process can be maximized [39].

- Economy

Through a paperless environment, a healthcare provider can minimize the usage of paper and of course cost. The system also reduces the redundancy of treatment that can save patients' money.

- Efficiency

The system simplifies most of the process of maintaining and managing patients' information. It also provides easy access and modification of records resides in the database or smart card.

d) Schedule Feasibility

The author has divided the time given according to the System Development Life Cycle phases that can be viewed in the project timeline. Please refer to Appendix A for the Proposed Project's Timeline.

CHAPTER 2
LITERATURE REVIEW

2.1 MULTIMODAL INTERFACES IN ENHANCING SYSTEM EFFECTIVENESS

2.1.1 Introduction to Multimodal Interfaces

Humans perceive the world through senses such as touch, smell, sight, hearing, and taste. All these senses communicate to each other in order to generate information to human. A "mode" basically is a communication through one sense. Nowadays, a computer has the ability to process information same as what can be done by a human. A computer processes all this information through modes or senses in human. The modes for a computer are those gadgets such as keyboard, microphone, camera, mouse, and several other input equipments.

All these modes provide a limited number of functionality when they are used separately. For example, a keyboard and a microphone provide a different functionality to a computer system. A keyboard is used to input characters. Meanwhile microphone is used to record sound. Due to these limitations, there are ideas to combine all these gadgets or modes into more than one mode of communication. It is known as Multimodal Interfaces.

What is the difference between Multimodal and Multimedia? The main difference between these terms is Multimedia use more than one mode of communications that are outputted to the user. For example, a sound clip is attached to a presentation slides to make the presentation more interactive and effective. Meanwhile, for Multimodal, the computer processes more than one mode of communications and outputted to the user. For example is the combined input of speech and typing in a word processor.

Multimodal Systems are more efficient in certain areas, which it is more appropriate to use Multimodal Interface than others such as portable computing, and some menu based computing. Since there are large individual differences in ability and preference to use different modes of communication, a multimodal interface permits diverse user groups to exercise selection and control over how they interact with the computer [6]. In this respect, multimodal interfaces have the potential to accommodate a broader range of users than traditional interfaces including users of different ages, skill levels, native language status, cognitive styles, sensory impairments, and other temporary illnesses or permanent handicaps. The natural alternation between modes that is permitted by a multimodal interface also can be effective in preventing overuse and physical damage to any single modality, especially during extended periods of computer use.

Users have a strong preference to interact multimodally, rather than unimodally. For example, 95% to 100% of users preferred to interact multimodally when they were free to use either speech or pen input in a map-based spatial domain. Likewise, 71% of users combined speech and manual gestures multimodally, rather than using one input mode, when manipulating graphic objects on a CRT screen [11].

2.1.2 Framework Design for Multimodal Interfaces

One desiring to equip an application with such an interface must start from scratch, implementing access to external sensors, developing ambiguity resolution algorithms, and making calls to the application's API based on the determined user intention. However, when properly implemented, a large part of the code in a multimodal system can be reused. This aspect was identified and used to implement a multimodal application framework. The framework uses a novel and parallelizable application-independent fusion technique that can be easily augmented to support application-specific demands as well as new modalities.

The framework enables existing applications to be equipped with a multimodal interface. Therefore the design is to be minimally intrusive on existing application code, but rather function alongside it, calling application code when data is needed from or actions need to be performed in the application; additionally, the interface accepts callbacks from the application when changes occur that change the discourse context or that need to be reported to the user. To gain user acceptance for a multimodal system, response times must be reasonably small. If the system takes too long to process a user's spoken command, the user will think the command was not understood and repeat it, resulting in confusion when the command then gets carried out twice. All this results in annoyance and should be avoided at all cost. Ideally, response times should be below a second.

Many multimodal systems are geocentric in nature [29]. Combining speeches with gesture, gaze, and mouse serves to link spoken references to spatial data. For example, objects and locations on-screen with their antecedents as derived from the aforementioned modalities. Direct manipulation is currently the most popular mode of interaction. It appeared in the late 1970's [30]. Its software design was described in [31]. It is a proven form of interaction that should not be replaced, but rather be complemented by conversational interfaces. The key components of the software architecture for direct manipulation are summarized in Figure 2.0. Primary inputs are mouse clicking and dragging and command selection through menus or toolboxes. On the other hand, recent multimodal interfaces focus on conversational interaction also summarized in Figure 2.0.

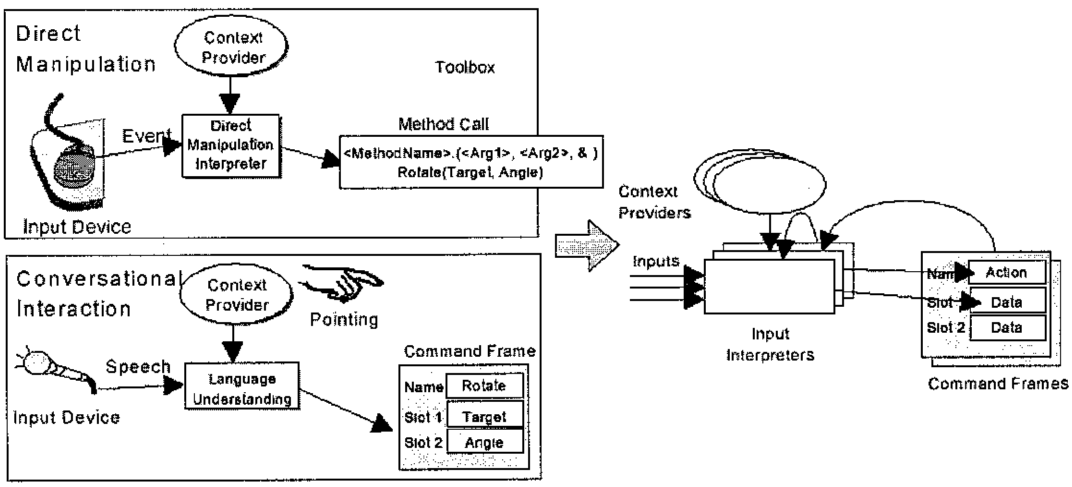

FIGURE 2.0: A high-level view of software architectures for direct manipulation and conversational interaction.

In direct manipulation, the toolbox, which is a part of a PowerPoint toolbox that determines the context of the manipulation, and the end result, is a method call on the application. Similarly, in conversational interaction, pointing helps to resolve ambiguities in speech. The architecture on the right hand side shows a generalization of these two paradigms.

Unfortunately, almost none of these interfaces include direct manipulation in conversational interaction. Pointing is used only to resolve deictic references in speech. The objective is to provide an architecture, which will support both. This architecture is summarized in Figure 2.0 on the right hand side. Creating architecture, which supports direct manipulation and conversational interaction in parallel, combines the strengths of both interaction styles while compensating for the weaknesses. By maintaining direct manipulation as a choice of interaction, there are no limiting user actions to those that are speech-centric. The user can choose between traditional direct manipulation, speech, and a combination of both. The focus is on single-user multimodal interfaces. Multiuser interfaces have many more problems, such as having to recognize multiple voices and determine the source of gestures

2.1.3 Advantages of Multimodal Interfaces

During the early design of multimodal systems, it was assumed that efficiency gains would be the main advantage of designing an interface multimodally, and that this advantage would derive from the ability to process input modes in parallel. It is true that multimodal interfaces sometimes support improved efficiency, especially when manipulating graphical information [9]

While in a study that compared task completion times for a graphical interface versus a multimodal pen/voice interface, military domain experts averaged four times faster at setting up complex simulation scenarios on a map when they were able to interact multimodally [2].

One particularly advantageous feature of multimodal interface design is its superior error handling, both in terms of error avoidance and graceful recovery from errors. There are user-centered and system-centered reasons why multimodal systems facilitate error recovery, when compared with unimodal recognition-based interfaces. For example, in a multimodal speech and pen-based gesture interface users will select the input mode that they judge to be less error prone for particular lexical content, which tends to lead to error avoidance [10].

2.1.4 Differences with GUIs

There are four basic ways in which multimodal interfaces increase the efficiency of multimedia as it differ from graphical user interfaces: First, graphical user interfaces typically assume that there is a single event stream that controls the underlying event loop, with any processing sequential in nature. For example, most GUIs ignore typed input when a mouse button is depressed. In contrast, multimodal interfaces typically can process continuous and simultaneous input from parallel incoming streams. Secondly, GUIs assume that the basic interface actions, such as selection of an item, are atomic and unambiguous events. In contrast, multimodal systems process input modes using recognition-based technologies, which are designed to handle uncertainty and entail probabilistic methods of processing.

Thirdly, GUIs often are built to be separable from the application software that they control, although the interface components usually reside centrally on one machine. In contrast, recognition-based user interfaces typically have larger computational and memory requirements, which often makes it desirable to distribute the interface over a network so that separate machines can handle different recognizers or databases. For example, cell phones and networked PDAs may extract features from speech input, but transmit them to a recognizer that resides on a server. Finally, multimodal interfaces that process two or more recognition-based input streams require time stamping of input, and the development of temporal constraints on mode fusion operations. In this regard, they involve uniquely time-sensitive architectures.

2.1.5 Future of Multimodal Interfaces

Multimodal interface is not a new technology. It has existed for decades in specific industrial environments [16]. It is not a new feature for home computers; multi-channel communication is an "old" technology. The use of keyboard, mouse, and audio feedback in the home computer is a primitive form of multimodal system. The new concept is that all tactile interactions are excluded and audio and visual channels are the main modalities.

An interesting observation from the study is the existence of an obvious misunderstanding of what a multimodal interface is and what it can do. Most users did not understand what a multimodal system was and how it should be used. The users did not understand the fundamental concept. Multimodal or multimedia interfaces are obviously something not seen before by the common man. One can think that this is strange, since multimodal systems surround us everywhere. Stationary computers are multimodal systems with both keyboard and mouse as input and sound, graphics, force feedback and text as an output. Obviously these kinds of multimodal systems are integrated to that extent that no one notices them.

Pros and cons can be discussed on whether to develop multimodal interfaces or not. The negative aspects are the extra workload on the designer, license costs, design time and sometimes decreased usability for the user. The positive aspects are the widen user group, increased usability, flexibility and faster interaction. If the user is not satisfied by the multimodal interaction, he can always use the interface as a unimodal one. In some sense a multimodal interface is an extension of a unimodal interface. This is true if the modalities can be used separately. Multimodal interfaces have a dynamic allocation of resources at the content provider. As more users can use the service without having to talk to an operator, the availability increases with this interface, since people can perform tasks without being physically present.

2.2 SMART CARD IN MEDICAL APPLICTION

Most health care institutions, including those in the United States, still maintain most of their patient records in the form of paper charts as was noted in [17,18]. This scenario has rendered the almost impossible task of integrating and seamlessly managing patient's record across hospitals, clinics and between countries or states. The emergence of smart card technology is recognized as a potential solution to effectively and accurately manage patient's medical record [19, 20].

In particular, smart card based on optical memory offers quantum storage capacity of up to 4-6 MB. Such storage capacity translates to the ability of the card to store basic patient information such as name, address, photographs, and PIN security, to medical information such as blood type, drug allergies and regular prescribed drugs. Moreover, medical records can be augmented to include multimedia-rich information such as scan photography images and voice recording, to facilitate rapid diagnosis of patient's potential symptom and problem. In short, smart card provides the rich benefits of storing comprehensive, accurate, and up-to-date medical history of a patient, while offering the ease of mobility in a pocket [21].

Although smart card presents an attractive alternative to recording complex medical record, it has failed to gain the critical mass required to spin off a wide market acceptance of such technology. Most usage of smart cards in medical arena is restricted to large organizations such as state hospitals, health insurance groups and government clinics. The lack of a unified data structure and open programming interface has resulted in ad-hoc implementation of medical information systems based on smart card technology [22]. Building on the same spirit as the original Java, Sun has developed the Java Card API specifications [23, 24] to facilitate the concept of "write once, run on all cards".

2.2.1 Introduction on Health Card

Healthcare and medical cards are probably the largest application of smart cards in which an older technology is not being replaced. Medical records on fibroid involve large quantities of data. A single patient's records will amount to several hundred kilobytes over a lifetime, and for those chronic condition this can be extend to megabytes. With smart cards, the patient can held and used the card wherever she goes for treatment. By storing only the minimum summary data on the card, this would alert a doctor to special conditions and other treatment that could affect the diagnosis or recommendation. In the United States, several organizations are now starting to use smart cards for patient and claim verification, and several say that they intend to move on to also storing medical records on the card [13].

2.2.2 Issues of Health Card

The main issues for medical data card are the need to protect the confidentiality of the data stored on the card and restrict access to qualified health professionals. As the main security device on the cards is the general used of write protected memory; the card can be read in any authorized hospital, clinic or general practice, but the insurer can only write it to. The card can contain an authentication area that allows each insurer to identify its own cards [12]. The card must usually be inserted into the terminal before the data on the patient can be accessed.

Another common issue in fibroid applications of smart cards is the need for patient consent. Many people want to understand what is being held on file about them and to control that sees that information. With a health card, patients may control who sees the information simply by deciding whether or not to hand over the card. If the card contains administrative as well as health data, then it will be necessary to protect the patient confidential health using a PIN or password. Most of the medical data are held on the optical memory, but in encrypted form [15].

One issue that needs to be carefully maintained is the patient-doctor confidentiality. Typically in many cases, the doctor may pass the information to another doctor on a need-to-know basis, and basically the patient's consent is not sought or required for this. Using a smart card, these relationships and the need for consent is formalizes, and sometimes removes an element of discretion that can benefit both doctors and patients. The health industry is seeking way for patients to monitor themselves to avoid many routine visits, which is due to a strategy in controlling costs.

Overall, the issue of health cards has political and legal dimensions; as well as having to meet user and acceptability criteria; issuers must be sensitive to these additional dimensions [14]. In general, the data should only be viewed with the consent of the patient by a health professional. The consent may be implicit when the patient hands the card to the doctor or transmits the data to his or her office or, in the case of more sensitive data, explicit by entry of password when the data is viewed.

CHAPTER 3
METHODOLOGY

3.1 PROCEDURE IDENTIFICATION

The methodology that has been used in this project contains many of the same elements as a traditional information-development process.

3.1.1 Phases of Project Development

The four phases of the methodology follows:

3.1.1.1 Planning Phase

During planning, the author chooses among competing opportunities for communication so that overall goals for the system can be set. These goals include anticipating and deciding on targets for the audience, purpose, and objectives for the information. The author has done planning for domain information through a process of defining and specifying the supporting information that must be collected, how it will be collected, and how the information will be updated. The author also anticipates the skills called for by the system specification as well as the skills needed for constructing particular parts of a system and also anticipate other resources needed to support the operation and development of the system.

3.1.1.2 Analysis Phase

In order to improve the system's overall quality, the author has gone through the process of gathering and comparing information about the system and its operation. An important operation is one in which the author examines information gathered about the audience for its relevance to some other elements or processes of system development. The author then weighs all alternatives and gathers information to help with a decision in the other processes of planning, design, implementation, or development. Please refer Appendix B-1 for the system Flow chart, Appendix B-2 for the Data Flow Diagram and Appendix B-3 for the Physical Data flow for the system.

3.1.1.3 Design Phase

During this phase, the author has been working within the system's specification, makes decisions about how a system's actual components have been constructed. This process involves taking into account the system's purpose, audience, objective, and domain information. It relies heavily on the other processes and elements in the system development. However, the author realized that the design process is not more important than any of the others, but it requires a thorough grounding in implementation possibilities as well as knowledge about how particular system structures affect an audience.

3.1.1.4 Implementation Phase

In this phase, the author builds the system using all the available tools. The author uses the Cyberflex Access SDK (V4.4) software to establish communication between smart card and its reader. For the application interface, the author uses Visual Basic 6.0. For the database, the author has chosen to use Microsoft Access 2000 database.

3.2 TOOLS AND UTILITIES

These are the tools and utilities that are used throughout the project:

NO	ELEMENTS	TOOLS
1	**Project Management**	Microsoft Project
2	**Documentation**	Microsoft Word
3	**System Modeling**	Microsoft Word or Microsoft Visio
4	**Hardware**	▪ 166 MHz processor or higher ▪ Hard disk space 1.5GB ▪ 128 MB RAM or higher ▪ Reflex USB v.2 smartcard reader ▪ Cyberflex Access card or J-Card
5	**Software**	▪ Windows 98/NT/2000/XP Service Pack 1 ▪ The Cyberflex Access SDK (V4.4) ▪ Visual Basic (COM) or Java ▪ Microsoft Access

TABLE 3.0: Tools and Utilities

CHAPTER 4
RESULTS AND DISCUSSION

4.1 FINDINGS

4.1.1 Smart Card and Health Care Application

A smart card can serve as interactive database. It contains a microprocessor to provide processing capability and memory for storing instructions and data. The card can be used to store and update account information, personal data, and even monetary value. Due to this, a smart card is ideal to for various applications including health care applications. The combined benefits of smart card to support mobility with the ubiquitous access of web technology, presents a new paradigm for medical information access system. This means, as patients move between hospitals or clinics, the mobility of the smart card database help them and doctors to access and update the medical records.

4.1.2 Cyberflex Card Architecture

Throughout the project development, the author found out that Cyberflex system architecture resides in both the card and the host machine to which the card reader is connected. It basically combines the Cyberflex card architecture and the host machine architecture. Please see appendix C-1 for Cyberflex card architecture and appendix C-2 for host machine architecture.

4.1.3 Cyberflex Card Data Integrity and Security

Cyberflex Access card is a secure medium of storing crucial information. It combines both hardware and software security. This card provides cryptographic services such as encryption and decryption, signing and verification, and authentication. Cyberflex card fully utilizes Java environment. Java environment is well recognized for its integrity and security capabilities. The card also provides General Purpose Operating System (GPOS) utility that maintains integrity and security of data and programs on the card, together with byte code checking. Besides that, smart card is tamper resistant. It means that it is difficult for hacker or intruder to take the card apart and read the code on the chip.

4.1.4 Programming Standard Supported by Cyberflex Card

This card supports a variety of languages and standards for developing smart card programs or applications. In general, it supports C and C++, Java, COM such as Visual Basic, PKCS #11, and Microsoft PC/SC. It supports standard and object-oriented styles of programming language. The author uses Visual Basic scripts for the standard communication between the smart card and the application. It allows users to insert, update, and delete information stored in the smart card.

4.1.5 Multimodal Interfaces Implementation

The author had implemented the primitive form of multimodal interfaces with the use of keyboard, mouse, and audio feedback. The new concept is that all tactile interactions are excluded and audio and visual channels are the main modalities are not yet been implemented because the cost in time of implementing a multimodal interfaces is prohibitive and lack of a framework to support development of multimodal applications in reasonable time and with limited resources.

4.2 DISCUSSION

E-Fibroid Patient Tracking is an efficient application for managing and tracking fibroid patient's information. The author has introduced few modules that are very beneficial and important for the operation of a care center. The implementation of smart card technology and decision support system in general will help most of a care center's staffs to manage, make decision and speed up the process of the service.

The author used Cyberflex Access card, as it is the latest technology used in the development of medical applications. As the usage and acceptance of smart card is increasing dramatically, the author has decided to integrate this technology as a part of the overall application. Smart card provides several advantages. Through the mobility of smart card, fibroid patients and doctors, can access and update the entire patient's related information easily and in a short time period. It benefits both the care center and patients. For a patient, the usage of smart card will reduce the cost of treatment as it will reduce the redundancy of treatment. The card stores all necessary information for the patient including demographic data and treatment related information. As all this information can be accessed through the card, a care center in general, and its staff in specific, it will be updated with the current level of treatment for a particular patient.

Smart card is also a flexible tool. It supports various programming standards that in fact help a system developer to develop a particular application using smart card technology. Besides its mobility, flexibility and robustness, a smart card is equipped with the latest technology of security. A smart card provides cryptographic services such as encryption and decryption, signing and verification, and authentication. With the implementation of these technologies, the author is assure that all crucial information stored in the smart card will take a few years to be decoded.

In general, the decision support system helps a care center's staffs to come out with a possible treatment options for a particular type of fibroid. It has speed up the process of decision-making between doctors and patients. Doctors need to follow few steps in order to come out with the best treatment options. They will choose the symptoms available in the system. From the symptoms that they choose, the system will identify the possible fibroid types that may exist. Then, they will proceed to diagnosis the problem. Finally, the system will propose the best treatment solution for the patient.

4.2.1 System Construction

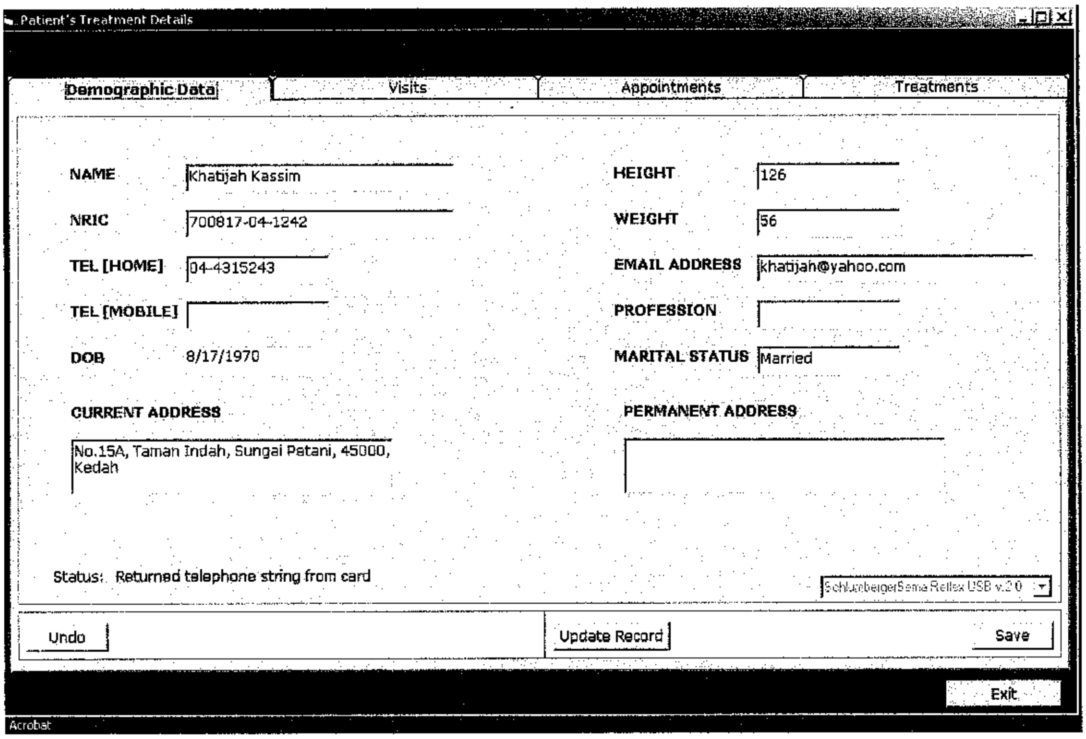

FIGURE 4.0: Patient Treatment Page

Figure 4.0 shows the patient treatment details module. This module consists of demographic data; visits, appointments and treatments sub modules.

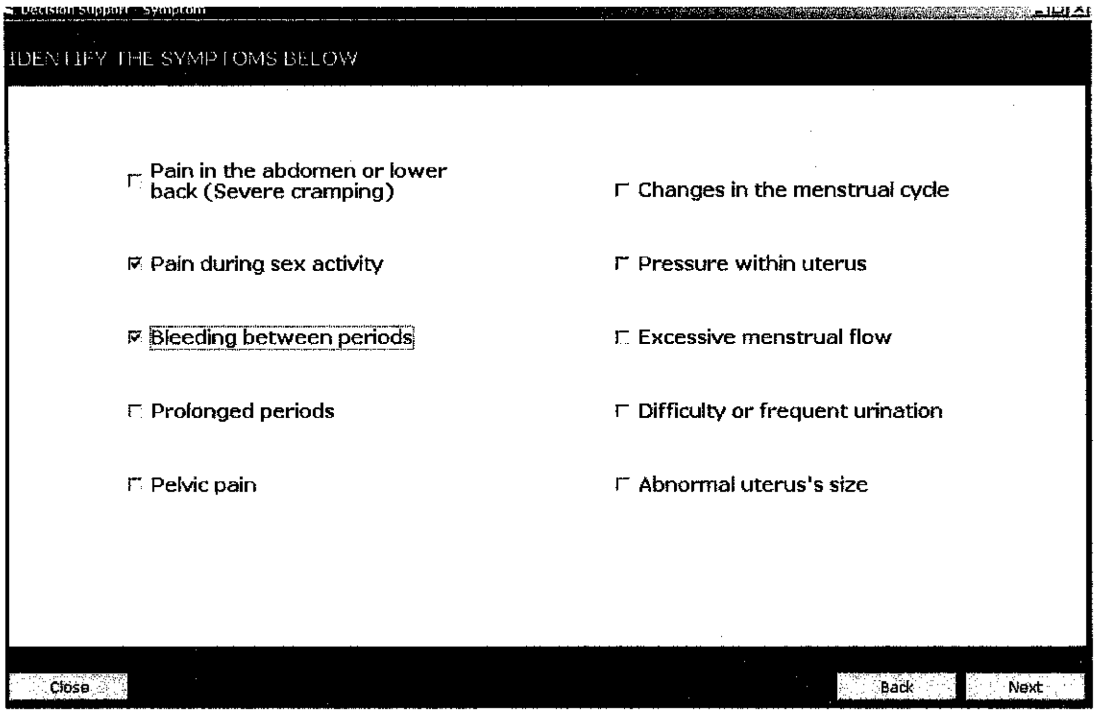

FIGURE 4.1: Decision Support System page

The most common symptom associated with fibroids is shown in Figure 4.1. Fibroids have no known cause and only have a few treatment options [28] and the reason for irregular and or heavy bleeding in the presence of fibroids is unclear [43, 44]. Fibroids also commonly cause pelvic pressure and or urinary complaints, depending on their size and location relative to other pelvic organs [31-35].

4.3 SYSTEM EVALUATION

4.3.1 Method of Gathering User and Task Data

The purpose of the questionnaire used is to elicit information on the efficiency and effectiveness of the computerized system together with the implementation of smart card in healthcare industry. It is an excellent way of obtaining either quantitative or qualitative data, since user responses are written and can be tallied to illustrate user preferences. Questionnaires can only evaluate users' opinions about the user interface, not their behavior while using it. Please refer to the Appendix D-1 for the questionnaire sample.

For these reasons, the author had decided to adopt a variant of the Delphi survey approach. In the early 1950s, the term Delphi was used to describe a reliable consensus of opinion, obtained from group of experts by a series of intensive questionnaires interspersed with controlled opinion feedback [25]. This approach is characterized as a method for the systematic solicitation and collation of judgments on a particular topic through a set of carefully designed sequential questionnaires interspersed with summarized information on feedback of opinions derived from earlier responses' [26]

Delphi is particularly useful when accurate information is unavailable or expensive to obtain, or where evaluation models require subjective inputs to the point where they become the dominating parameters [25]. The survey is the most common technique of Delphi application. Delphi surveys are specially designed to obtain the opinion of experts and such a survey has three special features;

1. Anonymity of participants.
2. Iteration and controlled feedback between rounds.
3. Statistical summary of group responses.

The author decided to use a Delphi survey that would allow gathering a wide variety of expert opinion on existing smart card introductions within the healthcare areas, so that the author could obtain consensus on the issues relevant to introducing smart cards to the medical areas. Administering the survey by distributing the questionnaire to the intended users allows the author to collate and return information to the participants quickly, thus improving the percentage of participants remaining committed throughout the session.

One of the benefits of questionnaires is that they can be administered without an evaluator present; forms can be distributed to users. Another benefit is that questionnaires can be distributed to large groups or geographically dispersed populations. But, the author faced one of the drawbacks of using questionnaires is that questions cannot be rephrased as they can during verbal interviews.

4.3.2 Research Design

A research design is a logically designed plan allowing the author to derive appropriate conclusions from his or her initial research question [27]. After deciding on the Delphi technique, the author made the following design decisions:

- The appropriate number of participants would be between 10 to 20 people in total, which is composed of 3-5 doctors, 5-10 Staff and 5-10 Patients.
- Since time was a limiting factor, it would be most appropriate to have only one rounds of Delphi survey.
- Structured questions would be used for the questionnaire to allow participants to provide analyzable data on what the author realized would be an enormous body of information.

4.3.2.1 The main steps involved in conducting the Delphi survey included:

- Identifying and contacting respondents to gain their agreement.
- Designing and sending the questionnaire to the intended users.
- Analyzing the results of the first round.
- Producing feedback.
- Preparing the final presentation of results.

Delbecq, *et al.* (1975) argued that the participants in a Delphi are individuals who have a deep interest in the issue under investigation; and important knowledge or experience that can be valuable for the study. The author selected as the survey sample, therefore, individuals considered to be experts'.

4.3.3 Reactions to the Idea of Smart Cards in Healthcare

First responses to the idea were mixed, as many people were immediately accepting, some were immediately rejecting. Irrespective of their initial views, most responded with questions about the nature, format and purpose of smart cards. Respondents quickly adopted the term smart cards, largely because it was more familiar, and this was used for the remainder of the discussions.

The initial tendency was for respondents to consider the benefits and drawbacks of smart cards and computerized system for themselves as individuals, and then the implications for the country or society more widely. Those initially most favorable towards the idea argued that individuals and society would both benefit. In addition, there were scattered references to smart cards already in existence, for example MyKad. Knowledge of these cards typically weakened resistance to their wider introduction, or improved acceptance of the idea.

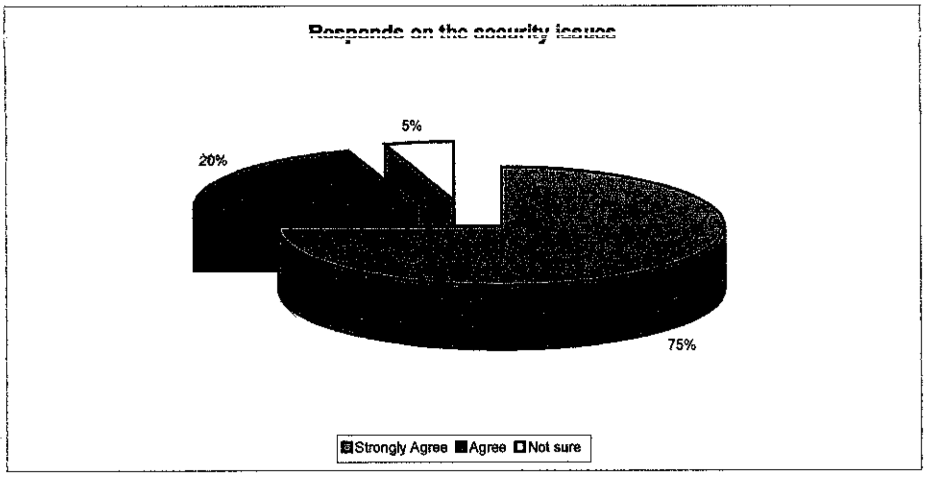

FIGURE 4.2: Responds on the security issues

Basically, the doctors and staff are concerned with the confidentiality issues associated with smart cards. Figure 4.2 show that 75 percent of the staff strongly agrees and about 20 percent agrees while 5 percent of them agree to a lesser extent. They generally don't have strong opinions about whether or not to support the implementation of a smart card system; however, patients are generally supportive of such a system.

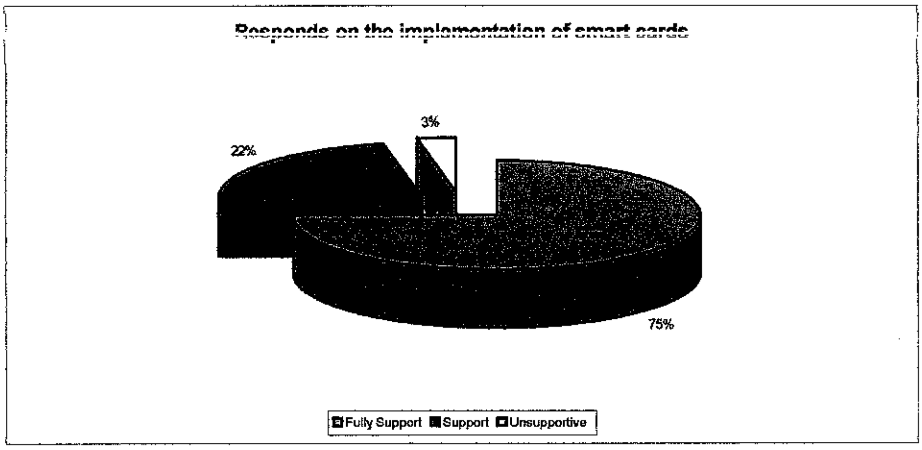

FIGURE 4.3: Responds on the implementation of smart cards

From the Figure 4.3, the author found that 75 percent of the staff really supports the implementation of smart cards. While 22 percent of them are somewhat supportive and 3 percent of them are somewhat unsupportive on the smart card implementation.

In relation to information carried on the cards and in the database, there is a tension between maximizing the value of the idea and minimizing worries about security and privacy. The strategy of storing only basic and harmless information on the card has help acceptance, but there is a need to convince the reassurance about other aspects of information. In particular, respondents need to be persuaded that that the database is secured enough. It is also important to inform respondents that the more personal information that could be in the system will not be mandatory particularly health information, and that there is a simple, usable procedures in the event of cards being lost such as emergency stop number and quick replacement be secure against hacking, forgery, fraudulent use and illicit commercial.

Doctors and staffs also generally feel that smart cards would be beneficial for them, but express concern about the confidentiality of medical information contained on smart cards. Since smart cards for healthcare use have only recently been introduced in Malaysia to a few hospitals, most individuals are not aware of the high level of information security offered by a smart card.

Physicians, who are least likely to be computerized, are most likely to indicate that cost is a major factor in the decision to acquire a computerized system. The cost-to-benefit ratio of computerization should be emphasized. Hospitals, who had consider the quality of healthcare delivery to be the most important factor in the acquisition decision agreed that if the labor-intensive processing and recording of medical information on paper were eliminated.

4.3.4 Reactions to the computerized system implementation

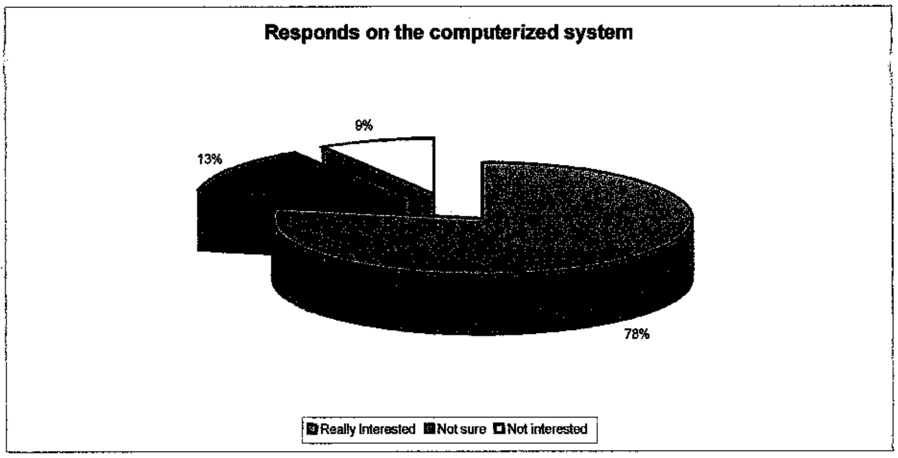

FIGURE 4.4: Responds on the computerized system

Figure 4.4 shows that 78 percent of the candidates expressed interest in having a computerized system, customized health record that they could access and modify themselves. However, 13 percent of the candidates are not sure and 9 percent of them are not interested with the computerized system. These personal health records will revolutionize health management [38]. When individual patients can build, own, and manage their own records, continuity of care will improve, efficiency will increase, and patients will take a more active role in managing their own health. Patients assume more control over and more responsibility for their personal health information. While, clinicians find they must adjust to the new attitudes and behavior of empowered patients. Computerization also improves the quality of healthcare delivery because it increases the amount of staff time available for patient interaction by decreasing the amount of time required for administrative functions.

4.3.5 Conclusion Derived From the Questionnaires

Those on both sides of the healthcare system have first-hand experience with the disadvantages of current paper-based processes. Patients know the frustration associated with registering and filling in forms more than once during office or hospital visits. Clinicians and their support staff understand the inconveniences of paper-based prescriptions, forms, and charts, which gather in overwhelming piles, require intricate filing systems, and are too easy to lose and too expensive to replace [42]. Paper-based systems waste large amounts of time and money. In some instances, these systems can even cause adverse reactions or cost lives such as disorderly charts and poor handwriting on prescription pads can cause patients to receive the wrong drugs. Patients have a strong interest in performing computerized system with the support of smart card as in ways the old system could not support.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5. 1 CONCLUSION

The system not only provide the complete and gapless documentation of an even extremely complex situation but also utilization of all fibroid patients' related information which has been acquired regardless of where, when and of which data structure. It is appropriate since it can cope with the demands for integration of existing distributed subsystems for the demands of future systems. A user-friendly system is achieved by integrating all the research area in the development process.

In addition, smart card has lower administrative barriers to healthcare by reducing the paperwork associated with the patient or client visit, improve quality of care and resource utilization by providing timely and accurate clinical information; promote personal responsibility in health care by placing individuals in control of the information on the card; make the delivery of nutritional benefits more efficient and less stigmatized by replacing paper vouchers with a PIN-secured card; and enhance the tracking of health care outcomes and medical decision-making by increasing the availability and accuracy of health statistics.

The system is expected to coordinate activities between independent practitioners, as well as hospital specialists. The author believe that the system allows them to spend more time on clinical decision making since they can receive complete data on patients long before their encounter through the centralize patients' data and information. Overall, the system achieves its objectives.

5.2 Suggested Future Work for Expansion and Continuation

For the future recommendation, the author planned to enhance the existing appointment module by integrating it with an-email application tool. The objective of this tool is to generate automated e-mails that enable the user to receive and send e-mails for their appointment, which is based on their current appointments records in the databases.

The author also planned to develop an Inventory Tracking module. The purpose of this module is to provide a care center a tool where it can manage its stock efficiently. Through this module, stock can be replenished by an automated process and or manually triggered by the person responsible. It should introduce a tool where the reorder documents for a new stock can be done automatically. The module is also planned to support expiry and non-expiry items. For expiry items stock is maintained at batch level with expiry date for each batch, and any transaction must identify the batches being processed as part of the transaction. In addition, the module is required to update the stock balance once a transaction is done. Stock balance must be updated immediately on confirming a transaction. Furthermore, this module will hopefully implement automatic validation and automatic warning on expired items.

The author plans to develop Report Generator module where care center staffs can generate reports for the usage of administration. This module will allow the staff to produce the report based on users' specific request.

Finally, the author plans to embed the multimodal interfaces in the system by combining speech with gesture, gaze, and mouse serves to link spoken references to spatial data. For example, objects and locations on-screen with their antecedents as derived from the aforementioned modalities.

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GLOSSARY

Adhesions : Abnormal bands of scar tissue that connect organs or tissues those are normally separate. Adhesions can result from surgeries, endometriosis, or previous infections

Anemia : A condition that occur when the number of red blood cells (or the hemoglobin in them) falls below normal and the body gets less oxygen and therefore has less energy than it needs to function properly.

Cervix : The entrance to (neck of) the uterus; dilates (opens) during labor to allow passage of the baby through the birth canal

Dysfunctional uterine bleeding : Heavy menstrual bleeding caused by imbalances of the female hormones estrogen and progesterone.

Endometrium (en-do-me-tre-um) : the lining of the uterus that is shed each month during menstruation.

Estrogen : A sex hormone found naturally in a woman's body which is produced by the ovaries, adrenal glands and other tissues.

Fallopian tubes : Narrow tubular structures attached to the uterus and extending toward the ovaries through which the egg travels from the ovaries to the uterus; fertilization occurs in the fallopian tubes.

Fibromyoma : Another word for fibroid.

Fibroids : usually benign (non-cancerous), fibrous growths in the uterus that can cause pressure and pain in addition to heavy periods.

Gonadotropin-releasing hormone (Gn-RH) agonist : Hormone therapy that helps shrinks fibroids by stopping estrogen production.

Hyperplasia (hi-per-play-ze-a) : A thickening of uterine tissue.

Hysterectomy : Surgical removal of the uterus. Hysterectomy may be performed through and abdominal incision (laparotomy), through the vagina (vaginal hysterectomy), or through laparoscopically-assisted vaginal hysterectomy (LAVH). Sometimes the ovaries and fallopian tubes are also removed.

Hysterosalpingography (HSG) : A test in which dye is injected into the uterus and fallopian tubes in order to help visualize them during an x-ray.

Hysteroscope (his-ter-o-scope) : A narrow tube containing a light that is used to look inside the uterus; it is inserted into the uterus through the vagina and cervix.

Hysteroscopic myomectomy : A myomectomy performed through the vagina and cervix using a hysteroscope to aid in viewing the fibroid; requires no incision.

Hysteroscopy (his-ter-ah-sco-py) : a method of examining the inside the uterus using a tiny, thin lighted telescope (hysteroscope), which is inserted into the uterus through the vagina and cervix. Hysteroscopy can be used to both diagnose and surgically treat uterine conditions.

Intramural fibroid : the most common type of fibroid, it grows within the muscle of the uterus and can cause pressure-type symptoms and, less often, heavy menstrual bleeding.

Laparoscope (lap-ah-ro-scope) : A thin, lighted telescope that is inserted through the navel into the abdomen to examine the internal organs and abdominal cavity. The laparoscope can be used as both a diagnostic tool and during surgery to avoid making a large incision.

Laparoscopic myomectomy : A myomectomy performed though tiny incisions in the abdomen using a laparoscope to aid in viewing the fibroid.

Laparoscopy (lap-ah-ros-ko-pe) : A procedure in which a laparoscope (see above) is inserted through the navel into the abdomen to examine the internal organs and abdominal cavity. Other small incisions may also be made and additional instruments inserted to facilitate diagnosis and allow surgical correction of pelvic abnormalities or removal of organs. The surgeon can sometimes remove scar tissue and open closed fallopian tubes during this procedure.

Laparotomy (lap-ah-rot-o-me) : A surgical incision into a cavity of the abdomen.

Leimyoma : Another word for fibroid.

Menopause : The final cessation of menstrual periods.

Menorrhagia (men -or-ah-jah) : Heavy or excessive menstrual bleeding.

Myolysis : An experimental procedure that uses lasers, electrical current or freezing to destroy fibroids during a laparoscopy.

Myomectomy : A surgical procedure to remove fibroids from the uterus, leaving the uterus intact.

Myoma : Another word for fibroid.

Ovaries : The two female sex glands in the pelvis, located on each side of the uterus. The ovaries produce eggs and hormones including estrogen, progesterone, and androgens.

Sonohysterogram : A type of ultrasound scan that is done to examine the inside of the uterus after fluid is injected into the uterus via a thin tube that is inserted through the vagina and cervix.

Submucosal fibroid : A fibroid that grows from just underneath the uterine lining into the uterine cavity. These can cause bleeding, pain or infertility.

Subserosal fibroid : A fibroid that grows from the uterine lining to the outside of the uterus and can cause pressure on the bladder, bowel and intestine. These fibroids can cause bloating, abdominal pressure, cramping and pelvic pain.

Tumor : A swelling due to abnormal growth of cells.

Ultrasound scan : A procedure that uses sound waves to produce pictures of the uterus, ovaries and pelvis.

Uterine artery embolization : A minimally invasive, still experimental procedure to cause a clot to form in the uterine artery leading to the fibroid, which cuts off its blood supply and causes it to shrink.

Uterus : The womb; where a fetus develops. During pregnancy, the uterus expands. But when a woman is not pregnant, the uterus is small, hollow and shaped like a flattened pear.

Vagina : The tube-like structure leading from the uterus to the outside of the body; the birth canal.

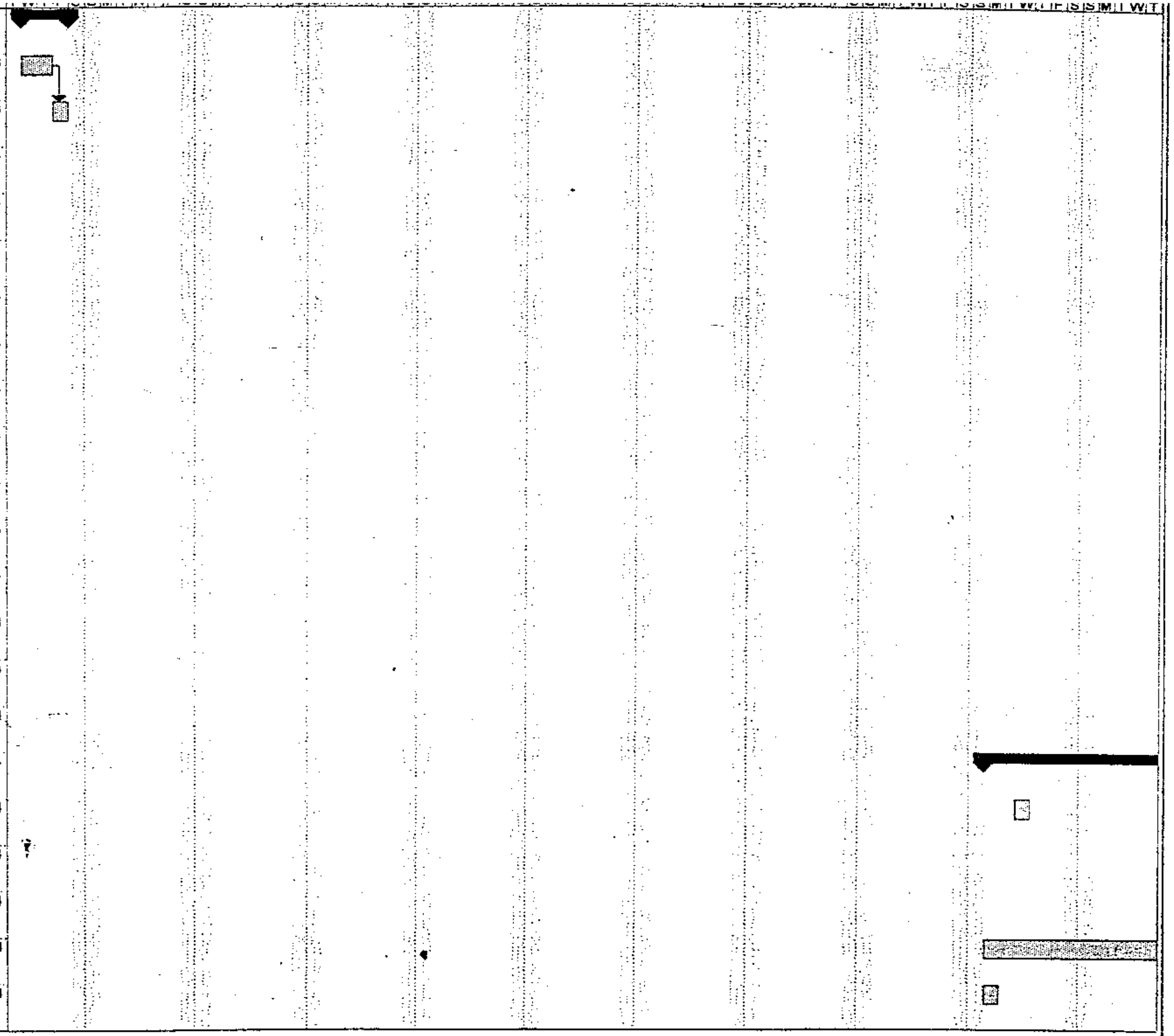
APPENDICES

Appendix	B-1	System Flow chart
Appendix	B-2	Data Flow Diagram
Appendix	B-3	Physical Data flow for the system.
Appendix	C-1	Cyberflex card architecture
Appendix	C-2	Host machine architecture.
Appendix	D-1	Questionnaire

APPENDIX A

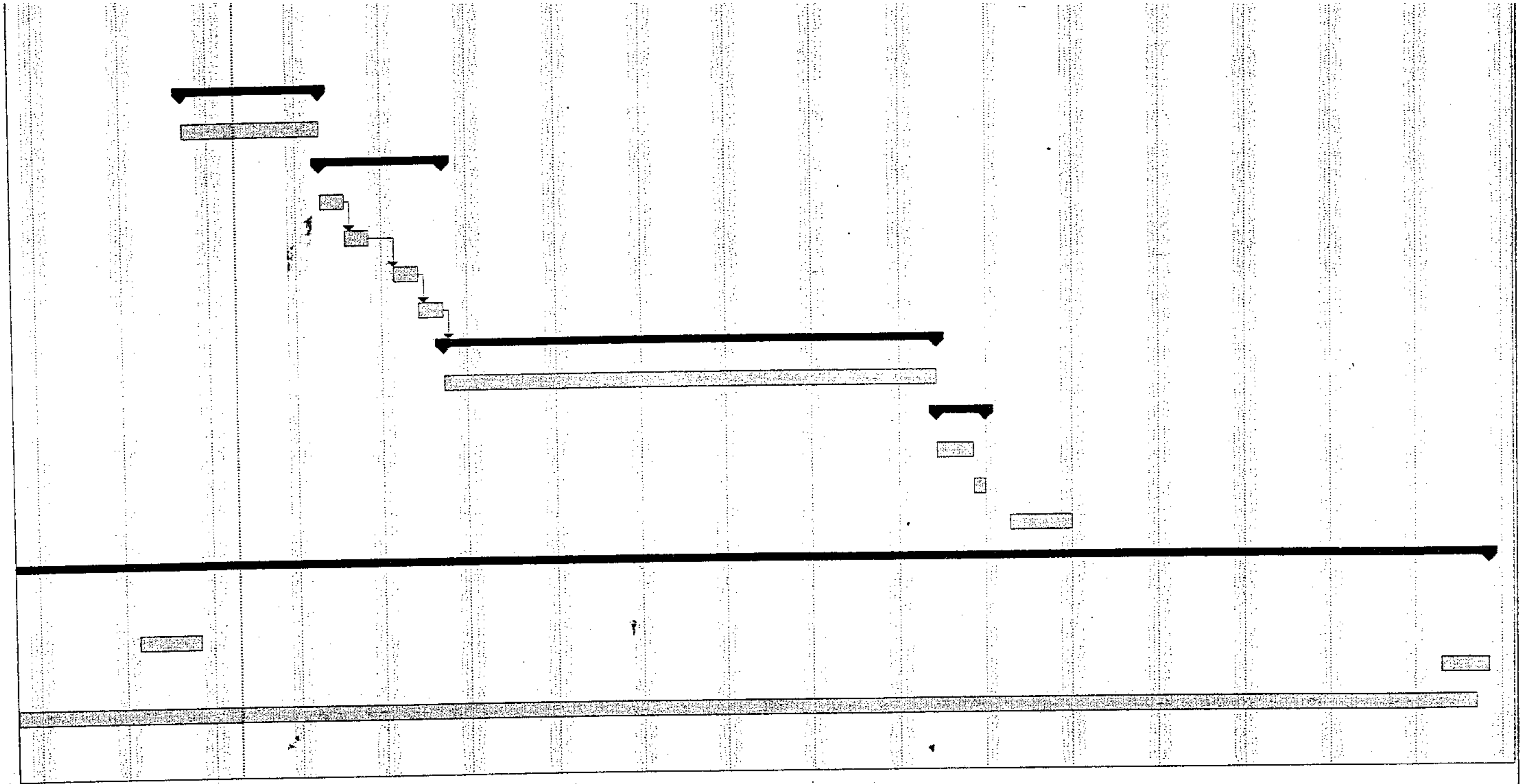
Proposed Project's Timeline

ID		Task Name	Duration	Start	Finish
1		**Selection of Project Topic**	**3 days?**	**Wed 11/26/03**	**Fri 11/28/03**
2		Propose Topic	2 days	Wed 11/26/03	Thu 11/27/03
3		Topic Assigned to Students	1 day?	Fri 11/28/03	Fri 11/28/03
4		**Analysis Phase**	**7 days**	**Fri 2/20/04**	**Mon 3/1/04**
5		Research and Planning	7 days	Fri 2/20/04	Mon 3/1/04
6		**Design Phase**	**8 days**	**Tue 3/2/04**	**Thu 3/11/04**
7		Conceptual Design	2 days	Tue 3/2/04	Wed 3/3/04
8		Physical Design	2 days	Thu 3/4/04	Fri 3/5/04
9		Input and output Design	2 days	Mon 3/8/04	Tue 3/9/04
10		User Interface Design	2 days	Wed 3/10/04	Thu 3/11/04
11		**Construction Phase**	**28 days**	**Fri 3/12/04**	**Tue 4/20/04**
12		System Construction	28 days	Fri 3/12/04	Tue 4/20/04
13		**Integration & Publishing Phase**	**4 days**	**Wed 4/21/04**	**Sat 4/24/04**
14		Integration & Testing	3 days	Wed 4/21/04	Fri 4/23/04
15		Publishing Testing	1 day	Sat 4/24/04	Sat 4/24/04
16		**Oral Presentation**	4 days?	Tue 4/27/04	Sat 5/1/04
17		**Documentation**	**96 days?**	**Mon 1/26/04**	**Fri 6/4/04**
18		Submit Preliminary report	1 day?	Wed 1/28/04	Wed 1/28/04
19		Submit Progress Report	5 days	Mon 2/16/04	Fri 2/20/04
20		Submit Dissertation	4 days	Tue 6/1/04	Fri 6/4/04
21		Logbook	95 days	Mon 1/26/04	Thu 6/3/04
22			1 day?	Mon 1/26/04	Mon 1/26/04



Project: Project1
Date: Tue 2/24/04

Task · Split · Progress · Milestone · Summary · Project Summary · External Tasks · External Milestone · Deadline



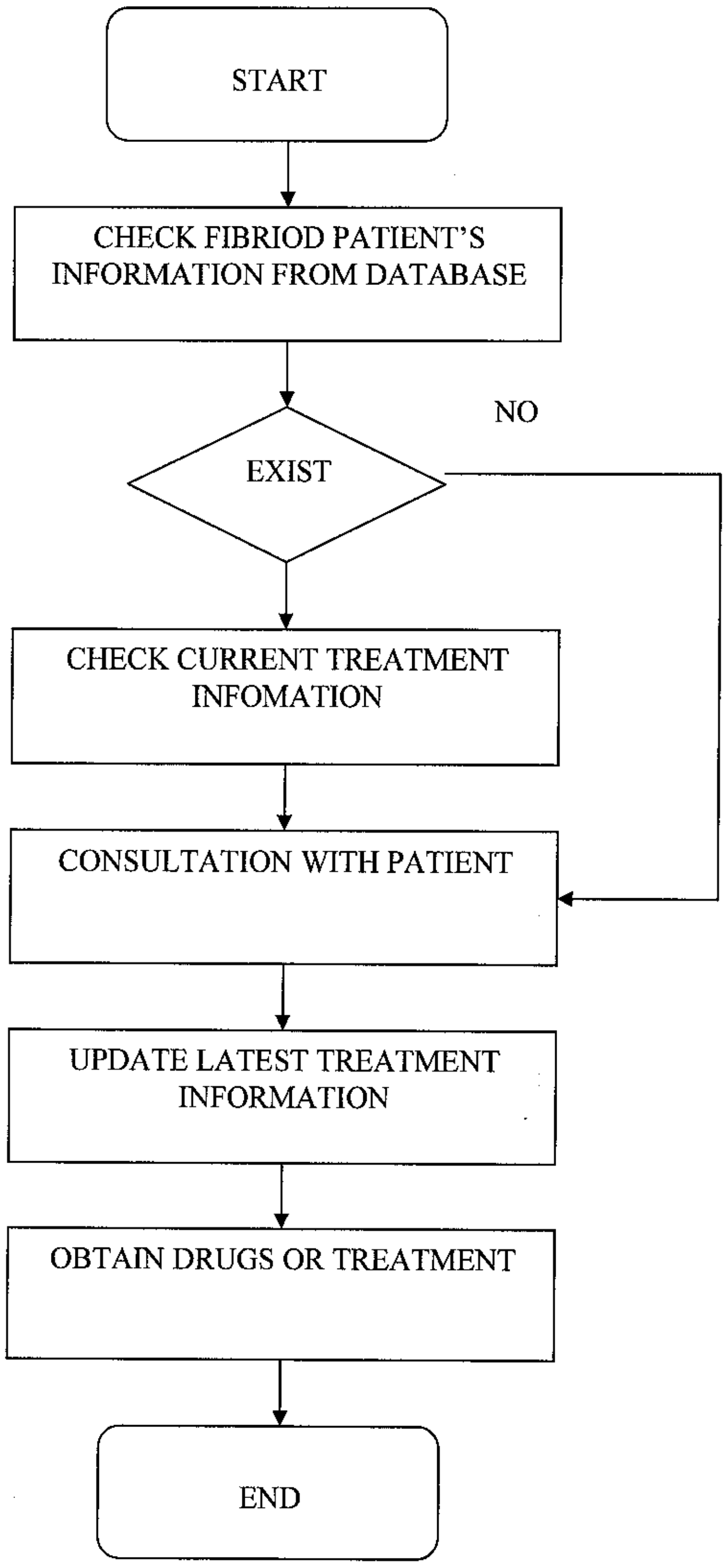
Project: Project1 Date: Tue 2/24/04	Task		Progress		Summary		External Tasks		Deadline
	Split		Milestone		Project Summary		External Milestone		

APPENDIX B-1

System Flow chart

APPENDIX B-1

FLOW CHART OF e-FIBROID PATIENT TRACKING SYSTEM

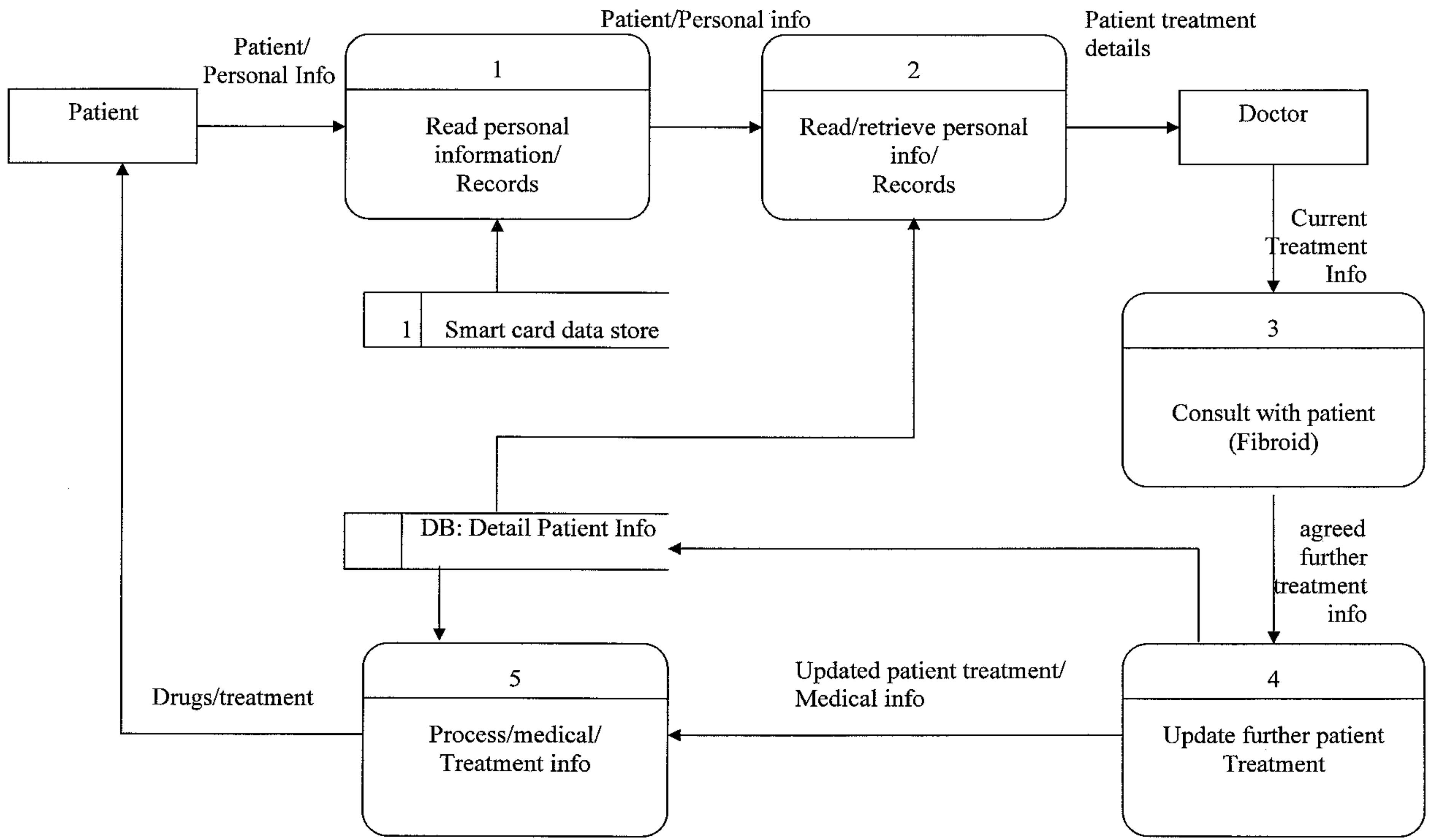


APPENDIX B-2

Data Flow Diagram

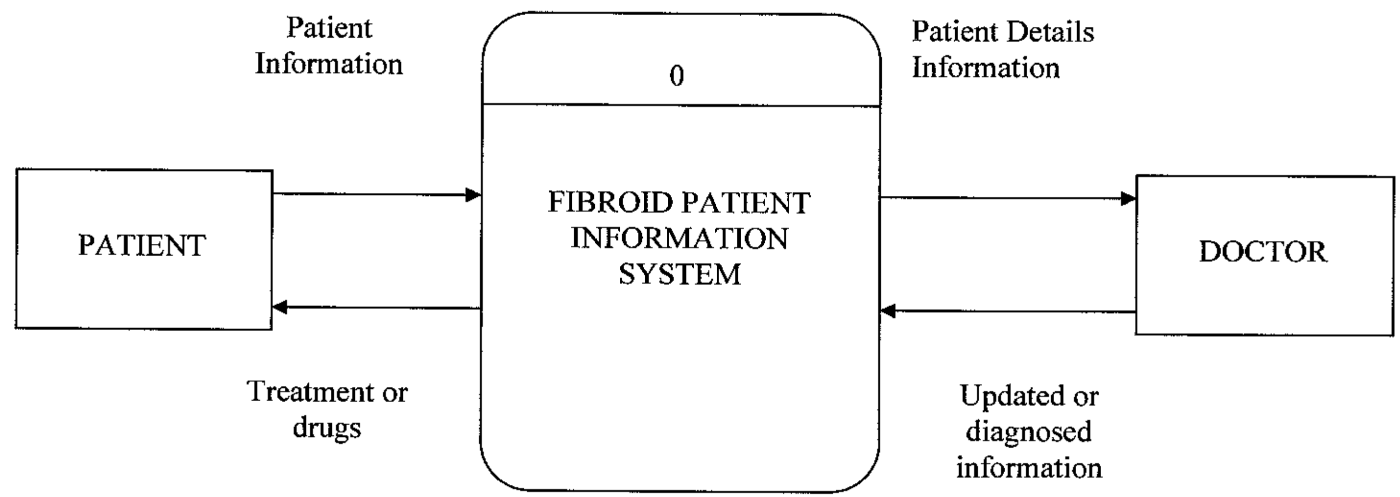
APPENDIX B-2

DATA FLOW DIAGRAM FOR e-FIBROID PATIENT TRACKING SYSTEM



APPENDIX B-3

Physical Data flow for the system.



APPENDIX B-3

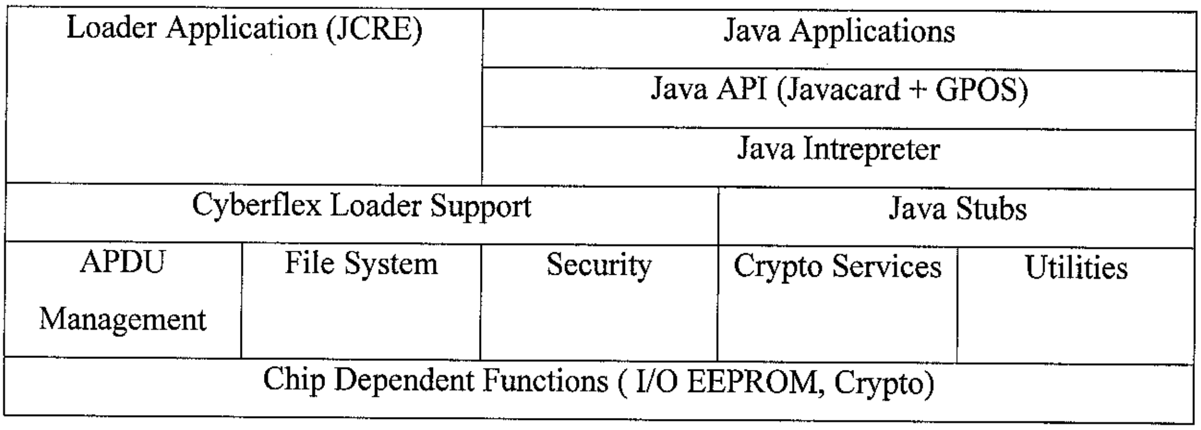
Diagram 1: PHYSICAL DATA FLOW FOR e-FIBROID PATIENT TRACKING SYSTEM

APPENDIX C-1

Cyberflex card architecture

APPENDIX C-1

CYBERFLEX CARD ARCHITECTURE

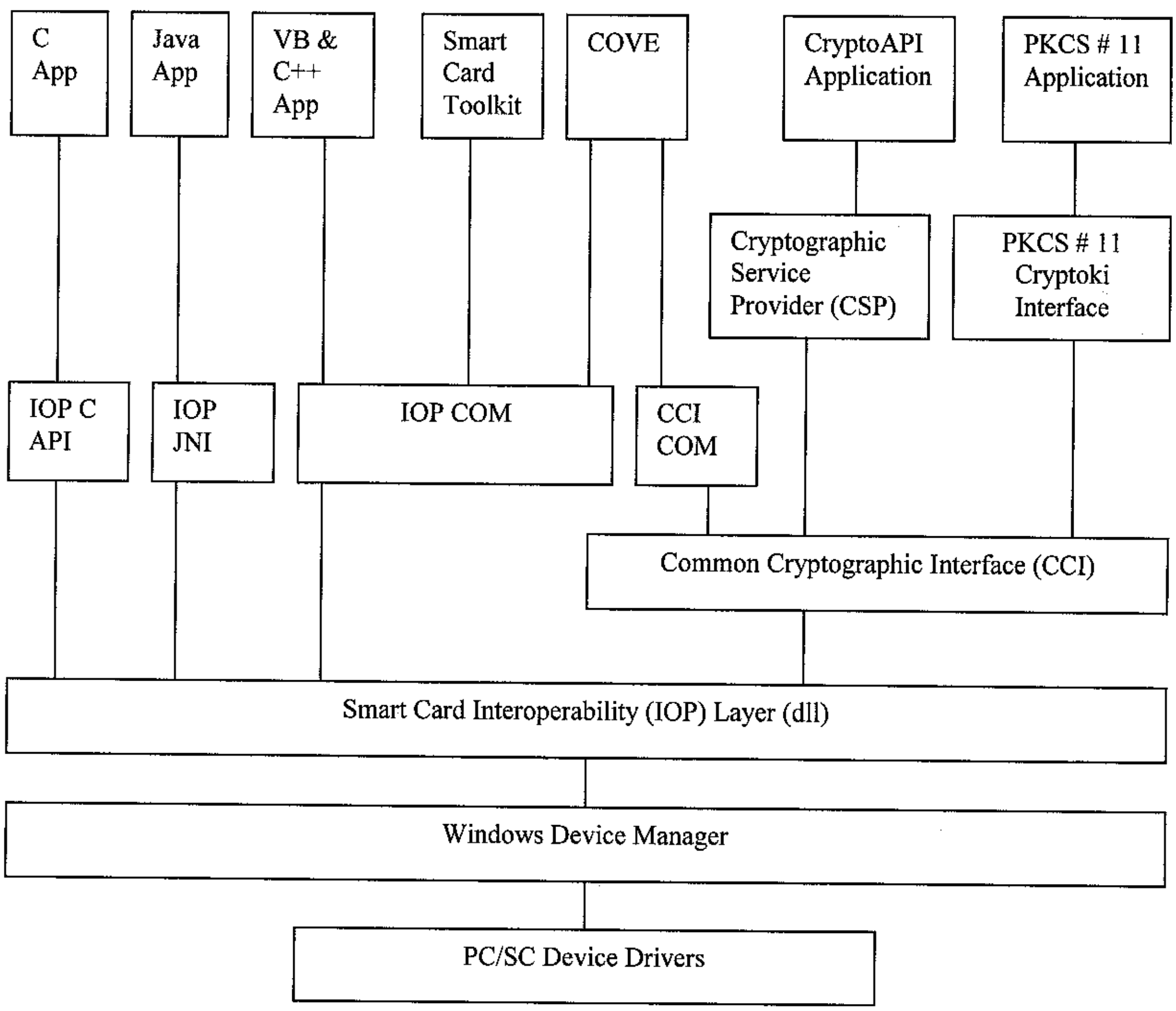


APPENDIX C-2

Host machine architecture.

APPENDIX C-2

HOST MACHINE ARCHITECTURE



APPENDIX D-1

Questionnaires

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The purpose of this questionnaire is to elicit information on the efficiency of the computerized system together with the implementation of smart card in healthcare industry.

Soal selidik ini adalah untuk mengumpul maklumat tentang keberkesanan pengunaan sistem berkomputer bersama kad pintar dalam industri perubatan.

Age/*Umur* : [ ] 20-35 [ ] 36-50 [ ] Over 65/Atas 65

Gender/*Jantina* : [ ] Male / *Lelaki* [ ] Female / *Perempuan*

Race/*Bangsa* : [ ] Malay / *Melayu*
[ ] Indian / *India*
[ ] Chinese / *Cina*
[ ] Others / *Lain-lain*

Status : [ ] Patient / *Pesakit*
[ ] Doctors / *Doktor*
[ ] Hospital Staff / *Kakitangan Hospital / Kesihatan*
[ ] Public / *Orang Awam*

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1. Are you using a computer-based application(s) to manage patient information?

   Adakah anda menggunakan sistem berkomputer untuk menguruskan maklumat pesakit?

   [ ] Yes / *Ya*

   [ ] No / *Tidak*

2. Do you have any problem with the current system?

   Adakah anda mengalami sebarang masalah menggunakan sistem sekarang?

   [ ] Never / *Tidak Pernah* [ ] Occasionally / *Kadangkala*

   [ ] Often / *Kerap kali* [ ] Always / *Selalu*

3. What are the current problems of manual process that support the need for computerization?

   Apakah masalah berkaitan dengan sistem sekarang yang memerlukan sistem berkomputer?

   [ ] Difficulty in managing patients' medical records
   Pengurusan maklumat dan rekod pesakit yang rumit

   [ ] Slow Processing
   Sistem pengurusan dan pemprosesan yang lambat/ mengambil masa yang lama

4. How often is patient's information forms incorrectly filled out, lost or illegible?

Berapa kerapkah borang maklumat pesakit salah diisi,hilang atau tidak boleh dibaca?

[ ] Never / *Tidak Pernah*

[ ] Occasionally / *Kadangkala*

[ ] Often / *Kerap kali*

[ ] Always / *Selalu*

5. Do you ever know what smart card is? Have you experienced using it?

Adakah anda mengetahui tentang kad pintar dan aplikasinya? Adakah anda mempunyai pengalaman menggunakan aplikasi kad pintar?

[ ] Yes / *Ya*

[ ] No / *Tidak*

[ ] Not sure / *Tidak pasti*

6. What are your concerns with the security aspect of smart card application in healthcare?

Apakah pendapat anda tentang tahap keselamatan pengunaan kad pintar dalam rawatan kesihatan?

[ ] Fully secured / Sangat terjamin

[ ] Not secured / Tidak terjamin

7. Do you agree with the idea of replacing the manual way of keeping the patient record with computerized system that uses smart card?

Adakah anda bersetuju mengenai penggunaan sistem berkomputer dan aplikasi kad pintar untuk menggantikan sistem yang sedia ada?

Strongly Disagree	Disagree	No comment	Agree	Strongly Agree
Sgt Tidak Bersetuju	*Tidak bersetuju*	*Tiada komen*	*Bersetuju*	*Sangat bersetuju*
1	2	3	4	5

8. Do you prefer to use smart card to access your healthcare records?

Adakah anda berminat terhadap pengunaan kad pintar untuk mendapat maklumat tentang informasi kesihatan anda?

[ ] Very Interested / *Sangat berminat*

[ ] Interested / *Berminat*

[ ] Not sure / *Tidak pasti*

[ ] Not interested / *Tidak berminat*

9. Do you think smart card is an efficient medium to store and retrieve information?

   Pada pendapat anda, adakah kad pintar merupakan cara yang baik untuk menyimpan dan mendapatkan informasi?

   [ ] Yes / *Ya*

   [ ] Not sure / *Tidak pasti*

   [ ] No / *Tidak*

10. What do you consider to be the benefits of computerized patient information together with smart card?

   Pada pendapat anda, apakah faedah yang diperolehi daripada pengunaan sistem berkomputer dan aplikasi kad pintar?

   [ ] Centralizing and coordinating patient's data and information
   Pemusatan dan penyelarasan maklumat dan data pesakit

   [ ] Decreasing time to access and process of information
   Menjimatkan masa untuk memperolehi dan memproses makumat

   [ ] Improving decision making
   Meningkatkan keupayaan dan keberkesanan dalam membuat keputusan

   [ ] Reducing human involvement and errors
   Mengurangkan pengunaan tenaga kerja dan risiko kesilapan

   [ ] Providing reliable and secure medical information
   Memberikan informasi kesihatan yang selamat dan boleh dipercayai

   [ ] Providing mobility of medical data or records
   Memperkenalkan rekod atau maklumat kesihatan secara mobiliti

11. Do you need a training session if smart card is being implemented in healthcare?

   Adakah anda ingin menghadiri sessi latihan jika kad pintar diaplikasikan di pusat kesihatan?

   [ ] Yes / *Ya*

   [ ] No / *Tidak*