# CLINIC TION SYSTEM RD

**NOOR FATIHAH BT MAZLAM**

**A report submitted in partial fulfilment**
**of the requirements for the award of the degree of**
**Bachelor of Computer Science (Software Engineering)**

**Faculty of Computer Systems & Software Engineering**
**Universiti Malaysia Pahang**

**NOVEMBER, 2009**

# ABSTRACT

In accordance with the advancement in technology, most companies or organizations have also been improving in the way they store data or important details belonging towards the organization more secure and not easy being intruded by people who are not related. By using the smart card is one way to ensure that data or important details that are just more secure and accessible only by those responsible. In this way, the probability of data to be accessed by people who do not respect is thinner. Smart card can be applying in few applications such as financial, identification, and also in health care. Smart health cards can improve the security and privacy of patient information, provide the secure carrier for portable medical records, reduce health care fraud, support new processes for portable medical records, provide secure access to emergency medical information, enable compliance with government initiatives and mandates, and provide the platform to implement other applications as needed by the health care organization. Clinical Laboratory Registration System is a prototype that allows patients' registration by using contactless smart card. The patients' data will retrieve from smart card, and the registration will do by clerk. After the patients' had done the clinical test, all the test result will save in CLRS's database. CLRS is developed to overcome problems since the process of patients' registration is still done manually. Besides, the test result of clinical test also saved manually in the log book. The problems that may arise during the registration are improperly filled the form and it will consume times to record the test results in the database. Besides, the test results become more secure because only the doctor and lab staff can view the clinical result.

# ABSTRAK

Sejajar dengan kemajuan di dalam bidang teknologi, kebanyakan syarikat ataupun organisasi juga telah memperbaiki cara mereka dalam menyimpan data atau butir-butir penting milik organisasi kearah lebih selamat dan tidak mudah dicerobohi oleh orang yang tidak berkaitan. Dengan menggunakan kad pintar adalah salah satu cara untuk memastikan data atau butir-butir penting itu tadi adalah lebih selamat dan hanya boleh diakses oleh mereka yang bertanggungjawab sahaja. Melalui cara ini, kebarangkalian data tersebut untuk diakses oleh orang yang tidak berkenaan adalah lebih tipis.Kad pintar boleh digunapakai di dalam beberapa aplikasi seperti di dalam bidang kewangan, pengesahan identiti, dan juga di dalam bidang kesihatan. Sebagai contoh didalam bidang kesihatan ,kad pintar dilihat dapat meningkatkan keselamatan dan maklumat rahsia pesakit, dapat mengetahui sejarah kesihatan pesakit, dan menyediakan platform untuk mengimplementasikan aplikasi lain yang diperlukan oleh organisasi penjagaan kesihatan. Sistem Pendaftaran Makmal Klinikal dengan menggunakan kad pintar ini merupakan salah satu prototaip yang digunakan bagi membolehkan pendaftaran pesakit dilakukan dengan menggunakan kad pintar. Selepas data diterima daripada kad pintar keputusan pemeriksaan ujian klinikal akan disimpan di dalam CLRS. Sistem ini dibangunkan dengan memanipulasikan kelebihan yang ada pada cirri-ciri kad pintar, untuk mengatasi masalah-masalah yang dihadapi oleh sistem manual. Masalah yang mungkin timbul semasa proses pendaftaran ialah pengisian maklumat yang tidak tepat dan kurang sempurna dan juga memerlukan masa yang panjang untuk merekod data-data pesakit. Sistem ini akan mendapatkan data dari kad pintar dengan menggunakan Pembaca Kad Pintar. Secara automatik, sistem ini akan merekod data pesakit dan seterusnya keputusan ujian klinikal akan disimpan ke dalam sistem oleh pegawai makmal klinikal. Selain itu, rekod keputusan pemeriksaan klinikal adalah lebih selamat kerana maklumat ini hanya boleh diakses oleh doktor dan juruteknologi makmal sahaja.

# TABLE OF CONTENT

# LIST OF TABLES

# LIST OF APPENDICES

# LIST OF FIGURE

# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

Clinical Laboratory Registration System (CLRS) is a system that is developed based on observation and research to meet the needed of the lab staff and also the doctors in Klinik Kesihatan Kuala Berang,Terengganu. This system will apply smart card application during patient registration, done by the staff. This system is handling the data entry which means the result of clinical test to be saved in the system. The numbers of the patients who get the treatment rapidly growth nowadays, where it's not already relevant to keep all patient's data and results of clinical tests by using conventional ways, log book and paper based form. It has high risk for the data to redundant and lost to occur.

At first, the staff will register the patient by using smart card and then wait for the treatment from doctor. After that, the doctor will ordered from the clinical laboratory the kind of clinical test needed by patient. Some of the clinical tests consume one to two weeks to execute the results. So when the patient came to the hospital for further treatment, they didn't need to come to the laboratory to take their result, but they just need to register, and directly can meet with the doctor.

The doctor can check patient's clinical test result by inserting patient's identification number to the system, where the result will save into the database. Then, the system will show the clinical test result.

## 1.2 Problem Statement

Problem statements in this research are stated as below.

1) The risk of probability of the clinical test to incorrect and may lead to human error occur are high because it is done in conventional way and unsystematic.
2) It took time to record all the clinical test result of the patient one by one in the log book and data inconsistency to occur is high.

## 1.3 Objective

The objective of Clinical Laboratory Registration System (CRMS) as below:

1) To develop Clinical Laboratory Registration System using contactless smartcard for Klinik Kesihatan Kuala Berang.

## 1.4 Scope

The scopes for this system are:-

System

1) Perform registration of the patients' registration by using smart card.
2) Allow patients' clinical test result store in the database by clinical laboratory staff.

User

1) Expected users of this system are the staff of the clinical laboratory and also doctors in Klinik Kesihatan Kuala Berang.

Environment

1) This system uses the clinical test result that only done in Klinik Kesihatan Kuala Berang.

## 1.5 Thesis Organization

The thesis contains 6 main chapters:

**Table 1.0** Thesis Organization for CMLS

| | |
|---|---|
| Chapter 1 | **Introduction**<br>In this chapter, it will discuss about the introduction the system, the objectives of the system and also the scopes of this system. |
| Chapter 2 | **Literature Review**<br>It will briefly describe about the research to the system that have been chosen. It will separate into two-sub research. |
| Chapter 3 | **Methodologies**<br>This chapter will discuss about the approach that will be used in this system. |
| Chapter 4 | **Implementation**<br>In this chapter, it will describe about the activities have been done during implementation phase. |
| Chapter 5 | **Result and Discussion**<br>This chapter will discuss about the analysis of the result and the constraint in the completing this project. |
| Chapter 6 | **Conclusion**<br>The last chapter will conclude what have been done in this system. |

# CHAPTER 2

# LITERATURE REVIEW

## 2.0 Introduction

This chapter will describe about the technology and tools which are suitable to implement in the development of CLRS. Nowadays, the numbers of patients who come to the hospital to get the treatment are increase. Some of the disease need to do the clinical test in the clinical laboratory first before it can know what the actual cause of that particular disease is, before the doctor can give their treatment to the patient. For example, the widely spread vector borne disease such as dengue fever also need to check the sample of specimens in clinical laboratory. So, the entire patient's data and the results of clinical test mush be saving safely in order to make sure that all the patients medical history are safe.

CLRS is a system developed to do the registration using smart card and also to manage the clinical test result wisely. The contactless smart card is suitable to be as one of the device to retrieve data, reliable and efficient to the registration system due to its function that can read the data. By inserting the smart card into the reader, it will read, retrieve and safe the data into it. So that, patients doesn't need to do the registration again and they just need to bring the smart card if they need to treatment at the hospital. So, the contactless smart card will replace the conventional way to register the patient. CLRS is aimed to change the conventional way during patient registration to paper-less way and also to assists the clinical laboratory staff to key in the data by using this system which will make it more accurate and efficient.

In addition, the integration of using smart card during patient registration and the organizing of the patients clinical test result in this system will aid the staff.

## 2.1 Practice of Clinical Laboratory Klinik Kesihatan Kuala Berang.

This study is done in Clinical Laboratory in Klinik Kesihatan Kuala Berang. Based on the current process, the registration on the patients is done manually, where: the patient need to register at the counter and the staff will record all the possible data about patients in the paper based form. Then, the patient need to wait a while before they can get in to meet with the doctor. After that, the doctor will order from clinical laboratory staff to do the clinical test to that particular patient.

Some of the tests need one or few days to get the results. So, the patients need to come again to get their clinical test and seek with the doctor again to get further treatment. During their second visit, the patients need to take their test result before meet with the doctor to get the further treatment.

Patients' clinical test results are not managed systematically in the laboratory. The staff will record the result in the log book according to the test types. Manual data collection may lead to the incorrectness of data inserted and possibility data to be redundant to occur also high. Besides, the data also highly risk losing, because it was saving in the log book. So, of the book was lost, all the save data will gone. On the other hand, the usage of log book to save data is not very practical. This is due to the ability the log book to misplace.

### 2.1.1 The current system in Clinical Laboratory Klinik Kesihatan Kuala Berang, Terengganu.

This process will start when patients come to the clinic to see the doctor and the doctor get the patient to do the clinical test in laboratory. This process will begin with;

1. Staffs will do the patients' registration. They record the entire patient's data in paper based form.
2. Patient's meet with the doctor. The doctor ordered the clinical test from clinical laboratory to be done to the patient.
3. Clinical test done and wait for result. Usually, it takes a few days to get the result.
4. After a few days, patients come to take the results at the clinical laboratory first before meet with the doctor for the further treatment.
5. The test result will record in the log book. According their test month the test was taken. If the doctor or other staffs want to refer this data, they need to find log book according test types and that particular month.
6. The processes will follow the flow for every clinical test done.

## 2.2 Contactless Card

A contactless smart card is in any pocket-sized card with embedded integrated circuits which can process and store data. This implies that it can receive input which is processed and delivered as an output via radio frequencies. There are two broad categories of contactless smart cards. Memory cards contain non-volatile memory storage components, and perhaps some specific security logic. Contrary to popular belief contactless smart cards do not contain an ordinary read-only RFID, but they do contain a re-writable smart card microchip that can be transcribed via radio frequencies. A "contactless smart card" is also characterized as:

i) Dimensions are normally credit card size. The ID-1 of ISO/IEC 7810 standard defines them as 85.60 × 53.98 mm.
ii) Contains a security system with tamper-resistant properties (e.g. a secure crypto processor, secure file system, human-readable features) and is capable of providing security services (e.g. confidentiality of information in the memory).
iii) Asset managed by way of a central administration system which interchanges information and configuration settings with the card through the security system. The latter includes card hot listing, updates for application data.

iv) Card data is transferred via radio waves to the central administration system through card reading devices, such as ticket readers, and ATMs .

These cards require only close proximity to an antenna to complete transaction. They are often used when transactions must be processed quickly or hands-free, such as on mass transit systems, where a smart card can be used without even removing it from a wallet. The standard for contactless smart card communications is ISO/IEC 14443. It defines two types of contactless cards ("A" and "B"), allows for communications at distances up to 10 cm. There had been proposals for ISO/IEC 14443 types C, D, E, F and G that have been rejected by the International Organization for Standardization. An alternative standard for contactless smart cards is ISO 15693, which allows communications at distances up to 50 cm.

Example of widely used contactless smart cards are Hong Kong's Octopus card, South Korea's T-money(Bus, Subway, Taxi), London's Oyster card, and Japan Rail's Suica Card, which predate the ISO/IEC 14443 standard. Like smart cards with contacts, contactless cards do not have a battery. Instead, they use a built-in inductor to capture some of the incident radio-frequency interrogation signal, rectify it, and use it to power the card's electronics.

### 2.2.1 Readers

Contactless smart card readers use radio frequencies to communicate with, and both read and write data on a smart card. When used for electronic payment, they are commonly located above "PIN pads" or near cash registers. When the readers are used for public transit they are commonly located on fare boxes, ticket machines, turnstiles, and station platforms as a standalone unit. When used for security, readers are usually located to the side of an entry door. Most readers display the card's symbol located to the right on the reader. All readers have indicator lights that indicate when a card is "tapped".

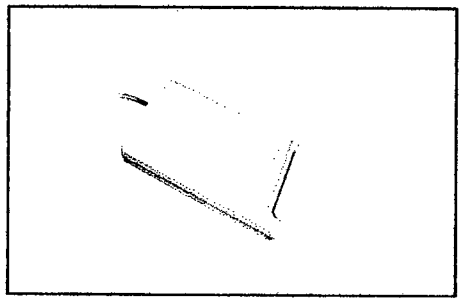

**Figure 2.0** Contactless card reader

## 2.3 Smart Card

A smart card is a plastic card about the size of a credit card, with an embedded microchip that can be loaded with data [1]. It is used for telephone calling, electronic cash payment and other applications and then periodically refreshed for additional use.

A smart card contains more information than a magnetic stripe card and it can be programmed for different applications. The data on the stripe can easily be read, written, deleted or changed with off-the-shelf equipment. Therefore, the stripe is really not the best place to store sensitive information. Some cards can contain programming and data to support multiple applications and some can be updated to add new applications after they are issued. Smart cards can be designed to be inserted into a slot and read by a special reader or to be read at a distance.

The microprocessor on the smart card is there for security. The host computer and card reader actually "talk" to the microprocessor. The microprocessor enforces access to the data on the card. If the host computer read and wrote the smart's card random access memory (RAM) , it would be no different than a diskette. Smart cards may have up to 8 kilobytes of RAM, 346 kilobytes of ROM, 256 kilobytes of programmable ROM and a 16 bit microprocessor[2]. The smart card uses a serial interface and receives its power from external sources like a card reader. The processor uses a limited instruction set for applications such as cryptography. Smart cards can be used with a smart-card reader attachment to a personal computer to authenticate a user.

The most common smart cards are memory cards. It contains EEPROM (Electrically Erasable Programmable Read Only Memory) and also non-volatile memory. Non volatile means

when the card removes from the card reader, power is cut-off, and card stores data. It just likes a normal data storage device which has a file system and managed via a microcontroller. This microcontroller is responsible for accessing. All communication is done over the microprocessor. There is no direct connection between the memory and the contacts. In ROM there is an operating system to manage the file system in EEPROM and run desired functions in RAM.

### 2.3.1 Smart Card Application

Smart Cards provide a new set of technologies with a great deal of promise. Smart Cards provide a secure, portable platform for "any time, anywhere" computing that can carry and manipulate substantial amounts of data; especially an individual's personal digital identity [1].Here goes some of application that implemented smart card in their operating.

- *Financial services* - Financial institutions are looking to use Smart Cards to deliver higher value-added services to businesses and consumers at a lower cost per transaction. These services include money on a card, corporate card programs, and targeted marketing programs based on analysis of consumers' buying patterns.

- *Affinity programs* - Airlines, retailers, and other companies that offer a range of ancillary services and loyalty programs along with their basic product want to use Smart Cards to deliver these programs with a higher level of service, improved ease of use, and at a lower

- *Cellular phones* - Cellular phone services in the United States are losing $1.5 million per day because of fraud. Although Smart Cards offer a mechanism to secure cellular phones against fraudulent use, only Java Cards offer the ability to download new functions into a phone in real time.

- *Set-top boxes* - Subscription satellite and cable services suffer from fraud problems similar to those in the cellular phone business. Once again, Java Cards offer security and the ability to add/update customer functions available to consumers in real time.

- *Secure network access* - Smart Cards can carry an individual's digital signature. With this ability, they provide a special mechanism to secure access to computer networks within a corporation, they help ensure that only individuals with the proper authority can get access to specific network resources, and they reduce the likelihood that hackers can break into a system.
- Other Applications of Smart Cards and Java Card technology include: Government, Healthcare, Information Technology, Mobile Communication, Banking, Loyalty Programs, Mass Transit, Driving Licensing, Electronic Toll Collection, Telephone Cards, and so on.

### 2.3.2 Future of Smart Card

Many organizations and academic institutions are discovering the usefulness of smart cards. Currently, individuals use their ID card for identification within the organization and as an electronic door key. They carry other credit type cards for purchases, phone calls, etc. The smart card can incorporate several applications on one card. Another promising aspect is the involvement of Microsoft in developing open standards for the interoperability of smart cards. Java support is another crucial tool for the development of new applications. A novel feature of smart cards is the ability for individual owners to create their own personalized applications and load them onto the smart card using appropriate devices.[2]

The ability of smart cards to contain differentially encrypted data offers the opportunity for the same card to provide access to multiple applications. A corporate employee could use a card for storing information about a health plan and other benefits, for gaining physical or virtual entry to different rooms or programs, and for controlling expenditures.

A different type of concern is prevalent among national banking authorities. Smart cards introduce a new type of currency that is invisible. However, one need not be overly alarmed since the monetary value carried by the smart card is still a form of the national currency. Smart card issuers and backers will have to set up reliable systems to fund the smart cards, using a national currency.

### 2.3.3 Smart Card Reader

Smart card reader is a electronic device that used to read data from smart card. There are external devices and internal drive bay card reader devices for PC. Some laptops have built-in smart card reader and generally the reader manufacturer provide along the Software Development Kit (SDK) for the development of smart card application [5].

SDK consists of application programming interface (API) and existing object libraries where these components are needed to access the data from smart card.

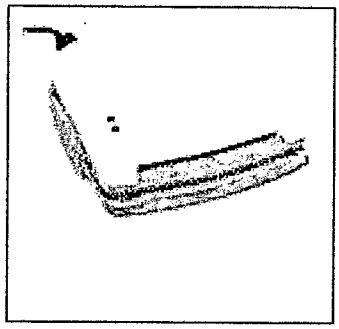

**Figure 2.1**: Smart Card Reader[5]

Secure Access Module (SAM) slot enhances the reliability of the authentication systems considerably. It contains a secret cryptography algorithm that enables data from MyKad to retrieve securely.

## 2.4 The Current Application using Smart Card

MyKad, or Government Multipurpose Card, (GMPC) is the official compulsory identity card of Malaysia. It is regarded as the world's first smart identity card. Part of the Multimedia Super Corridor flagship applications. Starting from seven years ago, Malaysia already used the GMPC. It was officially launched on September 5, 2001 by the vice Prime Minister on that time, Dato' Seri Abdullah Ahmad Badawi.

The Malaysian Government smart card employs state of the art technology that incorporates multiple layers of security feature. These features include the card authentication using symmetric key cryptography, multi applications Operating Systems with firewalls and a secure chip platform [3]. The GPMC will become the basis of a digital infrastructure being deployed by the Government of Malaysia. [3].

### 2.4.1 MyInfo System

Established since 2006, MyDBWare Solution is a Malaysian company actively involved in designing and developing software solution for a wide range of commercial applications [6]. It offers key consultancy services such as advance data collection (barcode solution), MyKad and MyKid software application or integration, Smart Card or contactless card and terminal application system which is MyDBWare developed and offered.

The MyInfo is a reliable and efficient system that can read data from MyKad for registration purposes. By inserting the MyKad into a special reader, the user's card details are retrieved and displayed on the screen as on the Figure 2.7. The information retrieved from the card can be stored for use at a later time. It comes with a powerful Report Designer module to customize by user need[6].

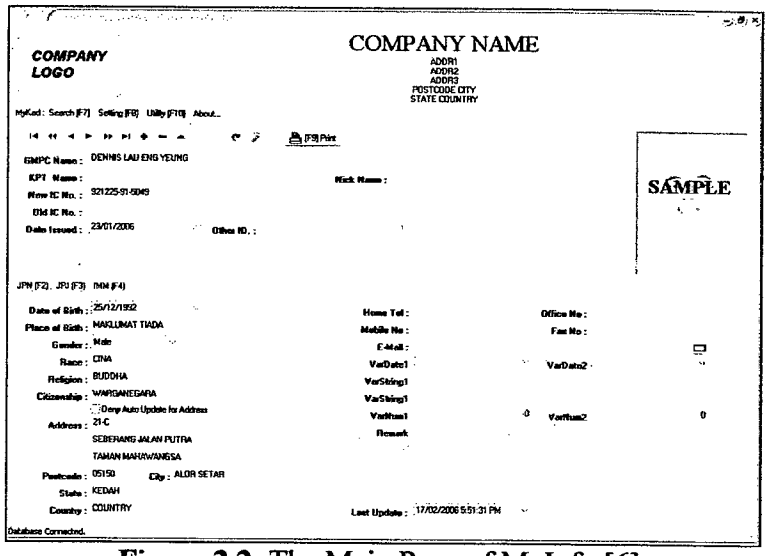


**Figure 2.2**: The Main Page of MyInfo [6].

Figure 2.8 and Figure 2.9 show that this system comes with powerful Report Designer. To display and print the information retrieved from the card, the workstation is used. To easy and integrate with other application, the database is using Microsoft Access.

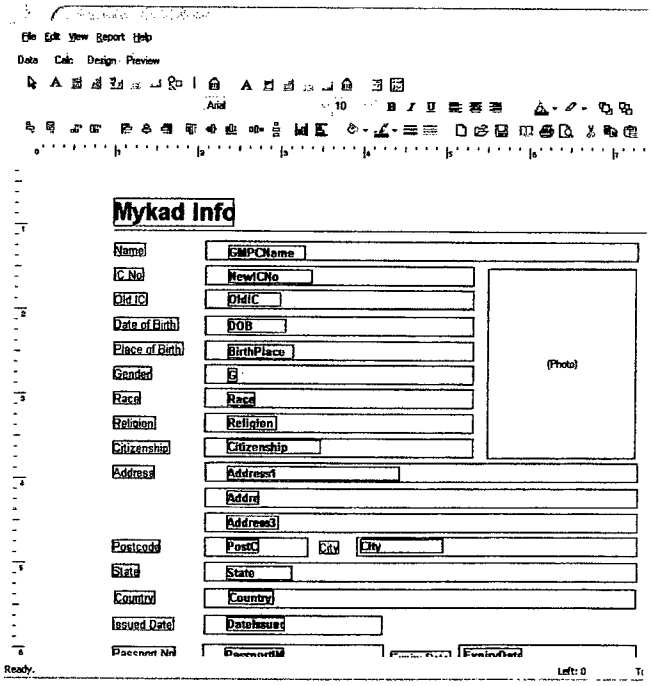


**Figure 2.3** Report Builder of MyInfo System [ 6]

## 2.5 System Description

CLRS is a system developed to do the registration using smart card and also to manage the clinical test result wisely. The contactless smart card is suitable to be as one of the device to retrieve data, reliable and efficient to the registration system due to its function that can read the data. By inserting the smart card into the reader, it will read, retrieve and safe the data into it. So that, patients doesn't need to do the registration again and they just need to bring the smart card if they need to treatment at the hospital. So, the contactless smart card will replace the conventional way to register the patient.

There are four main functions in this system. Firstly, patients' registration will do by the clerk. All the patients details will be save into the CLRS database and each serial number of contactless card will be assigned to the patient. Then, when the patient meet up with the doctor, the doctor just attach the contactless card and the details of the patient will appeared. During this flow, doctor needs to choose which clinical test types are suitable with the patients. After this test had been done the details will be saved into the database and the information will be sent to the lab staff.

After that, the doctor can view the clinical test result had been done by the lab staff. The result only can view by the doctor and also lab staff due to the privacy of the data. Next, the doctor needs to give the prescription to the patients and set the next appointment if patient need so.