SMART LIBRARY – The Use of Smart Card to Patronize Library Facilities

by

Nora Azura Ali

A project dissertation submitted in partial fulfilment of
the requirements for the
Bachelor of Technology (Hons)
(Information Technology)

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Universiti Teknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF ORIGINALITY

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

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NORA AZURA ALI

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Approved by,

_____
(Jale Ahmad)

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ABSTRACT

The project, SMART LIBRARY – The use of Smart Card to Patronize Library Facilities is initiated due to the increasing interest in computerized library management system. This has introduced number of problems areas that need to be addressed so that reliable library system can be carried out. The project has been adopted from the concept of e-Wallet where the patron makes payment to the library without using the intermediary parties such as bank or financial institution. Facilities provided by library such as internet usage and photocopy machine need to be managed efficiently so that patrons will enjoy the services without having any difficulties. This paper discusses the functionality of smart card in library management system. It investigates how smart card that will be introduced as debit card to patrons help them towards hassle free environment. This paper also discusses the impact of smart card system to the library management in tracking the money collected from the library facilities such as photocopy machine and internet usage. The author has chosen Waterfall model and prototyping as development method. It includes research on smart card capabilities, project analysis, design and implementation, and system testing. In the end of the project, the system would be able to produce transaction record for every facilities used by the patron. This report is an alternative solution for the library management to project the library's future planning.

ACKNOWLEDGEMENT

Firstly, I would like to express my gratitude to Allah, for His grace I was able to accomplish this project. I believe He has blessed me with sufficient strength and wisdom for me to carry out and complete this project

I wish to thank to the University Teknologi PETRONAS (UTP) for the opportunity and experience for completing my final year project there. I am greatly appreciated all the lessons I have learned throughout my study

I also would like to put my highest gratitude to all UTP lecturers, especially my supervisor Mr. Jale Ahmad for the commitment and guidance in this project. Under his supervision, I was able to learn many new things especially on the subject regarding my project. I am very much indebted with him for the resources and time that he had provided me through the semester. Truly, his generous guidance and help has put a light on my path in carrying out the project. Your sharing of knowledge, kindness and patience will always be appreciated.

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Last but not least, I would like to thank individuals such as the lab technician, other lecturers and students whose names are not mentioned but involved directly or indirectly in the success of this project.

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Increasing interest in computerized system has lead to an increase in computerized library management system. This has introduced number of problems areas that need to be addressed so that reliable library system can be carried out. The emergence of smart card has lead to inventions in many applications such as library system. Smart cards provide an alternative to storing usage information in the library's central repository. Smart cards allow users to keep the information themselves. Smart cards both store and process information. The purpose of a smart card system will largely determine what information will need to be stored on the card. New approach has been identified where smart card can be used by patrons in to store personal information. In addition to being used to store personal information, the card will enable cashless transactions for photocopies material and internet usage in the library center.

This project named Application of Smart Card in Library Management System is one of the systems that arises form the high demand of smart card. It provides real opportunities for improving the delivery of services and reducing the cost of administration. Smart cards are becoming an affordable solution to the requirements for a transportable, secure, reliable and compact device. Smart card applications are rapidly expanding beyond the areas that have historically made the most use of them. In the European public sector, smart cards are increasingly being used as portable personal files for health records, for example. Based on this statement, the smart card will be efficient for the use in the library.

For this project, the author focuses on the powerful function of smart card that can carry various amount of information in it. The smart card that will be introduced as debit card will show on how a piece of card can be use to many functions in the library such as

storing personal data, photocopy material and internet usage. Basically, the author will study on the benefits of using this smart card as debit card for the library's side and patron's side.

This project consists of two parts that are developing the program or system in visual basic and develop the card applet in Java file. The first part basically used by the librarian to assist the patron to borrow books and update personal information. The second part will show a simulation for the patron to use other library's facilities to photocopy material as well as internet usage. In this system, when the patron wants to borrow book from the library, the patron will give his smart card to the librarian and the librarian will slot in the card in the reader to read the name and library id installed in the card and to ensure the validity of the card. The librarian then will enter the catalog id into the system and the database will display all the information such as book title, date out and date due. If the patron returns the book after the due date, the system will calculate the total days and total fine. Same goes to other services (photocopy and internet) where the smart card is used to check the card validity and sufficient amount in the card before authenticate them to use the service. However, another important feature of the system is for the patron to pay the services without using real cash. The patron will upload certain amount of money in his/her smart card prior using the services offered at the library. At this moment, this reloadable card is top up only at the library that offer the service (issuer).

For security purpose, the system is provided with authorization page in order to make sure that only authorized librarian and patron can use the system. It will ensure the confidentiality of the data in the system and prevent from unauthorized party to manipulate the data for administrator's view.

1.2 Problem Statement

Library is the center of learning in society. As far we are concerned, library has indirectly contributes to formal education in all levels of society. Public libraries are already used by 58 per cent of the population. They are a first stop for information, they are widely used by children and young people as an adjunct to formal learning, and their reputation for supporting the knowledge-seeker is unparalleled (Lic, 1997). Therefore, a computerized system has become a necessity for every library to run. New computerized system using smart card will be the best solution in this new era. Traditional library use registration card to borrow book and record card for every usage of the library facilities such as material photocopy and internet usage. Further more, all the facilities provided (photocopy and internet) has to be paid by the patrons in cash. This is quite hassle for the patrons to bring such amount of money to pay for the usage especially when we talk about school kids. Schools kids sometimes are not aware of the money while in the library. Therefore, if one card can be used to borrow books as well as payment for library facilities usage, it will be easier for the kids to bring the card. From the library perspectives, sometimes it is hard to keep track all the money goes in to the library fund. Fraud cases may happen among library staff because there is no record for every single *Ringgit* debited to the library account. Besides that, cost of library management will increase as they have to pay for the man power at respective facilities counter. Manual system may take a longer time to process. For example, if patron wants to photocopy the material, one staff will be in charged to handle the money collected from the photocopy machine. Let say if the patron pay with big notes, the library has to give him the balance and this may cause problem as the library sometimes doesn't has smaller change. Therefore, the use of smart card as debit card for the patrons will be effective.

1.3 Objectives

One of the objectives of this project is to understand the effectiveness of using smart card in library system for patrons to borrow books, photocopy materials and accessing the internet using the library PCs. Besides that, this project is also aim to know how smart card that will be introduced to the patrons as debit card will help the library management to cut manpower cost and keep track all the money that go in to the library account. Another important element that will be investigating is the type of smart card and smart card reader that suitable for the library usage. The information of the device name, manufacturer, specification and reliability of the hardware are important to determine the feasibility of the project in terms of cost.

1.4 Relevancy of the Project

This project is aimed to provide convenience for both librarians and patrons. Therefore, smart card application in library management system will provide greater value and it is hope that it will help the library to reduce man power cost and time saving. New technology advancement has make today's life easier. Everything needs to be compact and mobile. By having smart card that will be introduced as debit card, personal data can be kept mobile and electronic money can be used without having to use any intermediaries such as bank or credit card companies.

1.5 Feasibility of the Project within the Scope and Time Frame

Feasibility study has been conducted once the scope of project has been narrowed down according to criteria discussed previously. System project feasibility is assessed in three principal ways: operationally, technically and economically.

Operationally, the system will be much accepted by the library management. Most of the current library has been accepted by the library management and this project is just an

enhancement of the current system. Further more, the system will create a portability of personal information and hence it will reduce the use of paper in the library's record.

For economically study, the basic resources to consider are time and cost of doing full system development. After a thoroughly study of time, the author found out that this project can be done within the time frame starting from January 2004 until April 2004. That time is enough to achieve both research and product elements required from the Final Year Project course. The cost of developing this project will be high considering that it involves smart card and smart card reader and writer. However, the smart card can be borrowed from electrical electronic department and automatically it will cut the project cost. For the real system implementation, the cost is affordable since the library need to buy few readers to read the smart card.

Technically, the current system of the library management can be upgraded to this added functionality system. Only the internet and photocopy functions need to be included into the system. For borrowing purpose, the existing system can be used and it just needs some enhancement to automatically detect the card expiry date.

CHAPTER 2

LITERATURE REVIEW/ THEORY

2.1 Smart Cards

The first smart card was produced at the end of the 1970's. However widespread distribution did not start to occur until the mid 1980's. French implemented smart card technology for use as public telephone pre-payment cards and personal health cards. Smart cards are now becoming more wide spread with many banks including them on their credit or debit cards. The US has been slower in the up-take of smart card technologies, mainly due to the popularity of magnetic swipe cards. Caret (2001, 138) said that however usage is increasing rapidly as American industry realizes the smart cards offer:

- Over 80 times the storage offered on a magnetic strip card
- Advanced hardware and software security features
- Multiple functionality in one card

The smart card comprises of a microprocessor and memory elements embedded into a credit card sized plastic holder (Figure 1). Typically, an integrated circuit chip consists of a microprocessor, read-only-memory (ROM), non static random access memory (RAM) and electrically erasable programmable read only memory (EEPROM) which will retain its state when the power is removed. The current circuit chip is made from silicon which is not flexible and particularly easy to break. Therefore, in order to avoid breakage when the card is bent, the chip is restricted to only a few millimeters in size (Figure 2). The standards for smart card appearance, architecture and communications protocols are well laid out and must follow guidelines set down by the ISO (International Organization for Standardization).

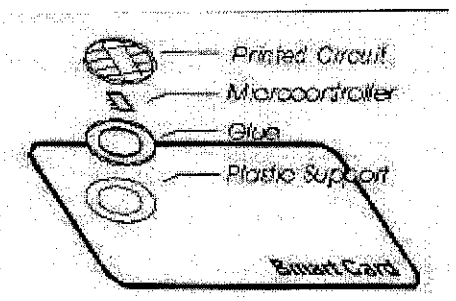


Figure 1: Physical structure of a smart card (Sources: Philips DX smart card reference manual, 1995)

Nowadays, smart card has become a valuable piece of card. As the proliferation of these cards has grown significantly over the past few decades, so too has the dependence upon them for personal data carrier. These cards are the key to many public and private sector services. Try getting access to health services, withdrawing money from a bank, checking out a book from the library, or charging a purchase, without the appropriate plastic card. No card can equate to no service, as it is frequently taken as proof of entitlement. Therefore, there is no doubt why most library system today, has moved to smart card technology where smart card can be very compact to store all the details about the patrons.

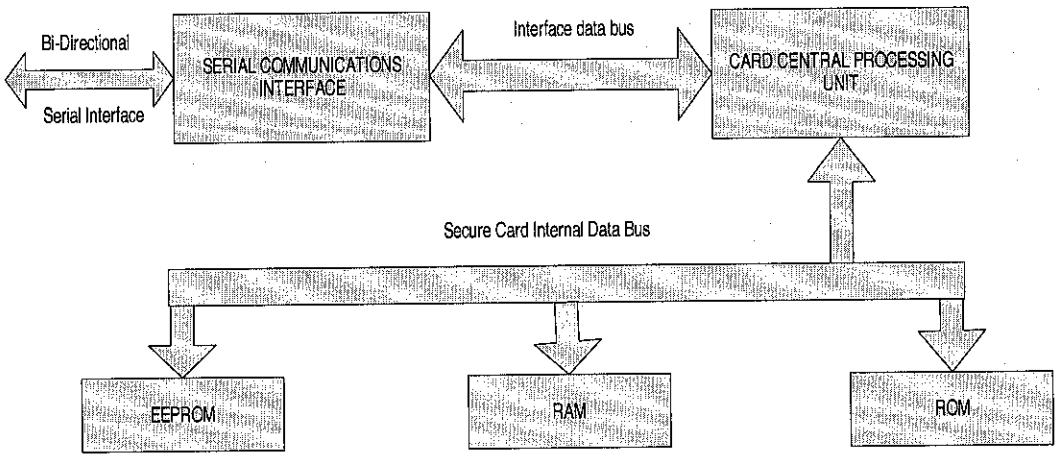


Figure 2: Smart Card Internal Architecture

2.1.1 Credit-card sized Smart Card

Smart cards have the same three fundamental elements as all other computers: processing power, data storage and a means to input and output data. Processing power is supplied by a microprocessor chip, and data storage is supplied by a memory chip. In some instances these elements can be combined in one chip. The means in which data is transferred varies from card to card. In order to operate, each card must have a power source, whether in a card reader or on the card itself (McCrindle 1990, 22). Microcomputer chip embedded into it that can produce as much power as some personal computers; some consider it to be the next generation of portable computer (McCrindle 1990, 2). The microcomputer is able to store and manipulate data, and solve mathematical problems. Due to its size and computing ability, it has many benefits. If all the personal data can be carried in a pocket size card, it is more practical to carry it instead of bringing the laptop for personal data retrieving. Further more, smart card is only a piece of card that weighted less than one kilogram compared to laptop that usually weighted around two kilograms. That is why most services nowadays require people to use smart card as a medium of identification and business transaction.

2.2 Automated Library System

Recent technological advances have affected the management of library systems in the world. Currently, the number of libraries and information centers that are gearing towards library automation and application of new technologies are increasing. This state of affairs has encouraged the leadership in the library profession to review its fundamental purpose and the mission of libraries, involving decision-making as they reach their communities besides considering economic demands for cost effectiveness and accountability. The place of the library in society would depend on how rapidly it integrates technology into its operations and how rapidly engineers and designers of information systems recognized the library as an important link in the system (Drake, 1979). Drake further, stressed that the potential of technology to provide information when and where needed, coupled with the need to produce the labor intensity of library

operation were prime motivators in innovation (Drake, 1979). Related to technological application in libraries, its impact is regarded as an important element in a general pattern of technological change. As Herman Kahn and Anthony Wiener have stressed, change as a force in society has become increasingly relevant because technological developments are numerous, rapid and pervasive (Kahn & Wiener, 1967).

At the end of the 1970s, "integrated systems" became the preferred model for automating library activities. Integrated systems were generally developed by a single vendor and offered automated support for multiple library functions, often called "modules" (e.g., cataloging, serials control, and circulation). The systems were based on shared databases so that most data could be entered once but be accessible across functions, a more efficient approach than that offered in earlier applications. Integrated systems also standardized searching and record-manipulation techniques across functions, presenting greater efficiency for users and staff. Early versions of integrated systems were designed to facilitate cataloging and circulation system.

However, because of rapid change of technology advancement, many libraries now have moved to smart system where it can be used as personal verification. Smart card has become a critical issue in government application such as personal identification, health record and access to public facilities for example public library. Smart card has been identified to be the effective medium towards cashless environment in the library where all the revenues gain from the patrons can be monitored. The emergence of smart library where smart library will be self- educating system has become popular nowadays. Their accessibility system will be generated in an interactive way in cooperation with the user.

2.3 Smart Card for Today's Library

Imagine a world where a computer no bigger than a credit card is capable of storing all your personal data, providing access to bank accounts, getting you through airport security, and providing easy and safe ways to make purchases online. Imagine you can use this single card to use the library facilities without any hassle because it carrier "your

money" in it. It is expected that new library facility, will include smart card system for patron use. A first smart card system to be implemented in a public library in the United States, and community leaders are considering how the system can be extended in the future to other applications, including public transit and utility payments (PRnewswire, 2001). In addition to being used for checking out library materials, the card will enable cashless transactions for internet fees and photocopy costs from the library's Photostat machine. Philip Cherry (2001) said that "Once patrons are used to the new smart card system, they are going to love the convenience it offers. This is an incredible opportunity to be at the cutting edge of technology". Smart card technology uses a credit card-sized card that includes a microchip containing information such as the owner's name and address. Smart cards will include patron photos as well as the information used for the circulation system. Smart card for library has created a hassle-free environment where patron can use the library facilities by inserting the card to the reader and automated transaction will be generated. Table 2.3 describes the benefits of having smart card system for library management.

Library	Patrons
• High cost saving in manpower • Provide better service to patrons • Better management of patron and library items, transactions and data • Management projection for facilities usage	• Shorter waiting time for borrowing and returning of library items as well as library facilities usage. • Enjoy better services from library through this new, hassle free and seamless technology and innovation • Accurate real-time access

Table 1: Benefits gained from library and patrons from smart card usage in the library system

CHAPTER 3

METHODOLOGY/ PROJECT WORK

3.1 Procedure Identification

The process model used in this project development is Waterfall with prototyping. Waterfall model is a liner sequential model that suggests a systematic, sequential approach to software development (Moussavi, Wang 1999). Figure 3.1 illustrates the linear sequential model for software development.

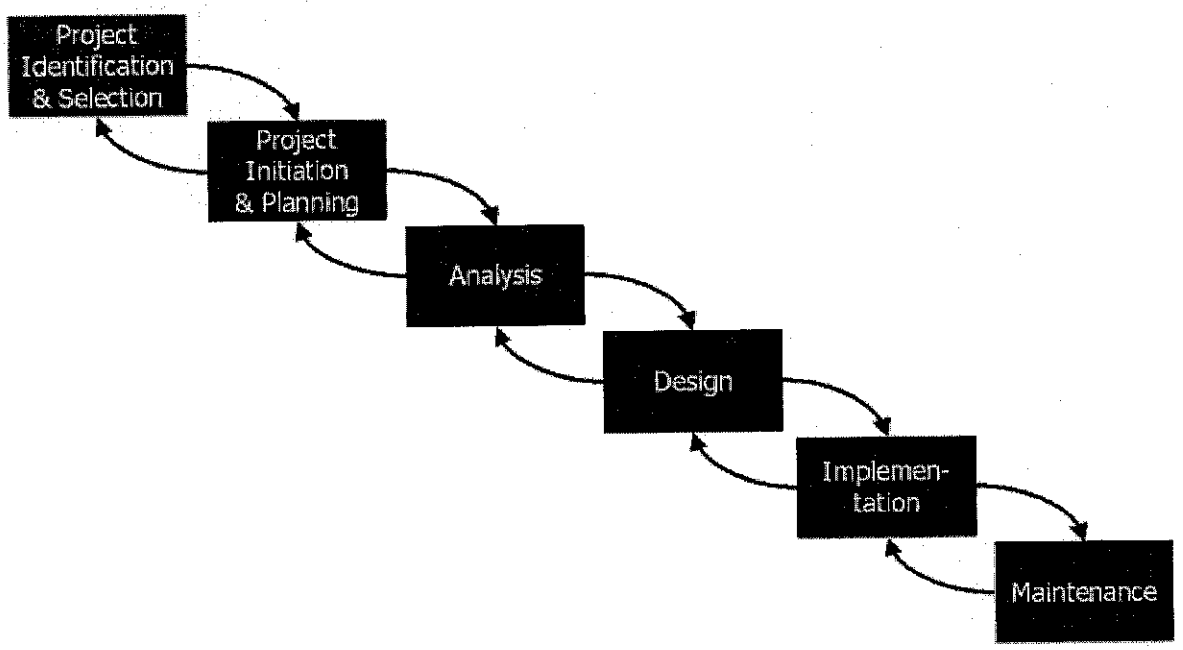


Figure 3: Waterfall model for project development

Strong cohesion between continuous design stages and prototyping is shown on the diagram. For this project, these design stages share some common time. The following diagram describes the relationship and process between Waterfall models with prototyping.

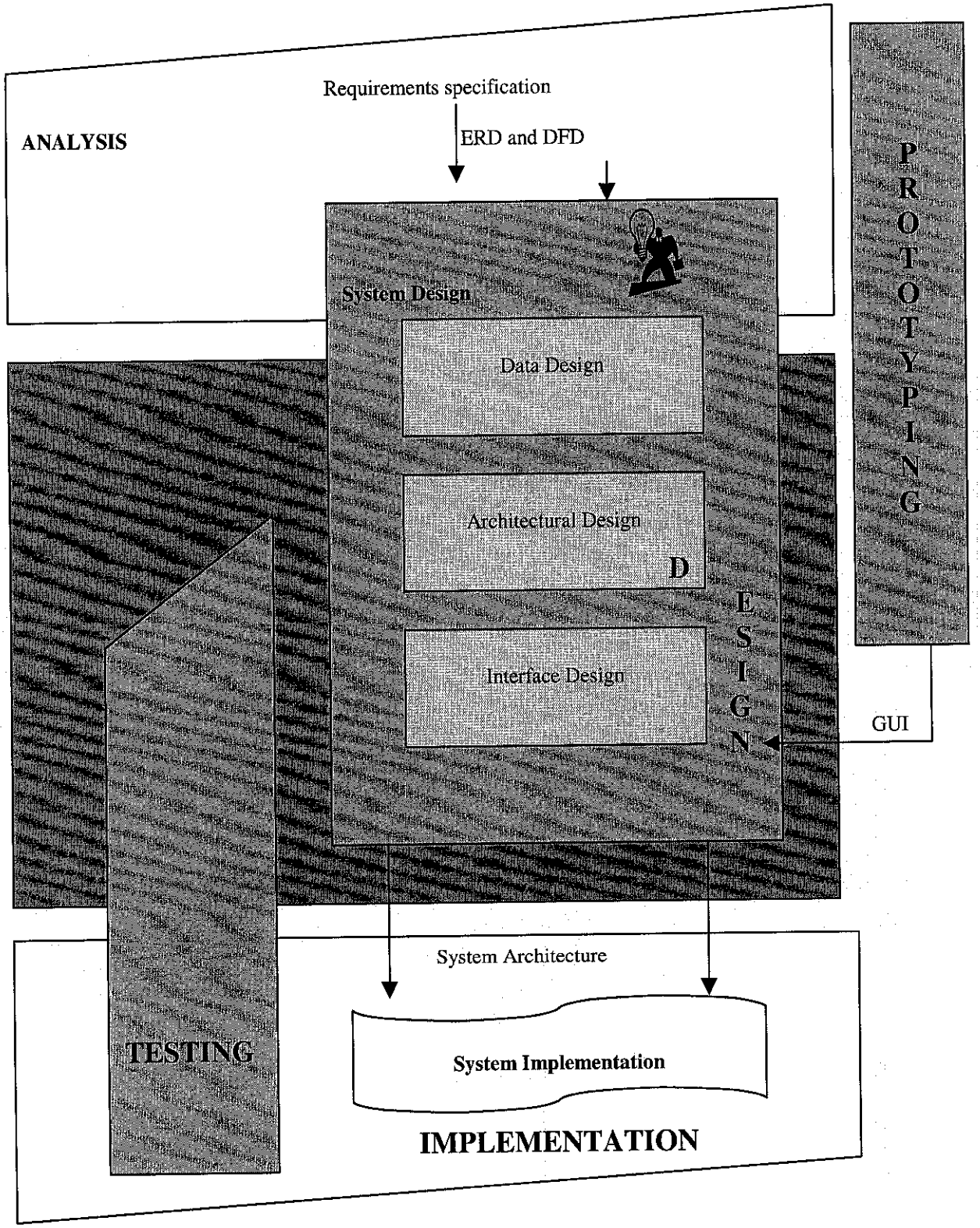


Figure 4: Relationship and process of Waterfall model and Prototyping

3.11 Phase 1: Project Identification and Selection

In this phase, the author began to focusing the problem arises in the library management. In order to gather data on library process flow, the author read through articles and journal for current library system. The author also made an observation on library scenario in University Technology Petronas (UTP) to get the idea of the common facilities provided in most libraries. Author has come out with the goals and objectives for this library project as stated in section 1.3.

3.1.2 Phase 2: Project Initiation and Planning

A rough time line for the project is developed as well as a draft of the scope. The author has estimated about one month for data gathering and research, three months for system development and one month for system testing and modification. Deliverables for this phase are a feasibility analysis, system specification, and a project work plan (refer to Appendix I).

3.1.3 Phase 3: Analysis

In this phase, the author began to identify the requirements that the system would be able to meet, in order to address and resolve the problems identified in Phase 1. The requirement must describe what the system must do in order to meet system objectives. The requirement identified by the author relate to such system functions as deducting the money in smart card for paying facilities usage, to store personal data in the smart card and many more. In brief, the process works as follows:

- Patron use smart card every time they want to use the library facilities
- Smart card is use for validation and identification. The system must check the balance in the smart card in order to allow patron for transaction.
- System will automatically deduct the amount of money in smart card to pay for the usage

- The transactions details are captured and recorded in transaction table reside in the dedicated database.

3.1.4 Phase 4: Design

The design phase is split into the following sub stages:

- Data design
  - The data design stage starts with defining the Data Dictionary (Appendix II). Data Dictionary is first defined during Phase 3: Analysis. The basic ERD diagram is built (Appendix III).
- Architecture design
  - The Architectural Design starts with the system information flow model (refer to figure 4, figure 5 and figure 6).
- Interface design
  - The interface design stage deals with design of the interfaces between software modules, system and external devices (smart card reader), and human users – User Interface.
  - The author first built the database in Microsoft Access Database and created a relationship between the entities.
  - After database has been established, user interface has been designed to connect the system and the database.
  - After the interface has been designed, the author started to create java card applet.

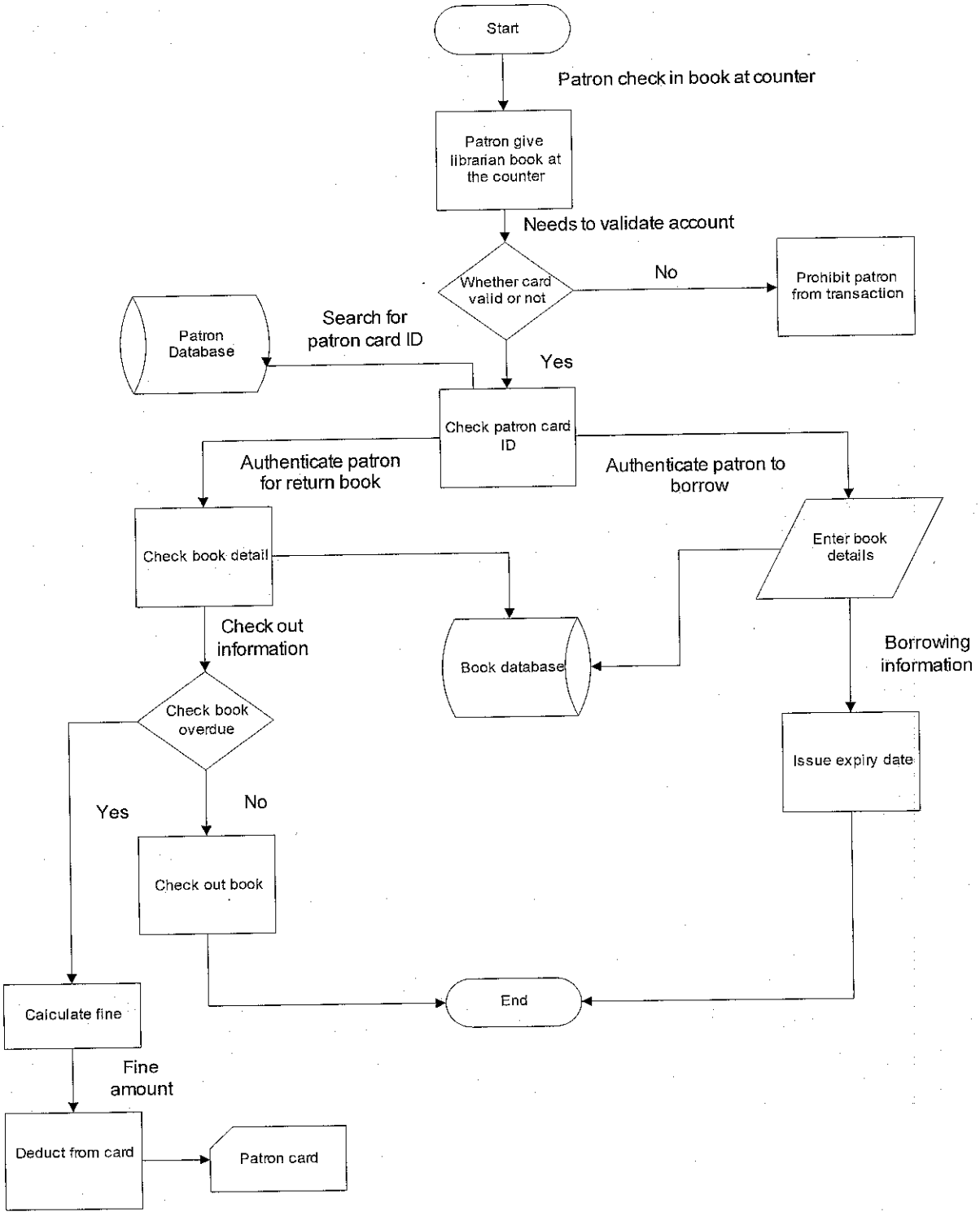


Figure 6: Data Flow Diagram for Book Borrowing/ Returning

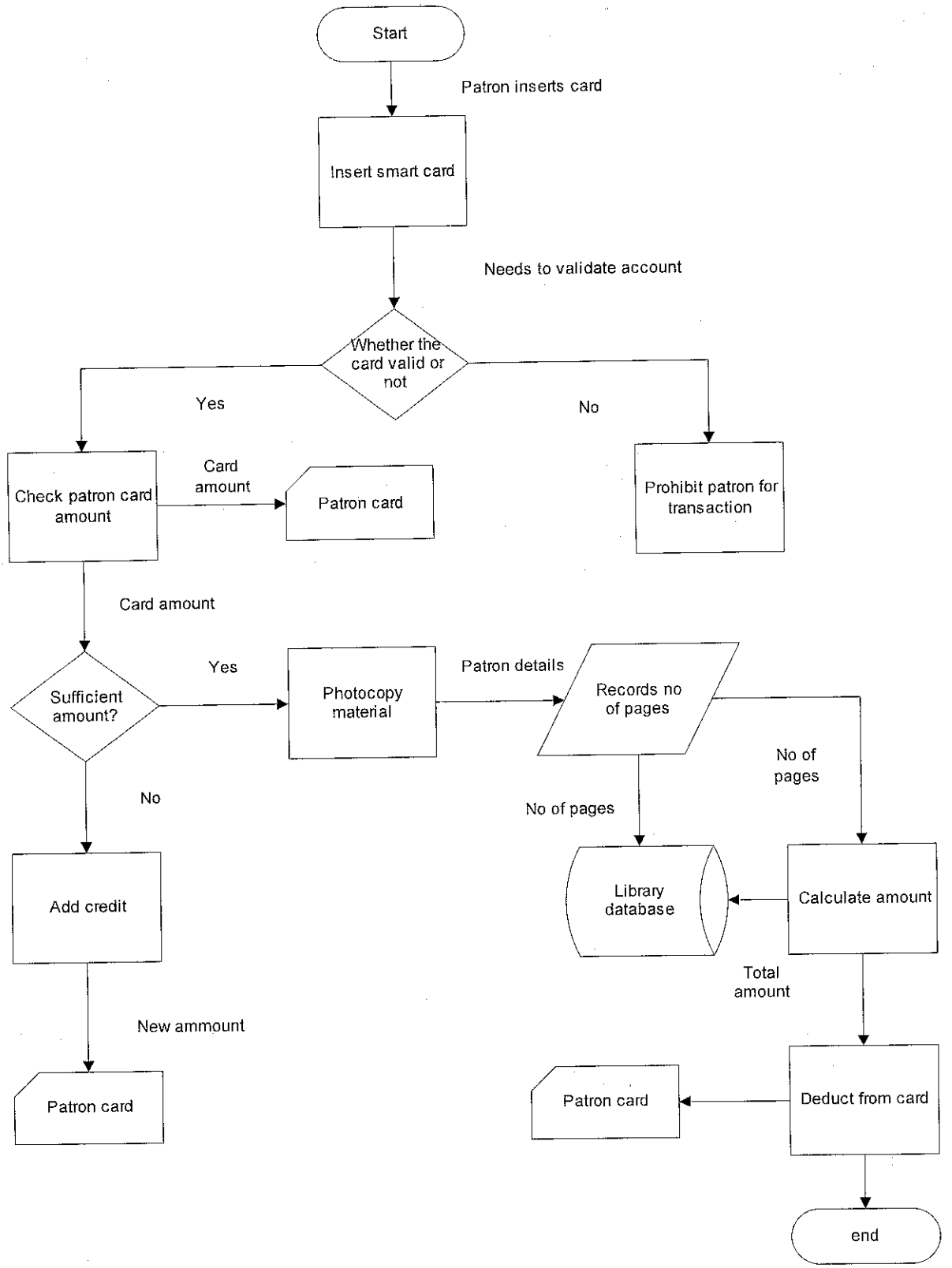

Start
Patron inserts card
Insert smart card
Needs to validate account
Whether the card valid or not
Yes
No
Check patron card amount
Card amount
Patron card
Prohibit patron for transaction
Card amount
Sufficient amount?
Yes
Photocopy material
Patron details
Records no of pages
No
No of pages
No of pages
Add credit
Library database
Calculate amount
Total amount
New ammount
Patron card
Patron card
Deduct from card
end

Figure 7: Data Flow Diagram for Photocopy Material

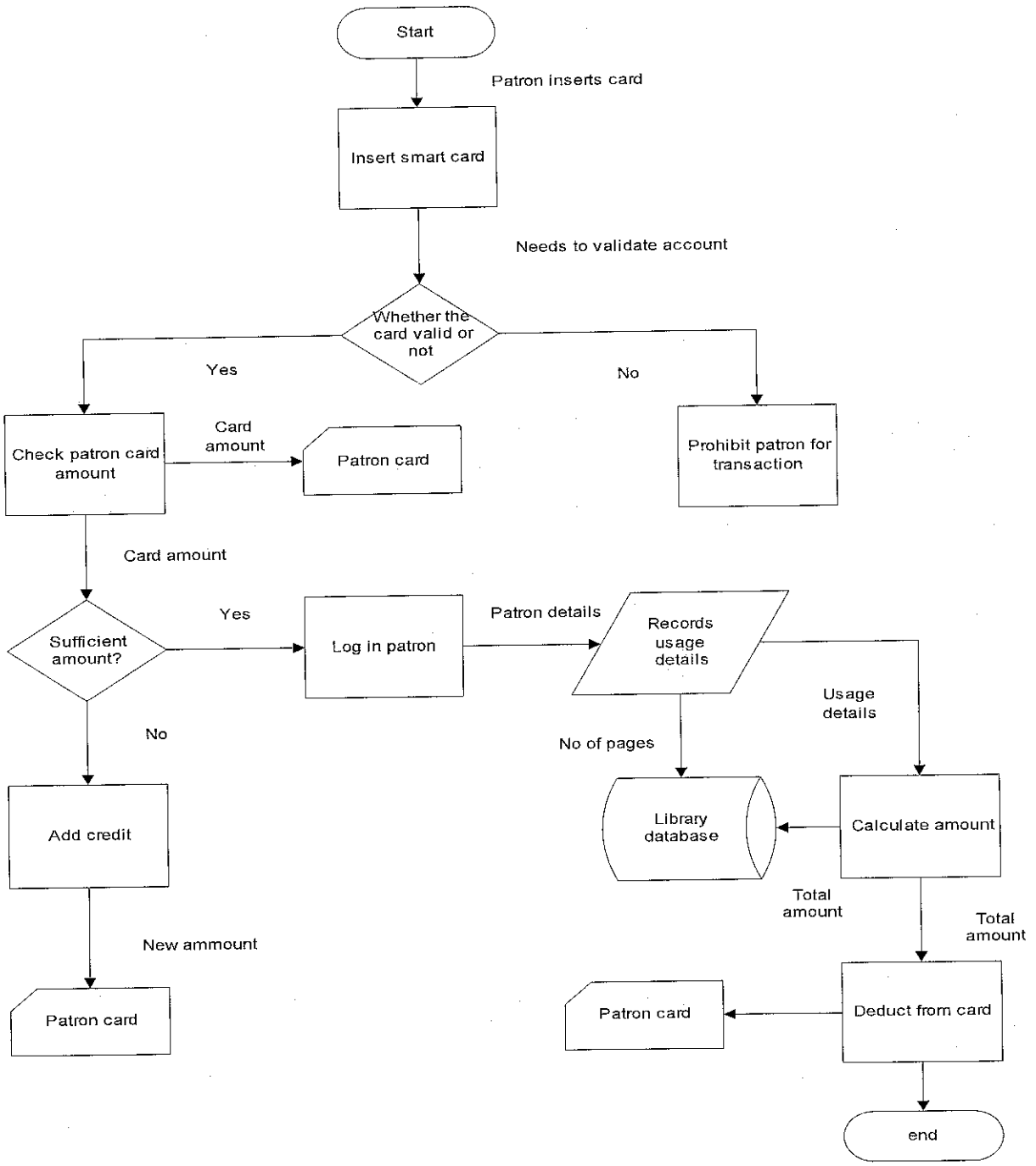


Figure 8: Data Flow Diagram for Internet Usage

3.2 Tools Required

3.2.1 Visual Basic 6.0 Programming

This programming language is chosen because the author already familiar with the system and a user friendly interface that would help in developing the application faster and efficient. Graphical user interface (GUI) is developed using Visual Basic enable User-System-Interaction.

Visual basic has several windows for user to easily interact and use the software. The windows are called IDE windows. Project window is important to provide an overview of all the modules that contains in the application. Form designer window is used to design the user interface. The code window is essential in determining the behaviors of object and forms in the application.

The software is also used to retrieve and compare data in the database. Visual basic is used as the means to access database stored in the Microsoft Access application. Thus, Microsoft DAO 3.6 Object Library is required. DAO communicates with the data sources through the JET database engine. It is a collection of object classes that model the structure of a relational database system. It provides properties and method that allow user to accomplish all the operations needed to manage such a system, including features for creating database, defining tables, navigating and querying database. To connect Visual Basic to database, Database object is used.
Recordset object is used to manipulate records in DAO. Recordset is a data construct provided by Jet engine. It is conceptually similar to a table, but includes some important distinctive properties of its own. The type of recordset used is Dynaset. Dynaset is updatble and efficient as it represents set of references to the data in the underlying query. It also can return records from more than one table through the use of join.

3.2.2 Cyberflex Access SDK 4.4

Smart card application consists of a smart card, smart card reader and reader driver. This project used Schlumberger Cyberflex Access SDK 4.4 that contains, Cryptographic Object Viewer and Editor (COVE), File generator to convert *.class* file to *.ijc* file. Data can be read from the cards and some data can also be written to them. Visual Basic sample program is supplied by the developer to read and write information in the smart card. The entire *dll* file extension library for smart card is also supported by the installed driver.

In order to develop the system, two stages are required.

- Write into smart card essential information needed about client in java file
- Retrieve the data from the smart card in order to authenticate patron

Below is the diagram showing the stages in developing smart card system.

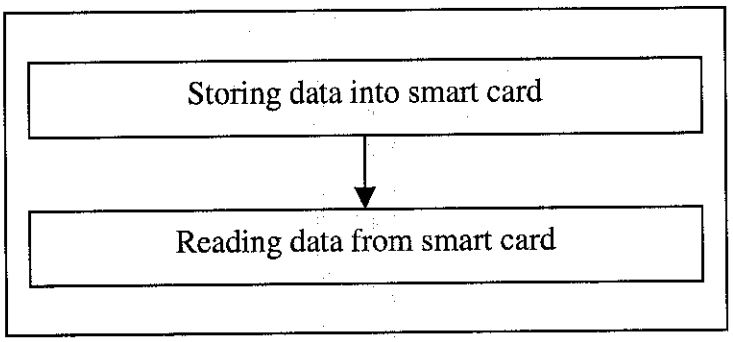


Figure 9: Smart Card Development Stages

3.2.3 Microsoft Access 2000

Database is created using this software and stored as the database server. A database is a collection of information that's related to a particular subject or purpose, such as maintaining patron information. Updating data can be performed more easily and centralized when using database application. Using Microsoft Access, all information can be managed from a single database file. The services offered are:

- Tables to store data
- Queries to find and retrieve data just when the data wanted
- Forms to view, add, and update data in tables
- Reports to analyze or print data in specific layout

Using access, database can be easily manipulated and managed. Microsoft Access also supports Microsoft DAO 3.6 Object Library. It is used to query the database in the Microsoft Access. The database that is created for this project is library.mdb. In this database several tables are created to store member data and activity. They are:

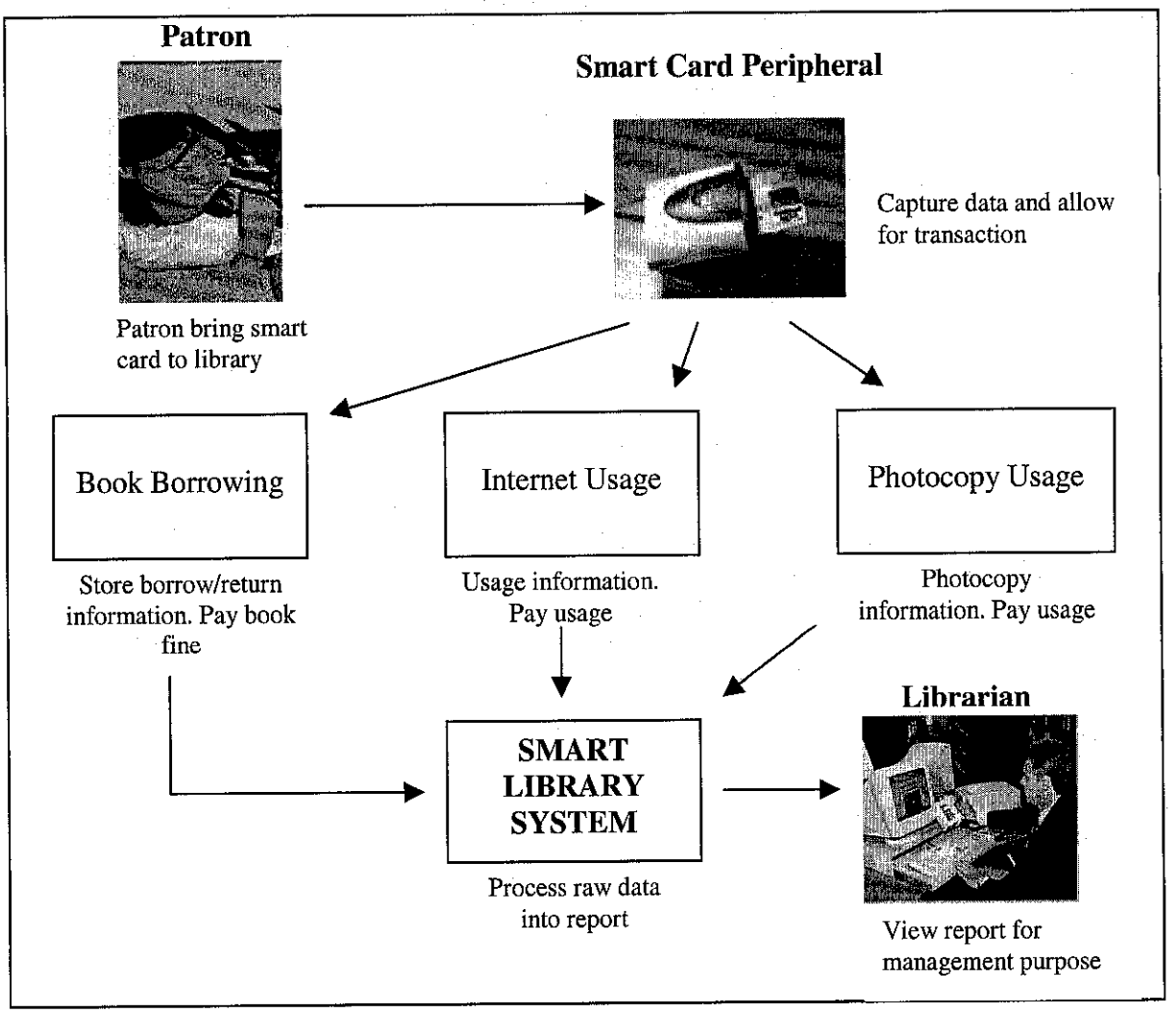
- Book – contains the data of all the books in the library.
- Patron – contains the data of the library's patron. PID is the field Visual Basic will retrieve for comparison with the data in the smart card.
- LibrarianPatronBook – contains the information of borrowing book form the library
- Fine – contains the information of book fine and late due of book borrowing
- Internet – contains all the information for internet usage such as time log in, time log out, duration and amount.
- Photocopy –contains information of Photostat machine usage such as date, no of pages and amount
- Librarian – contains information of librarian works in the library

CHAPTER 4

RESULT AND DISCUSSION

Application of smart card in library management has been shown by the author through the implementation of Smart Library System. In this system, the smart card is used by the patron to pay the facilities usage in the library. The smart card provides the cashless transaction in the library while maintaining the current system as well as the security of the transaction. This system contains a flexible mechanism for effective library management in terms of money collection gained from the facilities usage and its associating issues.

Figure 10: Conceptual Diagram of the system and all entities contributing to its establishment



4.1 System Front End

The user interface does play significant role in the system as per user ease-of-use of the system functions as well as for security purposes. It was designed as emphasizing to the management reporting needs. For this system, there are two separate modules created for the librarian or management, and patron.

4.1.1 Librarian/ Management Module

For librarian and management module, there are eight windows available:

- Login
- Main Menu
- Borrow and Return
- Add New Patron
- View Patron Details and Transaction Log
- All Patron Details
- All Librarian Details
- All Facilities Money Collection

4.1.1.1 Login

The purpose of this screen is to provide connection to the database data. Give the privilege, only then librarian able to precede the transaction. Besides, the login function is important for security purposes. It is ensuring only the authorized librarian is able to use the system.

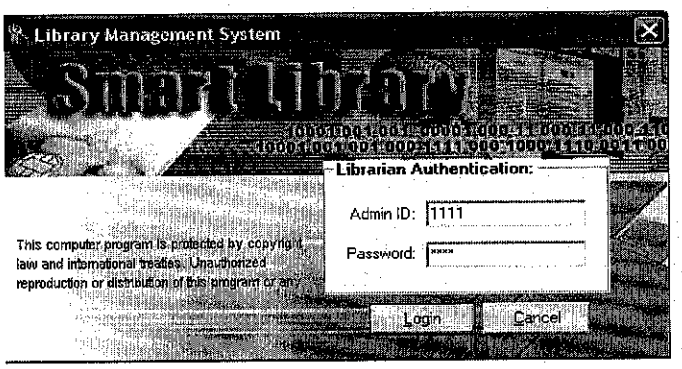


Figure 11: Librarian Login Page

4.1.1.2 Main Page

The menu screen appears, given the librarian access to the system functionality. This page contains six buttons for librarian to choose which activity to perform (Figure 12). The buttons are:

- Book Borrow/ Return
- Add new patron
- View Patron information
- Patron Listing
- Librarian Information
- Collection/ Income

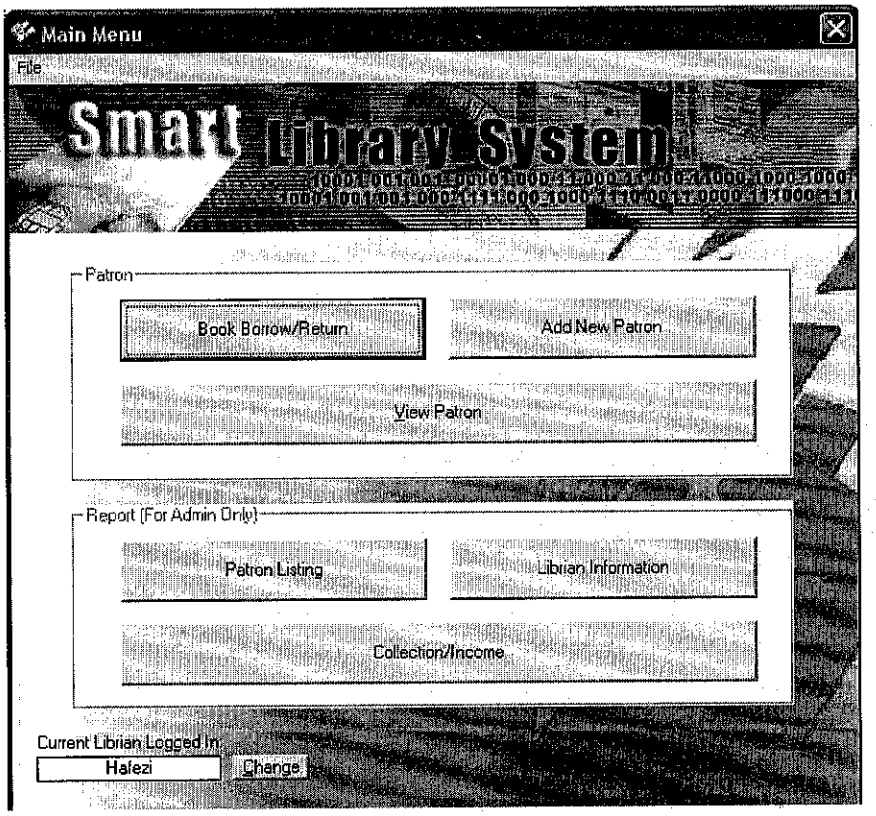


Figure 12: Librarian Main Page

4.1.1.3 Book Borrow/ Return

This window is use for borrowing and returning of book by patron. The first tab will show borrowing information such as patron details and book information. The system will detect whether the patron card has expired or not to ensure that the patron is granted to proceed the borrowing process. By default, the system will give 14 days of book loan.

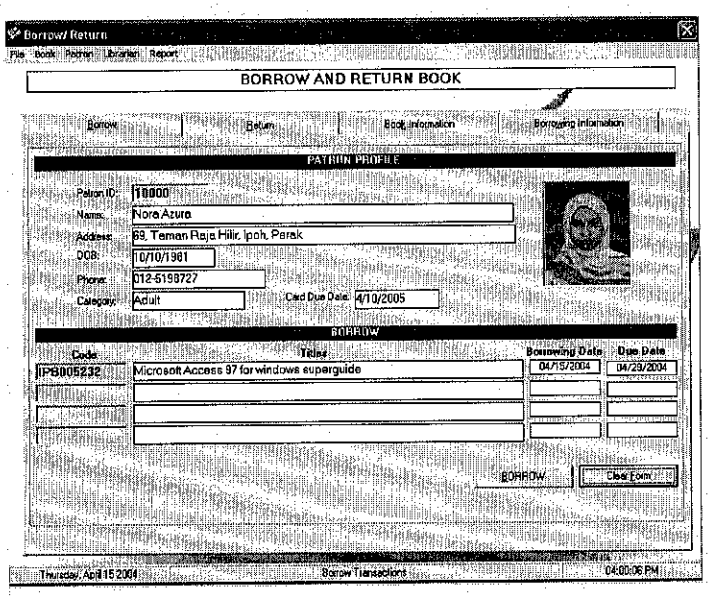


Figure 13: Book Borrowing Page

The second tab, will be used for book returning by patron. Again, the patron details as well book information borrowed by patron will be displayed. If there is a late return, the system will count the fine and it can be deducted directly from the patron's card.

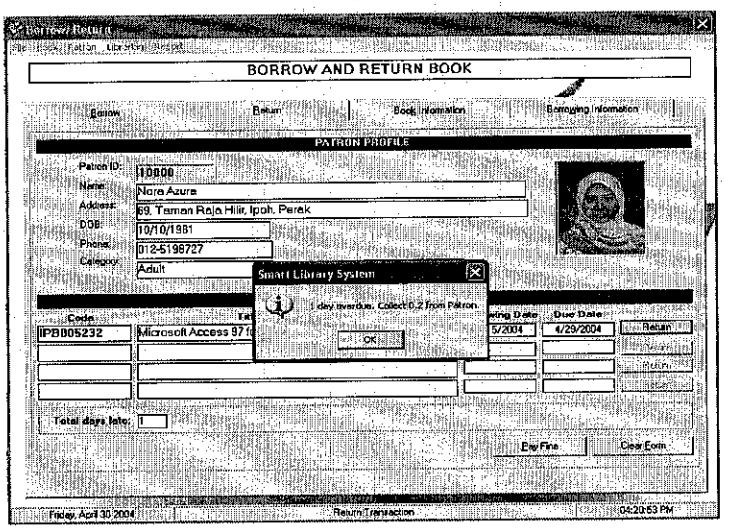


Figure 14: Book return and overdue count by the system

4.1.1.4 Patron Information

This window will display member information. Librarian must have patron's smart card in order to update any information. Information will be divided intro three headings in tab buttons.

The first tab button will display patron general information such as Patron ID, name, DOB, address, phone number and category (Figure 15). In this tab, librarian is allowed to change patron information provided that the librarian has the member smart card. Only patron ID cannot be changed as it is considered.

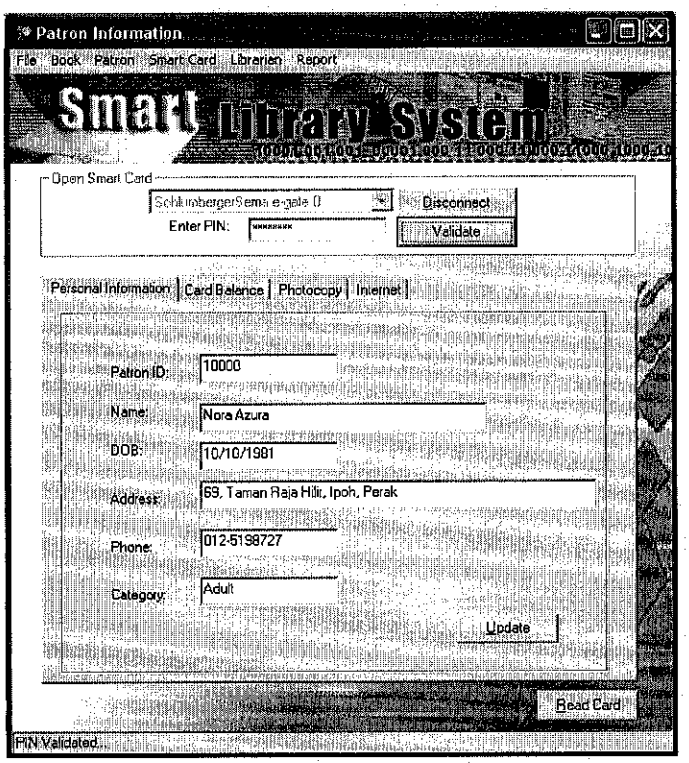


Figure 15: Patron information page for the first tab

The second tab consist information about balance report (Figure 16). The information available on this portion are card number, date issued, date expired, balance and reload amount. The system will read the current balance in smart card. Patron balance will be manually reloaded by the librarian upon request by patron. Librarian just need to key in the amount patron wants to pay and click the *Reload* button. It will store new balance in

database and patron smart card. When the balance has been updated, a window will appear to confirm the process (Figure 17). The *Get Balance* button is used to read the balance stored in smart card.

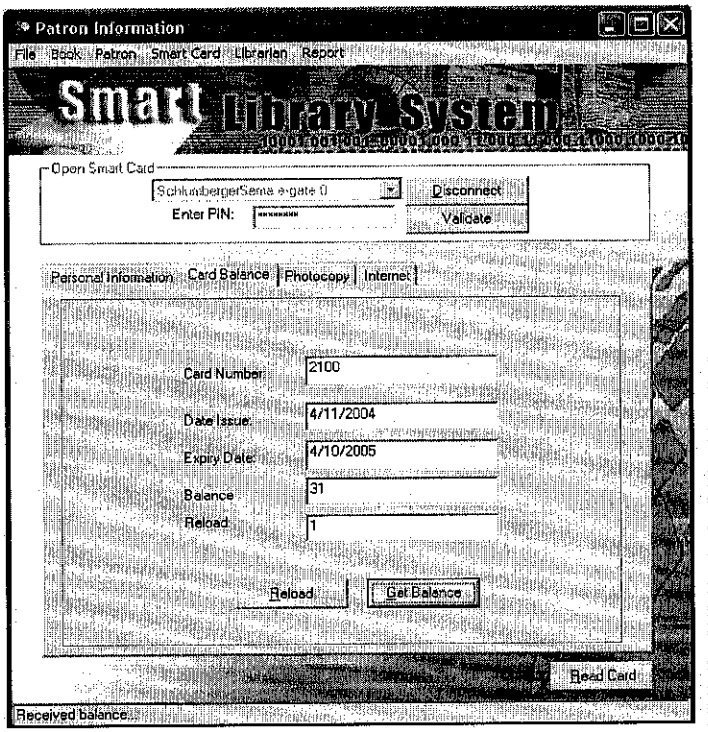


Figure 16: Patron's card information

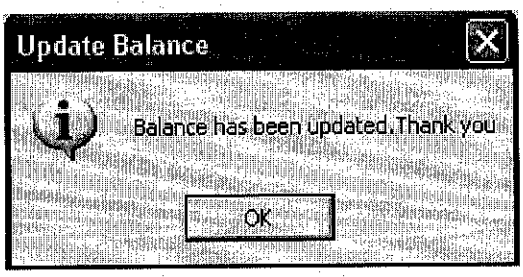


Figure 17: Update Balance confirmation window

This window also has transaction tab such as internet and photocopy (Figure 18). Each of time patron paid for the services in the library, transaction particular will be stored in the database. Through the transaction log information, the librarian will know how much the patron has paid for the services.

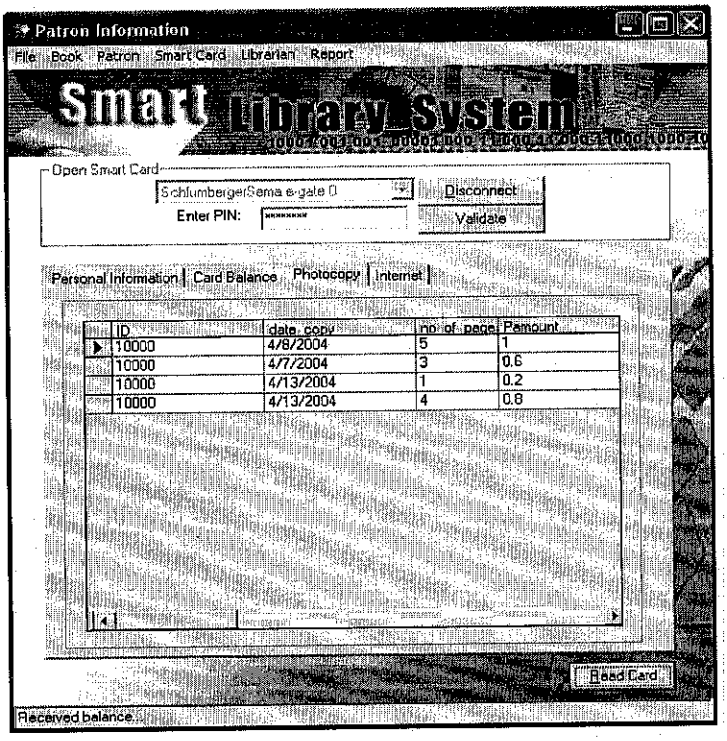


Figure 18: Patron Transaction information

4.1.1.5 New Patron Page

This window allow administrator to add new patron data and stored it in database and smart card (Figure 19). Thus, a smart card is needed to perform this activity. The patron data that librarian will has to enter are name, date of birth, category, address, phone number, date issued, expiry date and amount. Patron photo must be included for patron identification. Patron ID and card number will be automatically generated to maintain the uniqueness of the number. Exclusivity of these numbers is important in order to differentiate members that maybe have the same name.

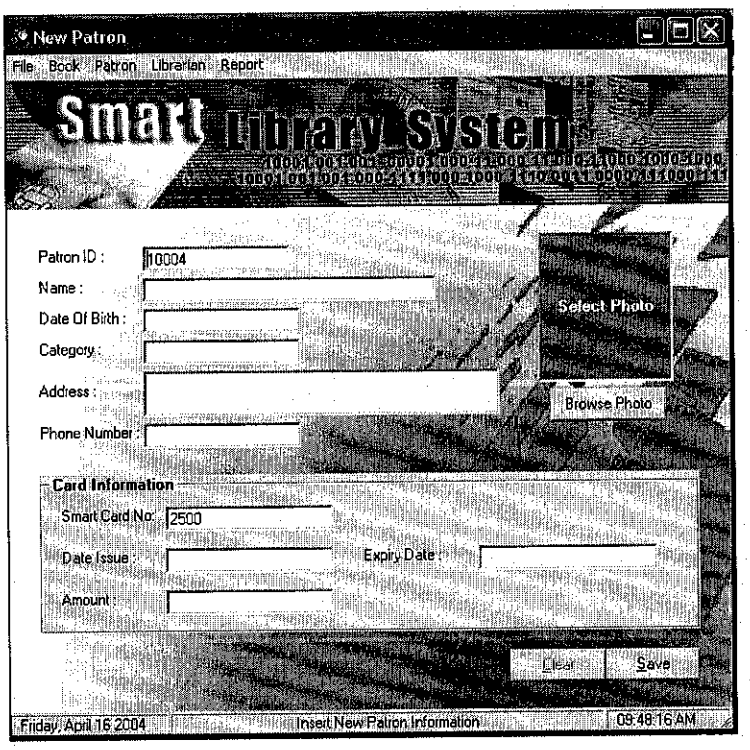


Figure 19: New Patron Page

4.1.1.6 Patron Listing

This window will display all patrons to the librarian. To view the patron information, data grid controls is used. ADO is used to connect the data grid to the Microsoft Access database. Librarian is not allowed to alter any data on this window because it is mainly for viewing purpose only. From this patron listing, Librarian would be able to know how many patron information and total patron the librarian has. The librarian also can browse the particular patron information using the search button. Please refer to Figure 20.

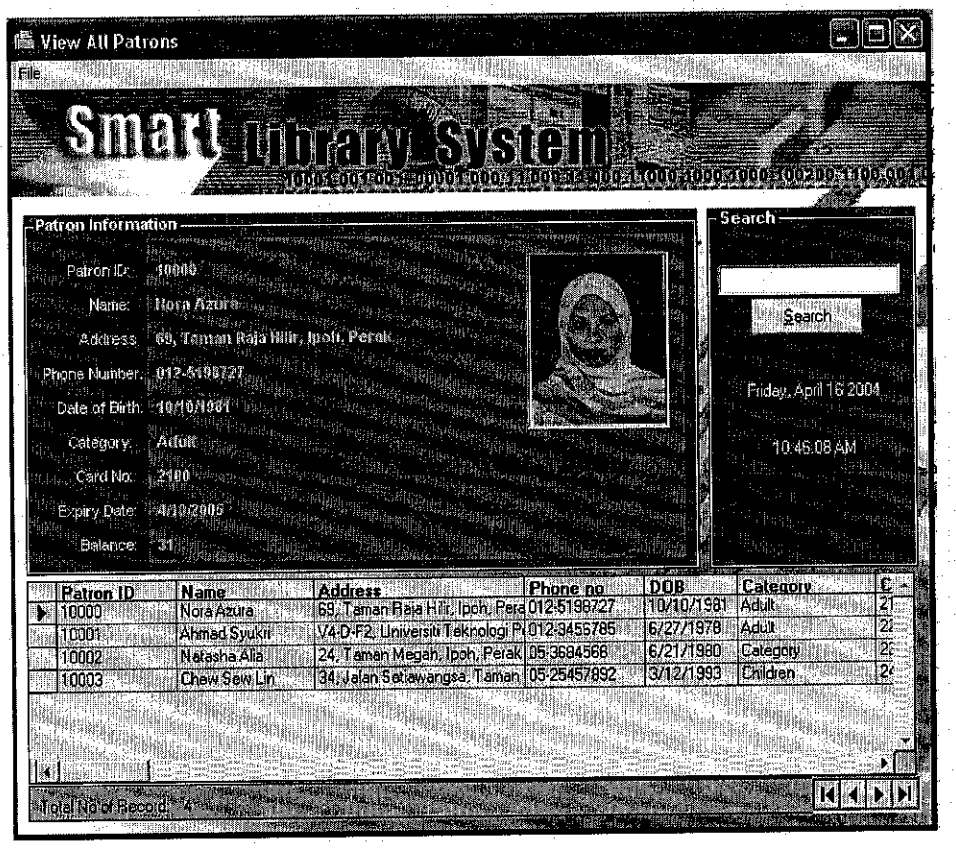


Figure 20: List of patrons available for librarian view

4.1.1.7 Collection or Income Report

The purpose of this report is to display the collection or income based on the facilities provided in the library (internet, photocopy and book fine). Librarian can view all the collection or income, and it can be specified the desired month for the report to display. It details out the list of income in the data grid. The button *Calculate* will calculate the overall income and this is useful for the library to project for future planning. For example, looking at the collection of photocopy material is high compared to others, it would be feasible for them to add new photocopy machine for patron use. Refer to Figure 21.

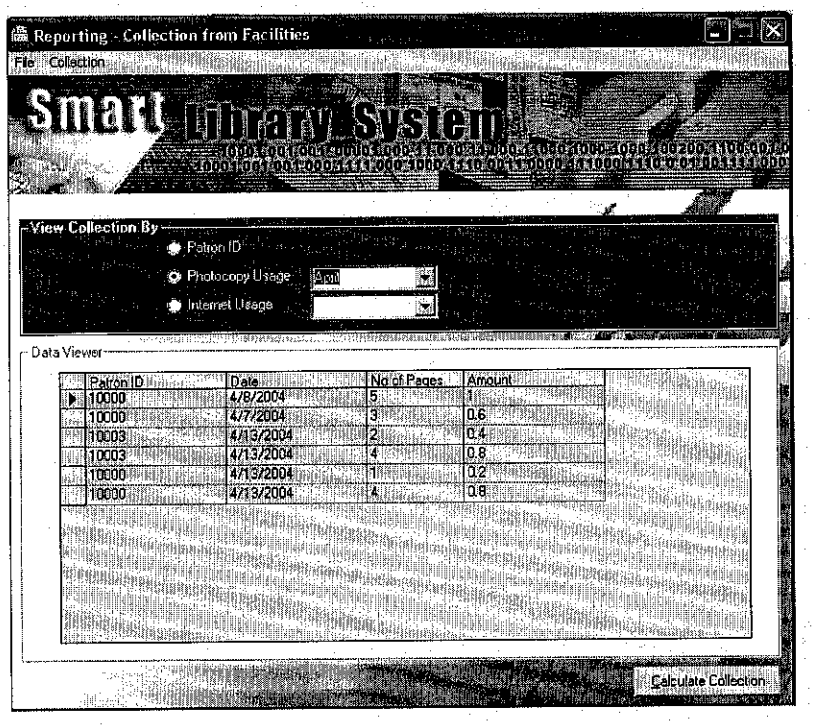


Figure 21: Collection or income report

4.2.1 Patron Module

For patron module, there are four windows:

- Patron verification
- Patron information
- Photocopy
- Internet

4.2.1.1 Patron Verification

This window will be authorized patron to use the photocopy machine and internet (Figure 22). This window requires patron to insert smart card before proceed with another transaction. The patron has to enter their ID and password before the system authenticates them to photocopy or to use the internet.

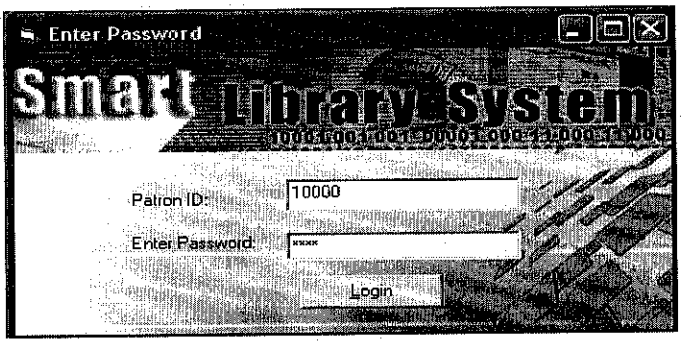


Figure 22: Patron's verification page

4.2.1.2 Photocopy Page

This window will allow patron to use the photocopy machine in the library. Patron has to click Pay button and the system will automatically deduct the amount it in. The transaction particular will be recoded in the database for future reference.

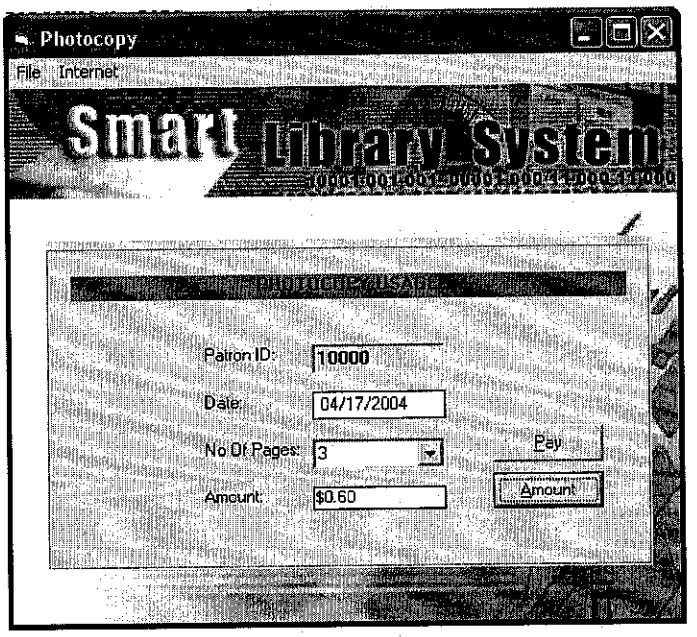


Figure 23: Photocopy Page

4.2.1.3 Internet Page

This window will allow patron to use the internet in the library. Patron need to punch in and punch out to capture the time. When patron clicks the Pay button, it will automatically pay the usage by deducting the amount in smart card. All the transactions detail will be recorded in database.

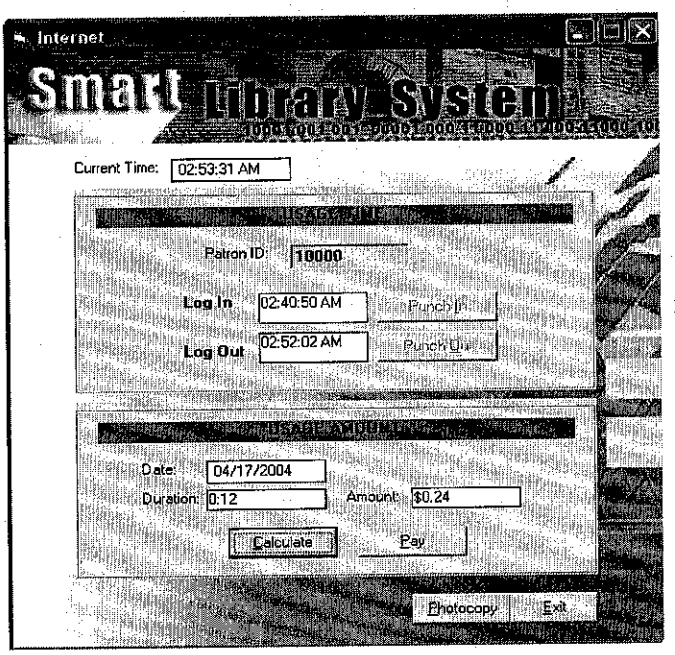


Figure 24: Internet Page

4.2 Discussion

Library has played a significant role as a center of knowledge. Therefore, a library should make all effort to keep this position by having an efficient management system. This means a library should has a proper management system to handle masses of patron's data, management data as well as book data.

The emergence of smart card will help the library to have a proper management. It will give the library perspectives towards efficiency and comfort. Through the result, it is found that creating a library system using smart card would benefit the libraries in terms of paper usage, man power, and also reduce the operation cost.

Library is a big organization that managing a lot of things starting from book inventory, cataloging, circulation and so on. This is labor intensive and time consuming. By having this system, it has contributed to the small parts of the library management where it can track all the collection gained from the facilities used by patron (see figure 21 for details). The transaction has been recoded and calculated by the system. Thus, it has reduced the time to manage the collection and ensure that fraud cases can be avoided. It also reduced the operational cost as no specific librarian will be in charged to specific machine (photocopy and computer). In other words, the library is able to reduce the total salary paid to the said librarian.

This project has been developed based on a few assumptions. It has been developed to show the functionality of smart card as debit card and how it can be applied in the library. The librarian used the bar code reader to scan and get the code ID of the book. In this system, it has to be keyed in manually by the librarian. Second, the Photocopy and Internet page has been designed in such a way based on the assumption that there should be a device attached to the machine to automatically deduct the money in patron's card. In real system implementation, patron should not be able to see the interface. As stated above, this project is only a simulation to show how smart card acts as a debit card in library. Therefore, such interface is needed to show how it works.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In this paper, the author has identified new requirements arising from money transaction in library management system. Manual money record will be kept each time the patron wants to use the library facilities such as photocopy material and internet usage. It is a tedious work for the management to manage and organized masses of patron's data as well as collection's data. The goal proposed system is to give ease of data management while providing convenience to patron.

Thus, the paper presented new flexible management scheme making use of smart card technology as an access token. The main advantage of this system is that it provides simple administration work of a centralized system. It is amazing that device of such as small size able to perform so many powerful jobs. Its technical achievement certainly plays an important role in improving our standard of life. Another proposed solution is automation credit deduction where patron's money will be deducted form their smart card according to duration of late return of books, duration of log in to internet and number of pages have been photocopied.

The prototype has validated the main concept presented in this paper where patrons are given flexibility to carry their "virtual money" in a piece of card. Computer timer functions will determine the number of days of late return and duration for log in the internet and later will deduct the money in smart card. Another application for librarian or library management has also been developed so that the management can view the current transaction occurs. For example, the librarian can view the current book available for borrowing.

From the research and findings suggest, the system would effect the library management and therefore, supports the library direction to become as a self reliant organization and creates a more productive services.

New smart card technology has always been explored and created for our ease in life. But some people would create technology for their own interest that would harm the society. Thus, it is important for us to learn this technology, fully understand the potential and able to exploit the benefits that a smart card could bring.

5.2 Recommendation

5.2.1 Development of Kiosk Centre

The main purpose of smart card is to provide convenience to the patron. The current system requires the patron to reload the balance through the librarian at the counter. Suggestion for kiosk center is for member to automatically reload their balance. The kiosk center will also be the placed for user to update their information. While all of these operations can be perform by a machine, administrator will be released from burden to do extra work.

Before any transaction is carried out, patrons must supply their card password in order to verify the patron. The kiosk will be granted permission to update user data if patrons have made changes. The kiosk should be able to accept either coins or paper money when patrons want to reload their balance.

5.2.2 Access Level and Time Management for Patron While Using the Internet

Current system is used by patron only to pay the internet using their library card. If the library management is concerned with protecting the library's computer network, there are

systems that help manage desktop security and restrict users to approved applications. To manage the patrons on Internet computers, there are time management and access level.

Time management systems typically let patrons know how long the session is and how much time is left. They log the patron off the computer when the session has expired. This will enable other patron to use the internet as well.

It is recommended that library card allows for patrons to determine the appropriate Internet access level for themselves and their children. Prior to the Smart Library System, Internet access at the library had no filters to safeguard against "questionable materials" for children. The smart card system that will be introduced as debit card should enable the library to better manage Internet resources, improve patron's experience, and comply with parent's requests for access control.

5.2.3 Printing the Internet Content

It would be feasible if the library can provide printing internet material when log in to the internet in the library. Print management systems typically include features to manage patron print jobs and payment. By determining the access level of patrons to visit the website, the library would also control the number of printing amount made by patrons. For example, patron is able to print using the laser jet printer up to 20 pages per day. Because this project requires automated payment thru smart card, printing internet material can be added.

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Appendix II: Data Dictionaries

a) Patron

- Name
- IC
- Card number
- Address
- Telephone Number
- DOB
- Expiry date
- Credit amount
- Fines

b) Book borrowed

- ISBN
- Book title
- Author
- Publisher
- Date of publishing
- Due date

c) Photocopy

- ID
- Date
- Number of pages
- Total amount

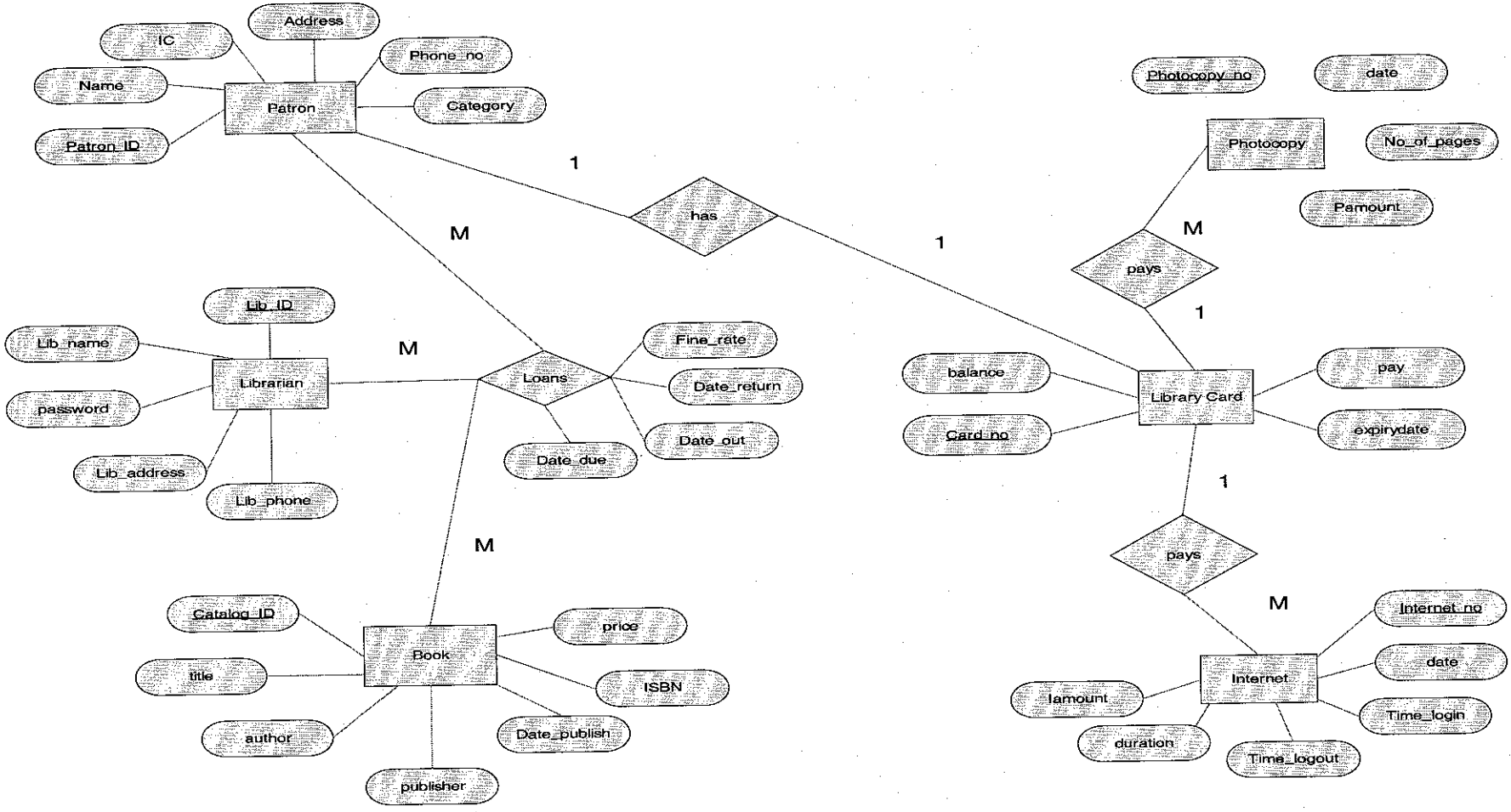
d) Internet

- ID
- Date
- Time login
- Time Logout
- Duration
- Total amount

e) Librarian

- ID
- Name
- Password
- Address
- Phone no

Appendix II : Entity Relationship Diagram



Appendix III: Portion of System Coding

----------Smart card Module----------

```
Option Explicit


Public Function HexCharToNibble(str As String) As Integer
 'convert half a byte
 Dim upperStr As String

 Let upperStr = UCase$(str)

 If (upperStr = "F") Then
  HexCharToNibble = 15
 ElseIf (upperStr = "E") Then
  HexCharToNibble = 14
 ElseIf (upperStr = "D") Then
  HexCharToNibble = 13
 ElseIf (upperStr = "C") Then
  HexCharToNibble = 12
 ElseIf (upperStr = "B") Then
  HexCharToNibble = 11
 ElseIf (upperStr = "A") Then
  HexCharToNibble = 10
 ElseIf (upperStr = vbNullString) Then
  HexCharToNibble = 0
 Else
  HexCharToNibble = Val(str)
 End If

End Function

Public Function HexStringToByte(str As String) As Long
 'convert two hex chars to a byte
 'must be exactly a length of two chars
 Dim loByteString As String
 Dim hiByteString As String
 Dim hiByte      As Integer
 Dim loByte      As Integer
 Dim result      As Long

 If (Len(str) = 0) Then
  str = "00"
 ElseIf (Len(str) = 1) Then
  str = "0" & str
 End If

 If (Len(str) = 2) Then
  hiByteString = Left$(str, 1)
  loByteString = Right$(str, 1)
  hiByte = HexCharToNibble(hiByteString)
  loByte = HexCharToNibble(loByteString)
  result = hiByte * 16 + loByte
  HexStringToByte = result
 End If
End Function

Public Sub HexStringToByteArray(str As String, myArray() As Byte)
 Dim Length As Integer
 Dim i     As Integer

 Length = Len(str) \ 2
 str = StripSpaces(str)
 ReDim myArray(0 To (Length - 1)) As Byte

 For i = 0 To Length - 1
  myArray(i) = CByte(HexStringToByte(Mid$(str, i * 2 + 1, 2)) And &HFF)
```

```
 Next i

End Sub

Public Function StripSpaces(str As String) As String
 Dim result      As String
 Dim Length      As Integer
 Dim beginSegment As Integer
 Dim endSegment   As Integer

 Length = Len(str)
 beginSegment = 1
 endSegment = 1

 Do While (beginSegment <= Length)
  endSegment = InStr(beginSegment, str, " ")

  If (endSegment = 0) Then
   endSegment = Length + 1
  End If

  result = result & Mid$(str, beginSegment, endSegment - beginSegment)
  beginSegment = endSegment + 1
 Loop

 StripSpaces = result

End Function
```

----------View Patron page----------

```
Option Explicit

Private WithEvents m_iopSys As IOPCOM3Lib.IOPSystem3
Private m_iopCard        As IOPCOM3Lib.IOPCard3

Private Sub cmdConnect_Click()

   If cmdConnect.Caption = "Connect" Then
   Set m_iopCard = m_iopSys.Connect(cmbReaders.Text, False)

      If Err.Number = 0 And (Not m_iopCard Is Nothing) Then
      cmbReaders.Enabled = False

      cmdConnect.Caption = "&Disconnect"
      cmdConnect.ToolTipText = "Click to disconnect from reader"


      cmdRead.Enabled = True
      cmdUpdate.Enabled = True
      cmdReload.Enabled = True
      cmdGetBalance.Enabled = True

      txtStatus.Text = "Connected!"
      Else
      txtStatus.Text = "Unable to connect to card."
      End If
   Else
      cmbReaders.Enabled = True

      cmdConnect.Caption = "Connect"
      cmdConnect.ToolTipText = "Click to connect to selected reader"


      cmdRead.Enabled = False
      cmdUpdate.Enabled = False
      cmdReload.Enabled = False
```

```
    cmdGetBalance.Enabled = False


    txtCardNo.Text = vbNullString
    txtBalance.Text = vbNullString
    txtReload.Text = vbNullString


    txtStatus.Text = "Disconnected!"

  Set m_iopCard = Nothing
 End If


' Private Sub cmdConnect_Click()
' Dim aid(0 To 6) As Byte
' Dim bResult    As Boolean
'
' If cmdConnect.Caption = "Open Smart Card" Then
'   Set m_iopCard = m_iopSys.Connect(cmbReaders.Text, False)
'
'   If Err.Number = 0 And (Not m_iopCard Is Nothing) Then
'    cmbReaders.Enabled = False
'
'    cmdConnect.Caption = "&Close Smart Card"
'    cmdConnect.ToolTipText = "Click to disconnect from reader"
'
'
'    aid(0) = &H11
'    aid(1) = &H22
'    aid(2) = &H33
'    aid(3) = &H44
'    aid(4) = &H55
'    aid(5) = &H66
'    aid(6) = &H77
'
'
'    bResult = m_iopCard.VisaOP.SelectAID(aid)
'    If Not bResult Then
'      txtStatus.Text = "Select applet AID" + m_iopCard.LastError.Description
'    Else
'      txtStatus.Text = "Connected and card applet selected!"
'
'      cmdRead.Enabled = False
'      cmdUpdate.Enabled = False
'      cmdReload.Enabled = False
'      cmdGetBalance.Enabled = False
'
'    End If
'   Else
'    txtStatus.Text = "Unable to connect to card."
'   End If
' Else
'
'   cmbReaders.Enabled = True
'   cmdRead.Enabled = True
'   cmdUpdate.Enabled = True
'   cmdReload.Enabled = True
'   cmdGetBalance.Enabled = True
'
'   cmdConnect.Caption = "Open Smart Card"
'   cmdConnect.ToolTipText = "Click to connect to selected reader"
'
'   txtCardNo.Text = vbNullString
'   txtBalance.Text = vbNullString
'   txtReload.Text = vbNullString
'
'
'   txtStatus.Text = "Disconnected!"
'
```

```
'   Set m_iopCard = Nothing
' End If
'
End Sub

Private Sub cmdMainMenu_Click()
   frmMainMenu.Show
   Unload Me
End Sub

Private Sub cmdGetBalance_Click()

 Dim CLA         As Byte
 Dim INS         As Byte
 Dim P1          As Byte
 Dim P2          As Byte
 Dim byteArray()  As Byte
 Dim emptyarray()  As Byte
 Dim iStatus      As Integer
 Dim bResult      As Boolean


 CLA = &H80
 INS = &H30
 P1 = 0
 P2 = 0

 ReDim byteArray(1)

 txtStatus.Text = "Getting balance..."

 bResult = m_iopCard.SendAPDU(CLA, INS, P1, P2, emptyarray(), 1, byteArray(), iStatus)

 If iStatus = &H9000 Then
  txtBalance.Text = Trim$(str$(byteArray(0)))
  txtStatus.Text = "Received balance..."
 Else
  txtStatus.Text = "SendCardAPDU " + m_iopCard.LastError.Description
 End If

End Sub

Private Sub cmdReload_Click()

 Dim CLA         As Byte
 Dim INS         As Byte
 Dim P1          As Byte
 Dim P2          As Byte
 Dim byteArray()  As Byte
 Dim emptyarray()  As Byte
 Dim iStatus      As Integer
 Dim bResult      As Boolean
 Dim db As Database
 Dim currbalance As Double
 Dim reload As Double


 CLA = &H80
 INS = &H10
 P1 = 0
 P2 = 0

 ReDim byteArray(0)

 If Len(Trim$(txtReload.Text)) > 0 Then
  If Val(Trim$(txtReload.Text)) > 0 Then
   If Val(txtReload.Text) > 255 Then
    txtReload.Text = "255"
   End If
```

```
    txtStatus.Text = "Depositing..."

    byteArray(0) = Val(txtReload.Text)

    bResult = m_iopCard.SendAPDU(CLA, INS, P1, P2, byteArray(), 0, emptyarray(), iStatus)

    If iStatus <> &H9000 Then
      txtStatus.Text = "SendCardAPDU " + m_iopCard.LastError.Description
    Else
      txtStatus.Text = "Deposit complete."
      MsgBox "Balance has been updated.Thank you", vbInformation, "Update Balance"


      Set db = OpenDatabase(App.Path & "\library.mdb")              'updating new balance into Database

      datPatron1.Recordset.FindFirst ("PID = '" & UCase(txtID.Text) & "'")

      currbalance = txtBalance.Text
      reload = txtReload.Text

      datPatron1.Recordset.Edit
        datPatron1.Recordset.Fields("Balance") = currbalance + reload
      datPatron1.Recordset.Update

      End If

    txtBalance.Text = vbNullString

   Else
     txtStatus.Text = "Amount must be greater than 0."
   End If
  Else
   txtStatus.Text = "Amount cannot be blank."
  End If
End Sub

Private Sub cmdUpdate_Click()
    frmViewPatron.datPatron1.Recordset.Edit     'save new patron info into database
    frmViewPatron.datPatron1.Recordset.Update
End Sub

Private Sub cmdValidate_Click()

  Dim CLA         As Byte
  Dim INS         As Byte
  Dim P1          As Byte
  Dim P2          As Byte
  Dim byteArray()  As Byte
  Dim emptyarray()  As Byte
  Dim iStatus      As Integer
  Dim bResult      As Boolean
  Dim aid(0 To 6)   As Byte

  aid(0) = &H11
  aid(1) = &H22
  aid(2) = &H33
  aid(3) = &H44
  aid(4) = &H55
  aid(5) = &H66
  aid(6) = &H77

  txtStatus.Text = "Validating..."

  bResult = m_iopCard.VisaOP.SelectAID(aid)
  If Not bResult Then
    txtStatus.Text = "SelectAID" + m_iopCard.LastError.Description
  Else

    CLA = &H80
    INS = &H40
```

```
 P1 = 0
 P2 = 0

 If Len(txtPIN.Text) <> 8 Then
  txtStatus.Text = "Length must be 8."
 Else
  HexStringToByteArray txtPIN.Text, byteArray

  bResult = m_iopCard.SendAPDU(CLA, INS, P1, P2, byteArray(), 0, emptyarray(), iStatus)

  If iStatus <> &H9000 Then
   If iStatus = &H6300 Then
    txtStatus.Text = "Wrong PIN"
   Else
    txtStatus.Text = "SendCardAPDU " + m_iopCard.LastError.Description
   End If
  Else
   txtStatus.Text = "PIN Validated..."
   cmdRead.Enabled = True
   cmdUpdate.Enabled = True
   cmdReload.Enabled = True
   cmdGetBalance.Enabled = True
  End If
 End If
End If
End Sub

"THE REAL ONE'
Private Sub Form_Load()

 Dim strReaders()  As String
 Dim ubnd        As Long
 Dim lBnd        As Long
 Dim i           As Integer

 Set m_iopSys = New IOPCOM3Lib.IOPSystem3
 If m_iopSys.LastError.Success = True Then
  cmbReaders.Clear
  If m_iopSys.ListReaders(strReaders) Then
   cmbReaders.ListIndex = -1
   lBnd = LBound(strReaders)
   ubnd = UBound(strReaders)
   For i = lBnd To ubnd
    cmbReaders.AddItem strReaders(i)
   Next i
   If cmbReaders.ListCount > 0 Then
    cmbReaders.ListIndex = 0
   End If
  Else
   cmdConnect.Enabled = False
   txtStatus.Text = "Cannot list readers"
  End If
 Else
  cmdConnect.Enabled = False
  txtStatus.Text = "Cannot list readers"
  MsgBox "Cannot list readers" & vbCrLf & m_iopSys.LastError.Description & " (0x" & Hex$(m_iopSys.LastError.Status) & ")"
 End If



End Sub


Private Sub mnuBorrow_Click()
   frmBorrowReturn1.Show
   Unload Me
End Sub

Private Sub mnuExit_Click()
   Dim iResponse As Integer
```

```
  iResponse = MsgBox("Are you sure you want to exit?", vbQuestion + vbYesNo + vbDefaultButton2, "Exit")
  If iResponse = vbYes Then End
End Sub

Private Sub mnuMainMenu_Click()
  frmMainMenu.Show
  Unload Me
End Sub

Private Sub mnuNewPatron_Click()
  frmNewPatron1.datNewPatron.Recordset.AddNew
  frmNewPatron1.Show
  Unload Me
End Sub

Private Sub tabPatron_Click()

  Select Case tabPatron.SelectedItem
    Case tabPatron.Tabs(1):                'Personal information selected
      framePersonal.Visible = True
      frameCard.Visible = False
      framePhotocopy.Visible = False
      frameInternet.Visible = False
      txtID.SetFocus
    Case tabPatron.Tabs(2):                'COntact information selected
      framePersonal.Visible = False
      frameCard.Visible = True
        txtBalance.Text = ""
      framePhotocopy.Visible = False
      frameInternet.Visible = False
    Case tabPatron.Tabs(3):                'Inventory menu selected
      framePersonal.Visible = False
      frameCard.Visible = False
      framePhotocopy.Visible = True
      frameInternet.Visible = False

      Dim db As Database
      Dim SQL As String

        Set db = OpenDatabase(App.Path & "\library.mdb")

        SQL = "Select * from Photocopy where ID like '" & txtID.Text & "%'"

        adoPhotocopy.CommandType = adCmdText
        adoPhotocopy.RecordSource = SQL
        adoPhotocopy.Refresh

    Case tabPatron.Tabs(4):
      framePersonal.Visible = False
      frameCard.Visible = False
      framePhotocopy.Visible = False
      frameInternet.Visible = True

      Dim db1 As Database
      Dim SQL1 As String

        Set db1 = OpenDatabase(App.Path & "\library.mdb")
        SQL1 = "Select * from Internet where ID like '" & txtID.Text & "%'"

        adoInternet.CommandType = adCmdText
        adoInternet.RecordSource = SQL1
        adoInternet.Refresh
  End Select
End Sub

Private Sub m_iopSys_CardRemoved(ByVal ReaderName As String)
 If cmdConnect.Caption <> "Connect" Then
  cmbReaders.Enabled = True
```

```
    cmdConnect.Caption = "Connect"
    cmdConnect.ToolTipText = "Click to connect to selected reader"

    cmbReaders.Enabled = False
    cmdRead.Enabled = False
    cmdUpdate.Enabled = False
    cmdReload.Enabled = False
    cmdGetBalance.Enabled = False

    txtStatus.Text = "Disconnected!"

    Set m_iopCard = Nothing
  End If
End Sub

Private Sub timTimer_Timer()

    Dim Today As Variant
    Today = Now

    txtDateIssue.Text = Format(Today, " mm/d/yyyy ")      'display current date in date

End Sub

Private Sub txtExpiry_Change()

    Dim IssueDate As Date, Expiry As Date
    IssueDate = Now
    Expiry = DateAdd("d", 365, IssueDate)

End Sub
```