

## Application of Smart Technologies for Mobile Patient Appointment System



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### ABSTRACT

The current standard operating procedure in healthcare environment for patient registration and appointment scheduling are time consuming and somehow tiresome. Normally, we see patients coming to the hospital and filling out registration forms and waiting to be called or patient calls in for getting appointment and waits for the response for an agreed date. In some places appointment can be done online via web but still patient has to walk in with the appointment card to be swiped by the front desk personnel before being sent to the concerned doctor. In view of these problems, many techniques like online patient registration and scheduling appointment, etc., have been suggested to improve the work flow and thereby smoothen the waiting time. However, these systems still possess some drawbacks like facilities towards prioritization, security level of patient and also no reminder system present for these appointments. Considering these drawbacks, we here propose to develop an alternate patient appointment system using Near Field Communication (NFC) technique and Android enabled mobile application with a view to redefining the core of hospital waiting time towards appointment and also collection of medicines. These are carried out in practice using appropriate NFC hardware, Android SDK, Php and MySQL database.

*Key words* : NFC, Android SDK, Php, MySql.

### 1. INTRODUCTION

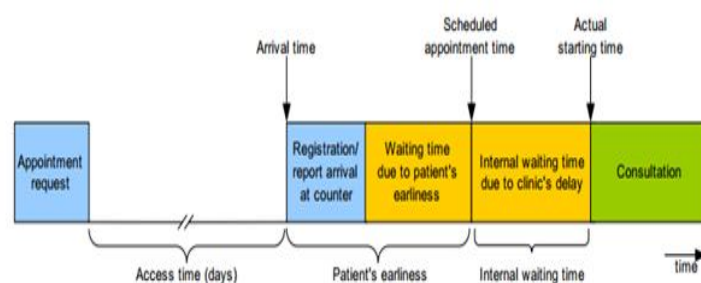
Patient management in respect of health records, patient appointment and priority calls are all very crucial in order to maintain the overall level of health care in the country. However, to aim the level of efficiency and effectiveness, there are certain areas which need a proper time management and quality performance. As such, most complaint issues recorded are the dissatisfaction in the length of time spent between patient arrival and actual starting time of consultation [1][2]. According to Clinic Audit (2012) [3] Brunei Darussalam has recorded an average of 2,710 general cases in outpatient department with the mean waiting time of 58 minutes per sessions. Furthermore, it has been reported that appointments slots are not organised that patient are not able to schedule an appointment within a week or be changed into later date for more than once. Patients are dissatisfied by

the inconveniencies and unavailable time of appointment slots, especially for patients with urgent needs. This has resulted from the lack of adequate information and managerial flow in standard operating procedure (SOP) which arises in delayed management of report updates, and an elevated delay in outpatient consultations.

Figure 1 describes the general patient flow through the outpatient services up to the moment of consultation [4]. Typically, patient will contact the healthcare administrator to schedule an appointment and waits for any replies towards confirmations which usually takes days or even months (i.e. Access time). Once appointment is confirmed, patients must first fill in registration forms upon arrival. Then between registration process and consultation, the total patient waiting time is divided into

- Patient's earliness – Time recorded between early arrival and scheduled appointment time.

- Internal waiting time – Period between scheduled time and the actual starting time of consultation.



**Figure 1:** The patient flow through outpatient clinic

The current procedure in outpatient department is depending on first-come, first-served basis, whereby there are two ways of having a professional consultation:

- Walk-in appointment where patients are required to fill in registration forms or presenting identification card to the registration staff which will then be given a less complex registration form. However, most of the time, this procedure is repeated for every outpatient visits. Hence, it will result in more paper-based forms and less organised management.

•Scheduling an appointment beforehand in which patient has to call in, ask for any available dates and waits for the response from the administration staffs. In other cases, appointments are made by the doctors, only for patient with frequent monitor.

The average waiting time for walk-in patients yearly has increased to 45 minutes per patient. During these two procedures, there are no prioritization made and paper work needs to be done in order to register a visit [5]. Following the challenges faced by the hospital staff, a great deal of work need to be done to handle a huge stack of patient files and records for health history, provider notes, appointment records, admission and discharge information, laboratory and radiology report information, index of summary and patient hospital visits. So taking these challenges, there has been a vast amount of technological advancement adapting the outpatient department aimed to refine the work flow of standard operating procedure (SOP).

For the last two decades, Information and Communication Technology (ICT) has made such innovation that it becomes accessible to worldwide organisation and individuals, including healthcare industry. In the last few years, there are major improvements in healthcare industry to ensure the quality of performance and effective standards of medical care and services. Goldsmith (2000) [6] stated that the Internet, in general, has a great impact in transforming both the structure and standard of procedures (SOP) of healthcare than any technology been adapted few years ago. However, due to the resistance associated from protecting the patient, records confidentiality cease the full potential of Internet in healthcare.

Online registration and scheduling appointment has been one of the options for the patients to avoid the hassle of queuing and filling out registration forms. It also gives the advantage for administrator to monitor and easy searching of any medical records or personal information as it is available online. However, it becomes inefficient as the transfer of data can be in filtered and accessible online and hence, the risk of online hacking is very huge. In addition, prior to online registration and appointment scheduling, there has been no advancement which provides any prioritization facility and so there is still a delay in entertaining them before they are being called for outpatient consultation. Last but not least, there is no reminder system on any platforms for appointments which has been confirmed by the healthcare administrators [7].

BruHIMS (Brunei Health Information System) has also made an attempt in acquiring the needs of healthcare management system by introducing an interactive scheduling for appointments and automatic transfer of prescription form from doctors to pharmacists. Moreover, the system also provides prioritization categories which are entered manually to the system. However, even though patient registrations are to be inserted onto a dedicated server, patient still required to

fill in a complex registration forms. Appointment management are still be made manually, whereby patients have to called in to schedule an appointment. In addition, with the realisation in collaborating ICT in healthcare, outpatient staffs are able to access to patient medical records, and making a quicker decision to lower the outpatient waiting times rate as it may reduce steps in procedures with consistent management.

It is now well recognized that Internet has not only connect people and data, but also objects in general. Radio Frequency Identifier (RFID) and Near Field Communication (NFC) are expanding significantly as they have been applied to various areas including healthcare industry [8]. According to 2012 World Economic Forum, many industries now rely on integrated information technology (IT) systems and infrastructure to monitor, control, manage and deliver their services [9].

Based on the above statement, an “Application of Intelligent Agents in Hospital Appointment Scheduling System on Android handset” [5] was developed in order to eliminate the need of healthcare staff in performing similar tasks and admission activities repeatedly. The project aims to improve the speed of processing any unscheduled appointment and take prioritization level towards making an appointment into account. The system takes into account the type of patient in prioritizing towards making appointment which is based fuzzy rules and constraint. The system also possesses facility for seeing the list of appointments from doctor’s handset and patient’s handset. In addition, systems also possess facility for sending appointment confirmation. The system got drawbacks of no reminder system for patients or doctors towards upcoming appointment. In addition, with prioritisation in place, there is still going to be some waiting time for patients but bit better than traditional paper based system.

So taking the weakness in the healthcare systems and by combining integrated technology i.e. NFC and ICT for healthcare industry, we here have developed NFC Technology and Mobile Android Application [10] which aims to refine the core management of Standard Operating Procedures (SOP) where patients need not have to register to the registration administrator, but rather scan his/her NFC device on the kiosk screen, which shows the prioritization level or any appointment scheduled. In addition scheduling using mobile application (using Android 4.1) be developed too where patients can make an appointment online and have weekly reminder system of their medical collections or urgent matters. This is much better system compared to any other systems in vogue which makes health care process faster and also efficiency is much better.

The rest of paper is organized as follows. Section 2 talks on literature surveyed on ICT usage in the health sector towards patient appointment. Section 3 talks on the proposed NFC

based patient appointment System followed by the architecture of the proposed system and its functioning. Section 4 gives the concluding remarks and future work.

## 2. LITERATURE SURVEY

We will survey in brief in this section on the various literatures citing the ICT usage in health sector which motivated us NFC technology for patient appointment

### 2.1 Paper Based Appointment System

Before considering technology advancement for healthcare industry, we must understand what healthcare Standard Operation Procedure (SOP). It is a written set of instructions that healthcare staff should follow to complete a job safely, with no adverse effect on personal health or the environment, and in a way that maximizes operational and production efficiency. SOP in outpatient clinic includes registration procedure and appointment scheduling process, which currently paper-based. Files and patient's health records are stored in physical storage, and will be transferred by nurses' or administrator to the doctor's office for consultation. This system is obviously inefficient and time-consuming, and the risk of misplacing records is transparent.

Registration process using paper-based system mostly requires patients to fill up the forms and submit to the registration table or they could simply place their identification card or appointment card in the box provided and wait for their name to be called. The question is what if the card is misplaced or taken by any unauthorised personnel? One of the issues being presented is that If patient's records are not to be found or unregistered patient, the current admission staff will delay his/her consultation time. Based on the survey report in 2007 [1], the most complaint issues are the time spent in the waiting room and 19% of the patients complained that they could not get an appointment within a week time. In addition, thousands of patients' appointments are changed to the later date for more than once. Outpatient satisfaction with healthcare procedures was not only associated with waiting times but over one-third chose to not fulfil the appointment schedule as they expected to have to wait for long periods. This issue still remain a challenge to healthcare industry worldwide

### 2.2. Online Appointment System

One of the applications being introduced is online scheduling and registering system (RegisterPatient.com). This is a 24 hours and 7 days per week system whereby healthcare administrator is notified automatically on upcoming appointments and registered patient via online system. It allows patient to complete registration forms at their own convenience without having to queue. Once it has been completed, the patient will be notified with a map to the nearest healthcare facility. However, there are some consequences towards this system. Firstly, registration

required patients to fill in important data such as credit card number, identification card number and etc. Since the system is web-based, these numbers can be hacked by malicious websites. Secondly, most of the online registration and scheduling appointment system requires payment to the provider per month. Third, online scheduling system is only limited to less diagnosed symptoms such as abdominal pains, nausea, vomiting, diarrhoea and etc. So if there are symptoms which are not included on the list, patient has to call in for any available appointment slots and wait for confirmations. For such cases of emergency and urgent need of consultation, this inefficiency may lead to problems for both patients and healthcare staff. Finally, this system does not provide any prioritisation towards scheduling the appointments.

Current on-going system in Brunei is BruHIMS [11] (Brunei Health Information Management Systems), which aims to enhance the management of patients' information in all healthcare industry as a centralised national system. It includes the development of clinical access and appointment slot scheduling. This system provides validation of availability and non-availability slots for both parties: patients and medical professionals (i.e. doctors, nurses and pharmacists); and allows instant retrieval of patient information on nurses' and doctors' workstations. Appointments for every healthcare facility in the country will be scheduled from a centralised desk and can be distributed across multiple locations whereby each healthcare location can schedule appointments independently through the appointment administrator. This system will reduce the wastage of time slots due to non-availability of either party. Hence, from the above statements, this system helps in managing patients flow by scheduling appointments beforehand and supports advance preparation of healthcare locations. However, it has been found to have such drawbacks and inefficiency to the system. First, scheduled patients must present their appointment cards which embedded with barcode to be scanned for alerting presence. The problem will arise when the card is accidentally misplaced, and as a result, patients are to be entered as outpatient instead. Secondly, in the case of urgency needs or any means of appointments, the patient is required to schedule physically at any healthcare facility or by call in and waits for the confirmation from nurses for available slots. Third, there will be a delay of consultation due to slow access to the current electronic system. In accessing patient's records and data, one must set and present his or her identification card to the administrator and queue. Finally, priority levels are set manually according to age and status of registration, but not the level of sickness. Currently there is not much research work available in the development of prioritisation in any healthcare facilities around the globe[12].

### 2.3. Mobile Appointment System

Recently, healthcare industry has slowly moved towards implementing cloud-based platforms, regardless of security issues that may or may not happen. With the existence of such system, storage size and ability to manage records and data

centrally will be tackled. This system will not only increase the efficiency of shared data between healthcare practitioners nationally, but may also reduce the operational costs of the healthcare industry generally as there will not be any redundancies. However, cloud networking are still raw that only some IT professionals has ability to comprehend the database structure and security aspects.

“Application of Intelligent Agents in Hospital Appointment Scheduling System” [5] developed employs an intelligent agents which eliminates the needs of human agents towards performing the similar search activities in scheduling processes aims to improvise the work flow and thus saving the healthcare staff’s time and effort. This system provides the negotiation and scheduling of appointments using mobile application, Android 2.2 Froyo. This system is based on fixing the priority level of patients in appointment scheduling. The agents developed are based on using fuzzy preferences, to gather information from patients and schedules appointment with the healthcare facility. The implementation and validation was carried out using JADE-LEAP in Android 2.2 Froyo mobile operating system. There are some drawbacks found in this technology. First, non-registered patients are required to schedule an appointment at least 24 to 48 hours before the scheduled time. Once approved, they will automatically become a registered patient. In urgency cases, this technology obviously cannot be applied. Secondly, it only considers one central healthcare facility, regardless of clinics and other location of healthcare facilities nearby. Finally, there are no automatic system calls as reminder before the schedule date which is as much important since it is a paperless network transaction.

#### **2.4. Near Field Communication Technology (NFC)**

Near Field Communication (NFC) the subset of Radio Frequency Identifier (RFID) [8][9] whereby data exchange can be established in shorter range than RFID. A high radio frequency is initiated by touching one passive and one active device in approximately 10 centimetres apart. The potential of NFC is widely known and applied in areas such as access control, consumer electronics, healthcare, information collection and exchange, loyalty and coupons, bill payment and transport payments as well as posters advertisements for its small detection range than radio frequency identifier (RFID) with transfer bit rate of 106 kilobits per seconds, driverless operation feature and anti-collision feature where only one card will be detected when multiple cards are presented but still maintaining its security features

Using magnetic induction, contactless smart card communication generates through radio frequency field, over the air, rather than through slots of smart card reader. The communication modes of NFC cards are classified into two types of modes: (1) Passive Communication Mode and (2) Active Communication Mode. A passive communication mode occurs when the initiator device (i.e. the NFC passive cards) initiates an electromagnetic (radio frequency) field and the target device (i.e. NFC reader) responds to the field. The

NFC card in this mode does not require any batteries or any sort of external power source. Every passive card is connected to a coil with a few turns (i.e. the antenna) needed to collect all electromagnetic (radio frequency) field initiated by the NFC reader antenna in order for it to “wake up” and responds the field back to the reader. An active communication mode is when both initiator and target device generates their own magnetic field and responds to each other alternatively. The initiator device will only activate when there is a transfer of data from the target device; hence, both devices need to have a power supply, for example smart phones. Both modes works on the same principle, which is the card, will receive instructions from reader and checking its validity. If validation is true, the card will respond to the next appropriate instructions (i.e. whether to read or to write).

Contactless smart cards are widely used around the globe, where most of the NFC applications use passive communication modes for ID cards, telephone cards, public transportation fares or any financial transactions, for example Taiwan’s EasyCard, South Korea’s T-Money and Hong Kong’s Octopus Card since the complete transaction speed of authentication, read, write, and verification, is less than 100 milliseconds and does not require much electric consumption. However, even though NFC contactless smart card has existed for almost a decade ago, there are still some security issues [13] that have to be tackled such as eavesdropping, interruption of operations and denial of service attacks. So from the literature surveyed it is clear that there has been quite amount of research carried out in automating the patient appointment system. But still these systems got some drawbacks of patients waiting time and also towards registration and so. In some systems there has been introduction of prioritisation of patients towards appointment too. So with the advent of NFC technology and mobile development, NFC based mobile patient appointment system been developed which is far more superior compared to earlier appointment system. These will be discussed in forthcoming sections

### **3. NFC BASED MOBILE PATIENT APPOINTMENT SYSTEM**

A well- designed appointment and walk-in patient system intent to achieve small direct waiting time for unscheduled cases (especially when it involves with urgent and emergency operation) without increasing the direct waiting times of scheduled patients or lowering the resource utilizations. After thorough research from previous work in enhancing healthcare standard of operation either using traditional paper based technology or advanced paperless technologies, healthcare still face problems. There are still issues for walk-in patient whereby they have to wait for a very long period of time for their turn to come up. Patient may schedule the appointment; however, they still have to wait for their appointments to be confirmed from healthcare administrator which may take weeks or even months for any available slots.

Both scenarios do not work with parties involved. The party which includes involves the patient, healthcare personnel and the healthcare centre as a whole.

This proposed system would bring in Near Field Technology (NFC) device as a queuing system for accessing patient's health records and reports which will alert nurses, doctors and pharmacists upon their arrival on a web application. This system will only be focused on the basic outpatient standard operating system such as registration, sorting out priority levels, scheduling appointment, and confirming or rejecting any upcoming appointments which is been discussed below.

### 3.1 Architecture of NFC based System

Appointments are divided into three groups: (1) Medical Consultation, (2) Medical Check-up and (3) Early medical collection. Medical Consultation is main operation in outpatient clinic where doctors can explore the patient's concerns and problem in order to identify the reasons of illness, then adding their diagnosis to medical records. Whereas medical check-up is essential process for patients who are accepted to work as a government employee or applying a scholarship overseas. Finally, early medical collection is for patient who is monitored for their health by supplying a monthly or yearly basis of medications. These categories will ease the patients as it can inform the administrator on last minute scheduling. Based on the above statements and functionalities, we have developed architecture for our system developed as shown in Figure 2



Figure 2. Architecture of NFC based appointment system

Figure.2 shows the patient arrives at the healthcare centre and taps his NFC card onto NFC reader provided in the main entrance, data will be recorded as outpatient lists. The records on the list will be compared between the identification of NFC card and Medical Record Identification. Once it had found

matched IDs, it will be displayed out on nurses' web application for basic check-up and sorting prioritization level. In the case of unregistered patient, administrator will have to enter his basic information to the database via web application. High priority patient will be served first than medium and low priority level patients. Once patient consultation is finished, patient records will be updated and prescription is sent through the system to pharmacy. This is to prevent any security issues which may involve in the process of patient hands the prescription himself. The system will also automatically check whether the patient are required to pay or otherwise. Since the NFC card is also an electronic purse, transaction will be made by automatically deducting the current amount with number of session. For early medical collection or timely medical collection patient, pharmacy will be alerted automatically upon their arrival. The system flow of medical consultation and medicine collection is shown in Figs. 3 and 4. All devices are connected to one database, which contains:

- Outpatient lists from NFC reader device, including date and time the NFC Card come in contact.
- Patient basic information which are entered by the administrator.
- List of confirmed appointments for nurses, doctors and pharmacists.
- List of new appointments, which has been entered by patients from mobile android application
- Patient and health personnel's' username and passwords.

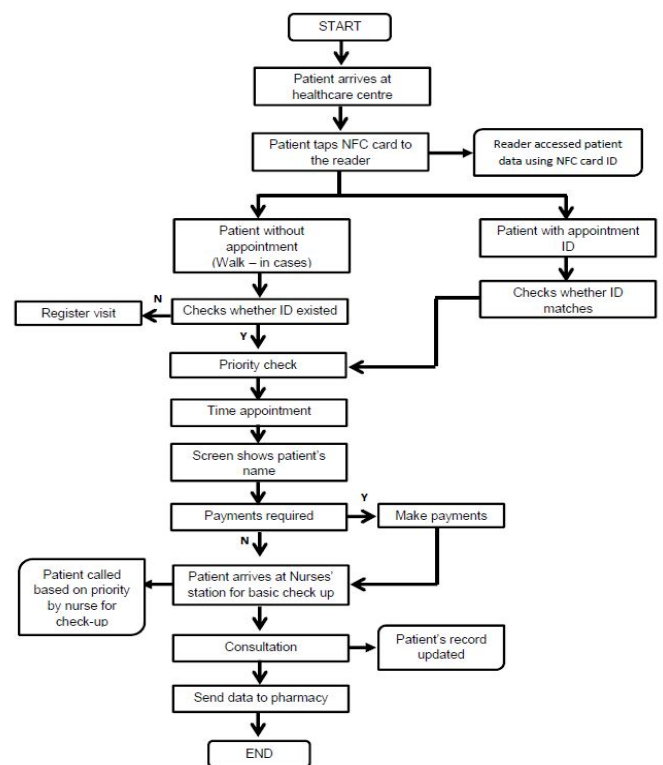
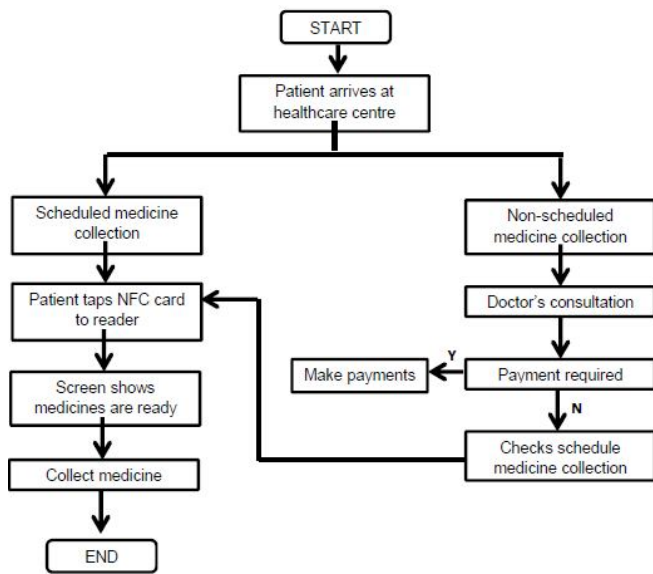
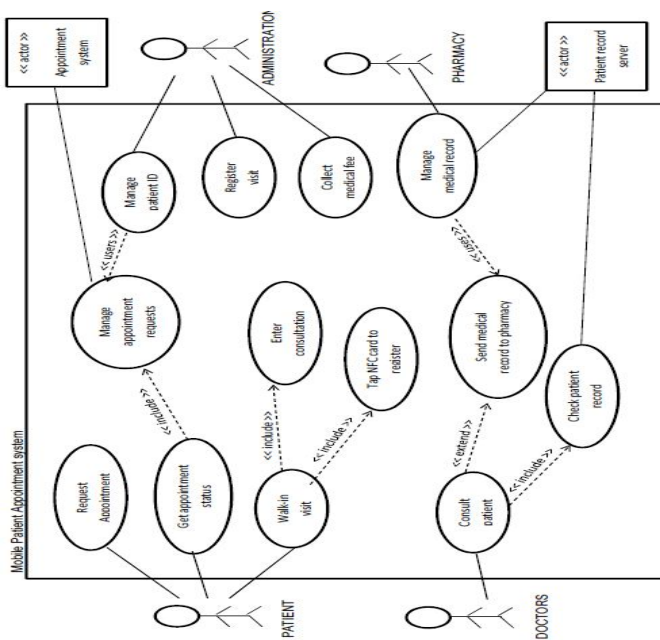


Figure 3. Workflow of Outpatient Clinic



**Figure 4.** Workflow of Pharmacy Department

Patient of system can request for appointment schedule and get confirmation either on mobile handset or NFC reader Kiosk at the healthcare centre. Nurse station is the one who got access patient information record and accept appointment record for calling the patient based on priority for initial screening. Doctor updates medical record based on consultation with patient. Once consultation over, medicines prescribed are sent electronically to pharmacy who got access to patient medical record and also scheduled medicine collection list. Here again medicines are served based on priority of patient as explained before. The user interaction of the system are shown in Figure 5.



**Figure 5:** Use Case Diagram

#### 4. IMPLEMENTATION USING NFC AND ANDROID

The NFC based mobile appointment system was implemented and validated using three types of technologies, as mention on the previous sections. In our implementation, we have faced certain restrictions towards patient and healthcare personnel outpatient clinics. Patients must be provided with NFC cards after the patients have registered to the system and NFC cards must only be tapped once to avoid any redundancies to the records in the database. The database was implemented using WAMP local host with specification of Apache version 2.2.22, MySQL version 5.5.24 and PHP version 5.4.3.[14]

##### 4.1 Near Field Communication Application

The implementation of NFC in this system is using NFC model ACR122S from Advanced Card System Ltd and Mifare 1K Classic passive NFC contactless card. ACR122S has a serial interface (RS232) for data exchange and USB interface for power supply to LED lights on the reader. This NFC model also supply the speed of 115.2 kilobits per seconds with power consumption of under 15 mill amperes to complete the transaction like authentication, verification and reading, which can further be modified in the advance settings. By using polling function, implemented in Java Language, NFC is able to detect the card which approaches of distance less than 10 centimetres. If in any case that multiple card are tagged or presented at one time, the NFC reader will only be able to poll one card after another simultaneously. The NFC reader will then send “tag” records to the database on outpatient table and display the records onto nurses’ workstation or pharmacy’s workstations (i.e. for early medical collection patients). Yet, with this function, there are some constraints and drawbacks found in using NFC technology for check-in application such as polling function will detect NFC cards regardless of record redundancies for which its solutions have not been discovered. From the statement above, adapting Near Field Communication in healthcare centre may result in quicker operations and more efficient as all healthcare personnel will be alerted on the patient’s presence before proceeding with consultations.

This system will be initiated using buttons displayed on the screen, as shown in Figure 8. First, the NFC reader must be connected to available port on the computer attached. The administrator or person in-charge pressed “Start” button as shown in Figures 6 to 8. If the connection cannot be fulfilled, it will be displayed as shown in Figure 9. The NFC reader will start polling, with the NFC card unique identification displayed as shown in Figure 10. The NFC unique identification will be record to the database as shown in Figure 11.

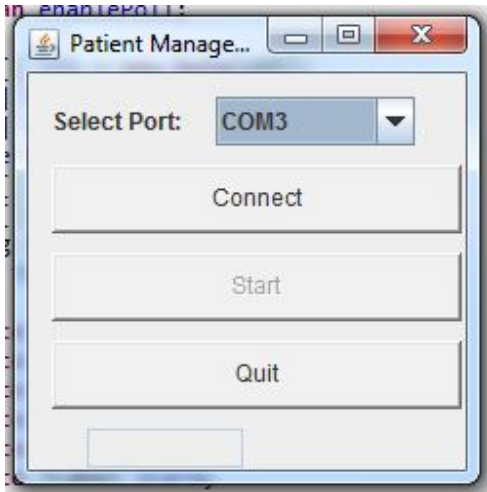


Figure 6. Connection is initialised

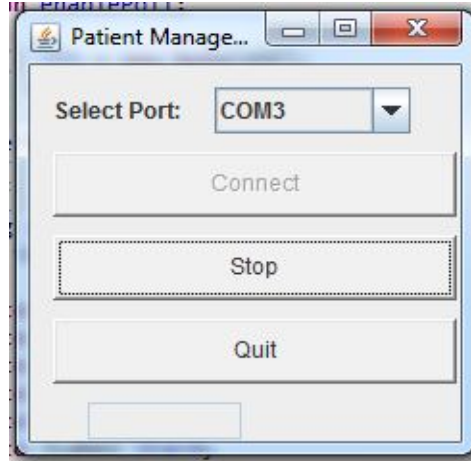


Figure 9. NFC Device started

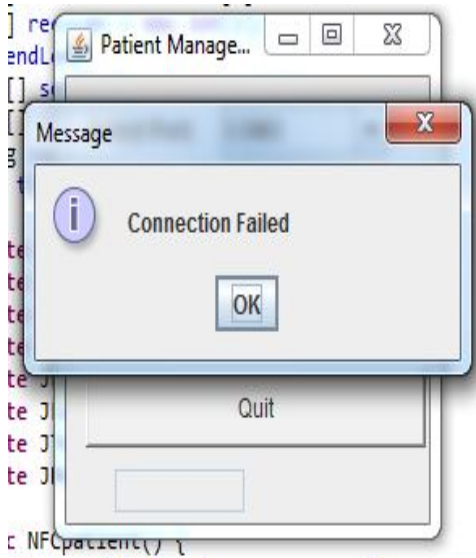


Figure 7. Connection Error

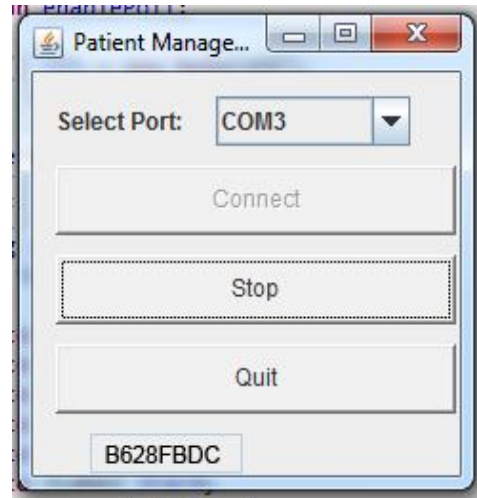


Figure 10. NFC Unique ID

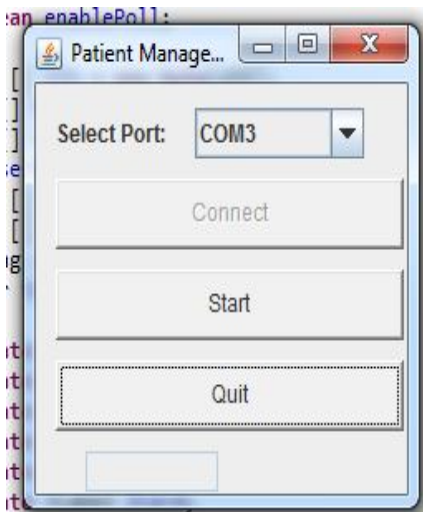


Figure 8. NFC Device has Connected

+ Options		op_id	clock	patientID	apptID	docID
		1	2013-04-02 10:22:15	B628FBDC	NULL	NULL
		2	2013-04-02 10:23:00	96DFADC	NULL	NULL
		3	2013-04-02 10:23:10	C6F0FADC	NULL	NULL
		4	2013-04-02 10:24:02	E6BAFDFC	NULL	NULL
		6	2013-04-02 10:24:15	066CF8DC	NULL	NULL
		7	2013-04-03 08:22:24	96DFADC	NULL	NULL

↑ Check All / Uncheck All With selected: Change Delete Export

Figure 11. Outpatient Table

The fields included in outpatient tables are (1) *clock* and (2) *patient ID*. Clock field will list out the time and date NFC cards are in-contact with, whereas patient ID is also the unique identification of NFC Card.

#### 4.2 Mobile Android Application

Inspired by the design initialised from “Application of Intelligent Agents in Hospital Appointment Scheduling System” [5], we are able to point out the main features of using Mobile Android devices for appointment schedule. Only registered patients are given username and temporary password for accessing the application. Figure 12 shows the main page and validation process as shown in Figure 13. If the validation is not true, the screen will notify that user are not found as shown in Figure 14. For the case of registered users and validation process is true, user will be directed to main page as shown in Figure 15 which contains two buttons: (1) List of appointments, to view CONFIRMED appointment list as shown in Figure 16, and (2) Schedule an Appointment, for scheduling new appointments as shown in Figure 17.



Figure 12. Android Application login

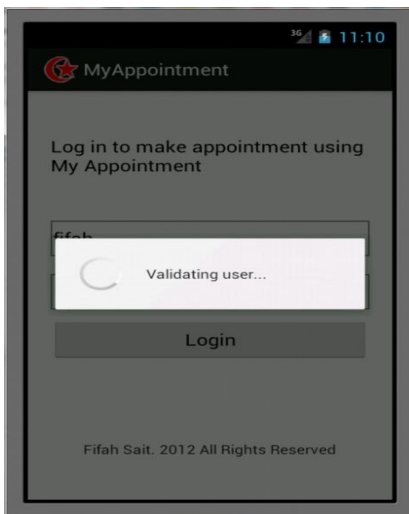


Figure 13. Validation Process

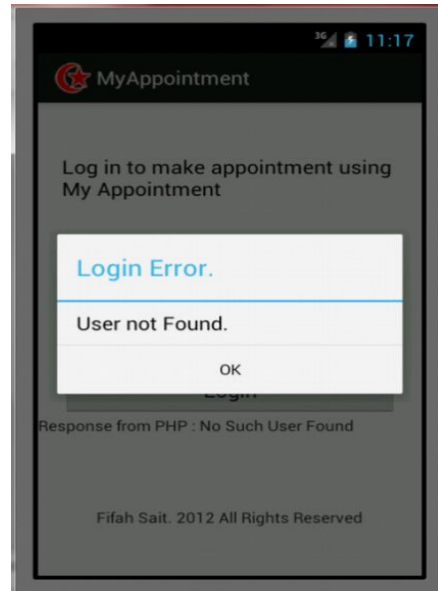


Figure 14. User Not Validated

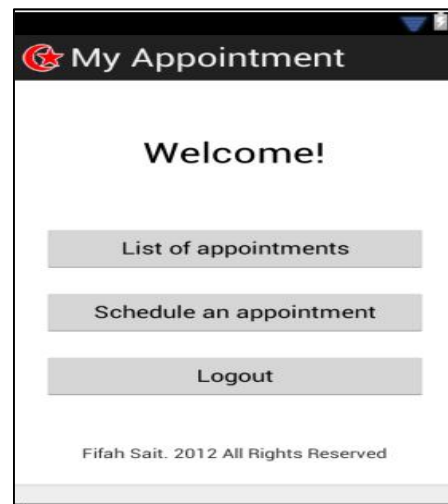


Figure 15. Welcome Page



Figure 16. Confirmed Appointment





Figure 17. Mobile Appointment Scheduling

### 4.3 Web Application

Since web application involves user permission, the application is further grouped into four accesses: (1) Administrator access, (2) Nurses' access, (3) Doctors' access and (4) Pharmacists' access

#### A. Administrator Page

Once the user logged in using given username and password, user will be directed to the welcome page displaying administrator's name. Administrator will register patient electronically by clicking "Register" link and will be directed to registration form in Figure 18. Once registration successful, screen will display as registration success. In addition, administrator can add value to the NFC card for electronic payments. To add value, administrator must first search for identification card number (IC), and once patient name are displayed with current amount hold in the NFC card, administrator can submit new amounts as shown in Figure 19. Administrator can also search for patient Identification card in the search page, in case family members want to add up the NFC card amount.

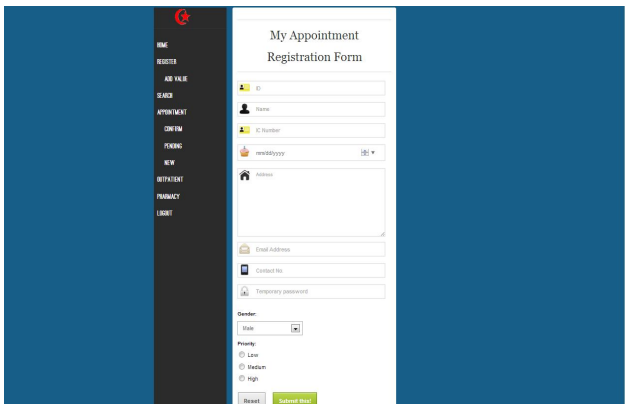


Figure 18. Registration Form

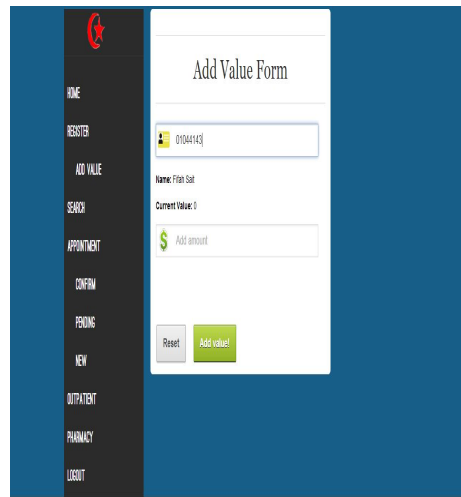


Figure 19. Patient Search and Add Value

#### B. Nurse Page

Nurses' has the access to all pages except Pharmacy patient List page. This is due to the fact that nurses are not involved with pharmacy operations. Once a nurse logged in, the screen will display a welcome page. Nurses have access to search page and in addition, nurse can view lists of patients who had scheduled appointment as shown in Figure 19, confirming appointments as shown in Figure 20, viewing pending appointment as shown in Figure 21, and scheduling new appointments shown in Figure 22. Nurses has the authority to assign which patients to respective doctors, and by just clicking "update" button, an update form will be displayed as shown in Figure 23. Once the appointment status has changed from PENDING to CONFIRMED or REJECTED, a notification will be send via email, as illustrated in Figure 24. Nurses can also view outpatient list for initial diagnosis and update patient priority level. Figure 25 shows the outpatient list page, which will be refreshed every patient new comings



Figure 20. List of Scheduled Patients

No.	Name	Request date	Request time	Description	Status	Actions
1	Tiara Rose	2013-03-13	10:30:00	Medical Consultation	Confirmed	[DONE]

Figure 23. Confirmed appointment patients list

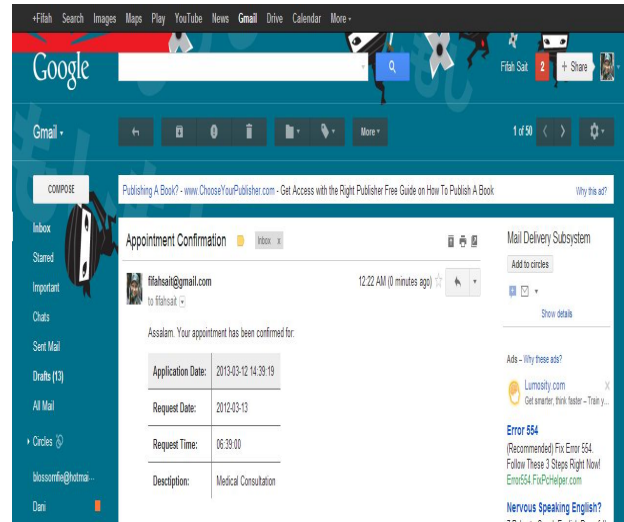


Figure 26. Confirmed appointment patients list

No.	Name	Request date	Request time	Description	Status	Actions
1	Azmi Sat	2013-08-09	09:00:00	Medical Checkup	Pending	[UPDATE] [CONFIRM]

Figure 24. Pending appointment patients list

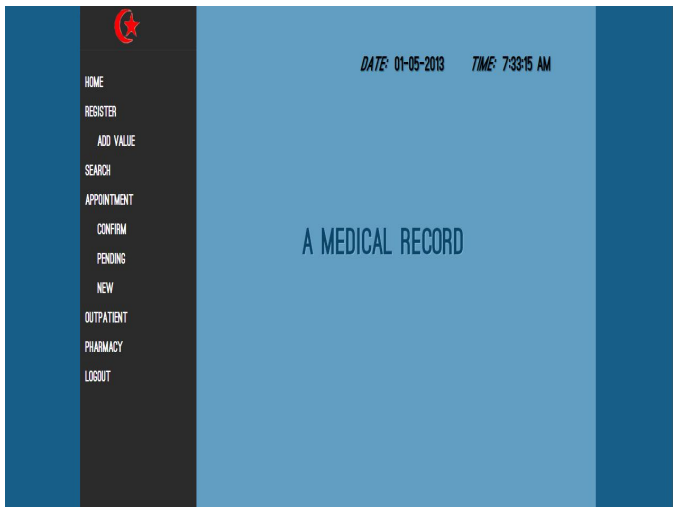
No.	Name	Priority	Doctor	Actions
1	Fifah Sat	M		[UPDATE] [DELETE]
2	Tiara Rose	L		[UPDATE] [DELETE]
3	Azmi Sat	L		[UPDATE] [DELETE]
4	Jennifer Lopez	M		[UPDATE] [DELETE]
5	Dani Cheth	H		[UPDATE] [DELETE]
6	Tiara Rose	L		[UPDATE] [DELETE]

Figure 27. Outpatients list

Figure 25. Update Appointment Form

### C. Doctor Page

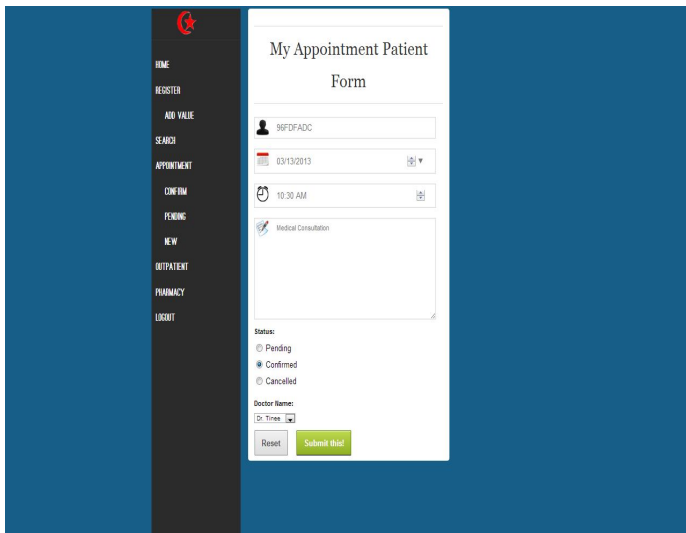
The major operation for doctors is to update the medical record of assigned patients when consultation has ended, similar to one shown in Figure 27. Once “open” button is clicked, it will display as shown in Figure 28. Since the scope of this project does not include medical record implementation, hence, the screen only assumes that medical record is viewed. In addition, doctors also be able to schedule new appointments as nurses as shown in Figure 29. Once the form has been submitted, a display showing that it is “successfully entered” will appear



**Figure 28.** Patient Medical record



**Figure 30.** Pharmacy Page



**Figure 29.** New appointment scheduled for patient



**Figure 31.** Delete Notifications

#### D. Pharmacy Page

Pharmacist can only access “pharmacy” page whereby it shows only the list of appointment patient for early medical collection and prescription passed from doctors, as shown in Figure 30. Once collection has been made, a pop-up notification will display to delete the record, shown in Figure 31

## 5. CONCLUSION

While it seems obvious that the slow acceptance of Information and Communication Technologies (ICT) has been a factor in the stagnation of the appointment scheduling process, this scheduling process can be loosely coupled from other health-care features. This loose coupling can allow the scheduling aspect of the health care industry to grow while leaving the option open for tighter coupling once ICT catches.

The research presented some of the challenges that currently face patient and staff alike where poorly executed and inefficient scheduling systems are concerned. For refining the core operations in outpatient clinics in respect of health applications, paper-based methods are used, resulted in low quality and efficiency as well as longer waiting times for both scheduled and walk-in patients. With the advent of ICT, lot of online appointment scheduling system has been developed but still face some challenges. There has also been work reported on using Intelligent Agent towards patient appointment using Android mobile handset which uses fuzzy

preferences for appointment scheduling. Also there has been work on BruHIMS by Government of Brunei on Electronic medical record. These two were motivation toward our proposed system on NFC based Mobile Patient appointment system which is believed to improve the performance which focuses on the critical component. It is proven that those technologies can be used to replace manual and traditional systems in appointment scheduling and outpatient records. This system will centralize scheduling system and sorting the prioritization. The architecture and system flow of proposed system been presented followed by brief discussion of various standards and technologies used in this solution presented as screenshots. In future the proposed NFC based Mobile Patient Appointment system can be extended to include the ability to develop the system towards further notification of appointments using messages. In addition System will possess feature to view patient basic information on NFC screen, providing automatic system calls as reminder before appointment time, provide more appropriate slot system for both nurses and doctors, and automatic call system for outpatient clinic. In addition it will further more produce better accuracy and efficient workflow since each process will be done automatically. Last but not least patients can just schedule by one click of button and check-in by just tapping their NFC card

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