



(RESEARCH ARTICLE)



Automation identifier approach for library management information system

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Abstract

Rapid technological developments provide benefits for library management. One of them is the application of automatic identifiers in library management, through RFID and QR Code implementation. Some problems that are faced by libraries at the moment, include the lack of guarantees for the safety management of books in the library, lack of services human resources library management, and book availability information has not been accurate. This research conducts the development of a library management information system to solve the problems by using automatic identifiers utilizing Near Field Communication and QR Code technology. The implementation scenario is each library member has the NFC Card and their personal information stored in the NFC card, also each book in the library is put with a QR Code label containing book code information. Transaction of book loan and book return are done by initially tapping NFC Card to record visitor returned or borrow the book and then continue to scanning QR Code label of each book borrowed or returned. In the final stage, the application tested by tapping the NFC card (RFID) on the reader/writer device, and it found the NFC Card could be read or record data from the device at a maximum of 7 cm, while testing phase conducted QR Code label could be read at a maximum distance of 40 centimeters from the device. Implementing automatic identifier help to manage transaction in library more accurate, improve services and provide added value for the library.

Keywords: Library; Automatic Identifier; QR Code; NFC Card; Accurately

1. Introduction

Rapid technological developments provide benefits for library management. Radio frequency identification (RFID) is a technology that combines the functions of the coupling electromagnetic or electrostatic in the radio frequency portion of the electromagnetic spectrum, to identify an object [1]. Rapid development of today's technology requires technology that make easier to make transactions, for example, internet online payments, smart cards, radio frequency identification (RFID), mobile payments, financial technology, and others. Some problems that are faced by libraries at the moments are lack of guarantees for the safety book management in the library, lack of human resources services and book availability information has not been accurate. Near Field Communication is the ent of radio technology frequency identification (RFID) which is used to communicate data using radio frequencies, where the media card can store data or data can be read using an NFC reader device. NFC can be used for digital transactions such as being able to transfer data quickly, make purchase transactions without the need to use unnecessary credit or debit cards go through a very complicated activation process [2]. RFID consists of active and passive RFID. Active RFID labels have a strong signal and can transmit data over long distances. Passive RFID labels rely on an RFID reader to transmit data with short scanning distances, and low cost [3].

The research conduct the development of a library information system based on automatic identification of borrowing and return of books transaction using RFID cards and QR Code labels. RFID cards are used to record library member or visitor data, while each book is put QR Code label containing book code information. Transaction of borrowing or

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returning books is performed by tapping the NFC to read who borrows or returns books and scanning QR Code labels to record which books are borrowed or returned. The research urgency through the use of RFID technology is expected to make the borrowing and returning books transaction is more practical, more accurate information, improve services for students and library visitors and give value added for library in the efficiency and practical service.

2. Related Work

Several studies have been conducted on the use of RFID for many purposes are detailed as follows: research from [4] developed a lecturer attendance information system to record lecturer attendance using radio frequency identification technology by implementing Near Field Communication Card. Application to record lecturer attendance for college class, by tapping NFC card to reader device. The NFC cards to record presence in class is more practical for lecturers better than manually using paper. Study from [5] to implement RFID in the patient medical record queuing system in hospitals, aimed to reduce patient queuing time when processing medical records at outpatient registration at the hospital, RFID used for unique patient codes. This unique code will display patient data automatically so that it makes efficiently to manage patient's medical records. Study from [6] examine the design of lecture attendance applications using NFC technology, to make easier for student attendance process using Android-based NFC. NFC technology on smartphones can detect the owner identification process on NFC chip, students simply touch their identity card to the NFC tag detector and the system will input attendance automatically and connect to academic information systems. Study from [2] examine the role and use of near field communication (NFC) technology in teaching and learning activities in universities, also the implementation is not depending on internet network. Lecturer presence in general is recorded on manual form sheets, or through web applications that are accessed on computers in class, but sometimes connection problems occurred, so that attendance could not have done via web application. To overcome this, an NFC card is implemented for attendance, by tapping the card on the NFC reader device, and the lecturer's attendance data is recorded on the academic attendance information system. The data stored in the NFC card can be encrypted so that is secure enough and it cannot have duplicated by others. Study from [7] regarding design of radio frequency identification (RFID) for the attendance system based on the AT mega 8535 microcontrollers to read employee attendance information in the form of an attendance application to store and make employee attendance reports. The tag reading by the RFID reader must be at a maximum distance of ≤ 4 cm. It requires about more than 2 seconds for the difference time between reading the first tag and the second tag. Study from [8] develop library application using smartcard RFID (Radio Frequency Identification). The increasing literature collection at the Regional Library and Archives Department of South Kalimantan Province, the demand of library materials increases, the limitations of librarian services are a problem in library management. The library information system starts from member registration, literature registration, book borrowing, book return, library free letter giving and making reports including member list reports, book list reports, book borrowing reports, book return reports and fine receipt reports. This library application can maximize library services and minimize errors in data processing. Study from [9] regarding the application of RFID technology in filling out library visit data, connects an Arduino-based RFID reader with database reading. The use of RFID technology for automation of library visit enable to prevent duplicating identifier by using RFID cards which may enable integrated with Internet of Things (IoT) practical data storage. Study from [10] the application of Radio Frequency Identification (RFID) technology to improve library services. The problem faced by libraries in general is lack of services and the performance of human resources in the library. By using RFID, users perform self-service to speed up the loan and return circulation process, so this make efficient in time.

3. Methodology

3.1. General System Overview

This research method develops a library information system by applying an RFID-based NFC Card. The flow of this research begins with study literatures related to working procedure of NFC card, develop prototype application / coding on how to read and save data from and to NFC card, study the activities flow of loan and returning books in library. The next stage is an analysis to determine the language programming .Net C# programming language, because it has feature to integrate into some digital devices. Next step is to analyze the hardware requirements, database design and system interface. The results of analysis and design are used to develop application, and then perform system testing to make sure application runs properly. This research ends with the preparation of reports and publications. The flow of this research is described in Figure 1.

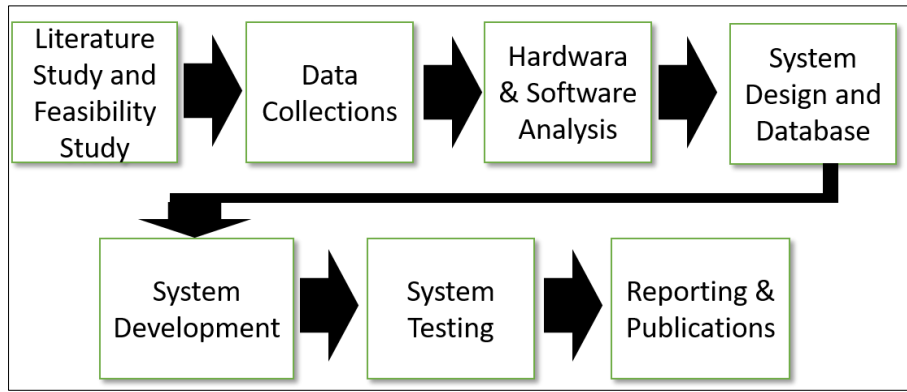


Figure 1 Research Flow

The data collection technique is carried out through direct observation and analyzing library data. At this stage, the system interface design is also carried out the system interface design consists of a library member master, a book master, a loan transaction books and book return transactions.



Figure 2 Book Loan Transaction

Figure 2 explains the flow of book loan activity starting from registering visitor, create a member card for new member using NFC Card. Next visitors enter the library to choose the books to be borrowed, then the librarian record the book borrowed by scans the visitor's NFC card and then scan the QR Code label on each book. Data book loan has been stored on library management systems.

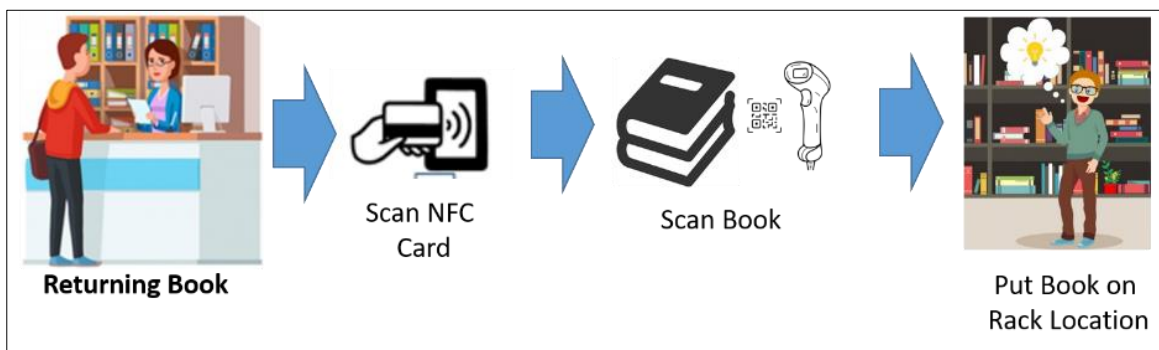


Figure 3 Book Return Transaction

Figure 3 describes the flow of returning library books. Once book returned, the librarian scans the borrower's /visitor card and scans books in the QR Code label. The returning book has been recorded in the system, the return date and book Id. Furthermore, the books are rearranged on the rack by the librarian after being returned. Transaction data of book loan and book returning can be neatly recorded on the system thus they could be automatically recapitulated by the system.

3.2. Context Diagram and Data Flow Diagram

Design system implemented in context diagram and data flow diagram. Context diagram is shown in Figure 4.

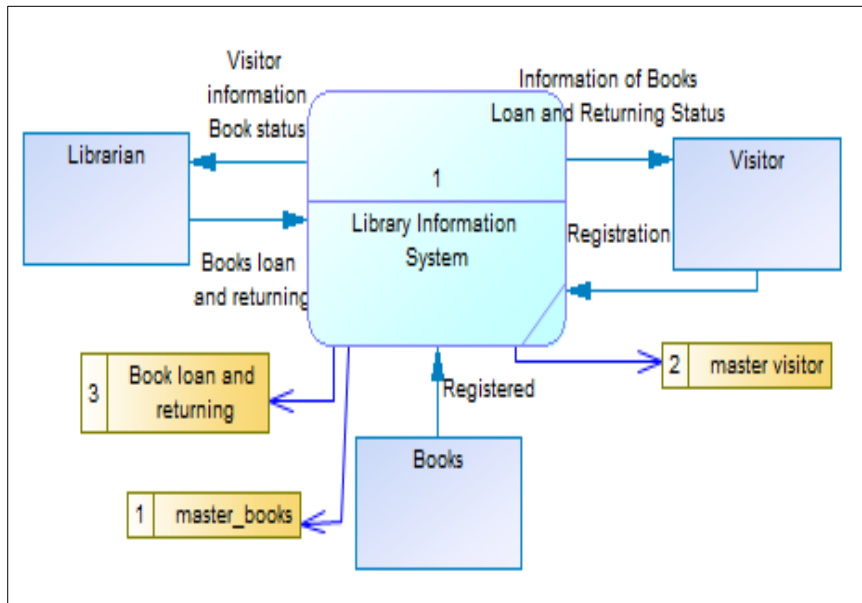


Figure 4 Context Diagram

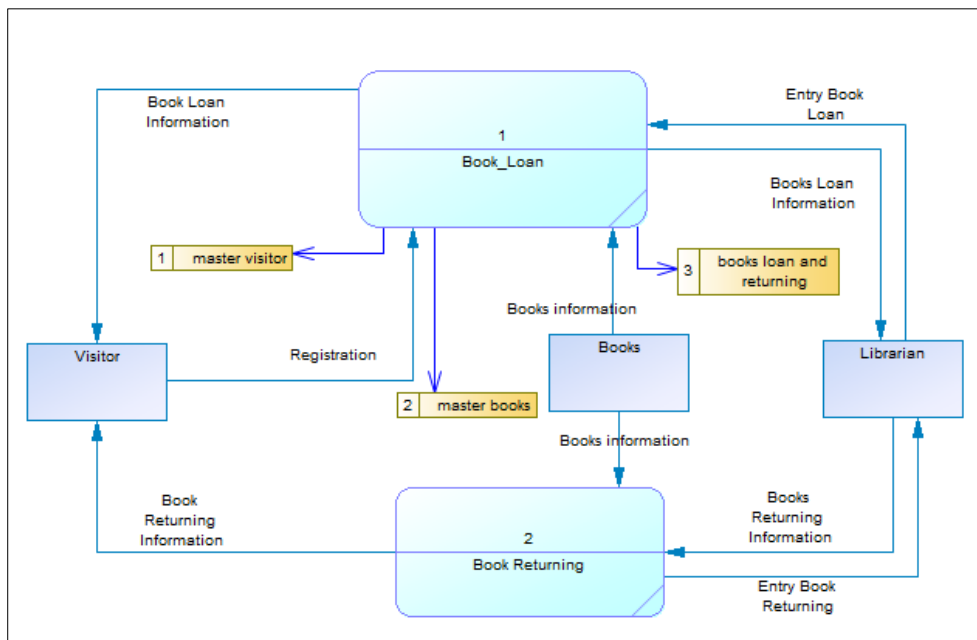


Figure 5 Data Flow Diagram Library Information System

A context diagram consists of one process node that generalizes the function of the entire system in relation to external entities. Context diagram composed of 3 external entities, 1 process, and 3 data stores. The entities are visitor, librarian and books. The arrow represents data flow into system or out from system, where each data flow is shown in the Figure 4. Master books database is used to save books information and master visitor database is used to save all information of visitors' data, while book loan and returning database is used to store book loans transaction from visitor and books returning transaction by visitor.

Data flow diagram in Figure 5 shows context diagram is splitted into 2 process namely book loan and book returning. Book loan is used to manage all transaction of borrowing book by visitor, while book returning is used to manage all transaction of book returned by visitor, handled by librarian.

4. Results

Library Information System main menu consists of sub menu master visitor, master books, verification module, loan and returning books module and reporting module, which is refer to main menu user interface shown in Figure 6.



Figure 6 Main Menu User Interface

The visitor data to be input in master data. The master visitor user interface shows in Figure 7.

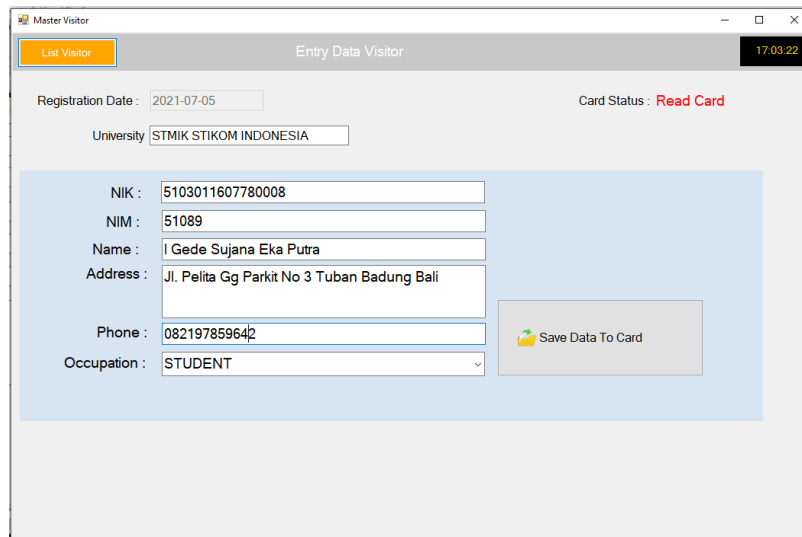


Figure 7 Master Visitor User Interface

Master data visitor is used to record visitor data, and then the visitor data stored in database and stored in RFID NFC Card.

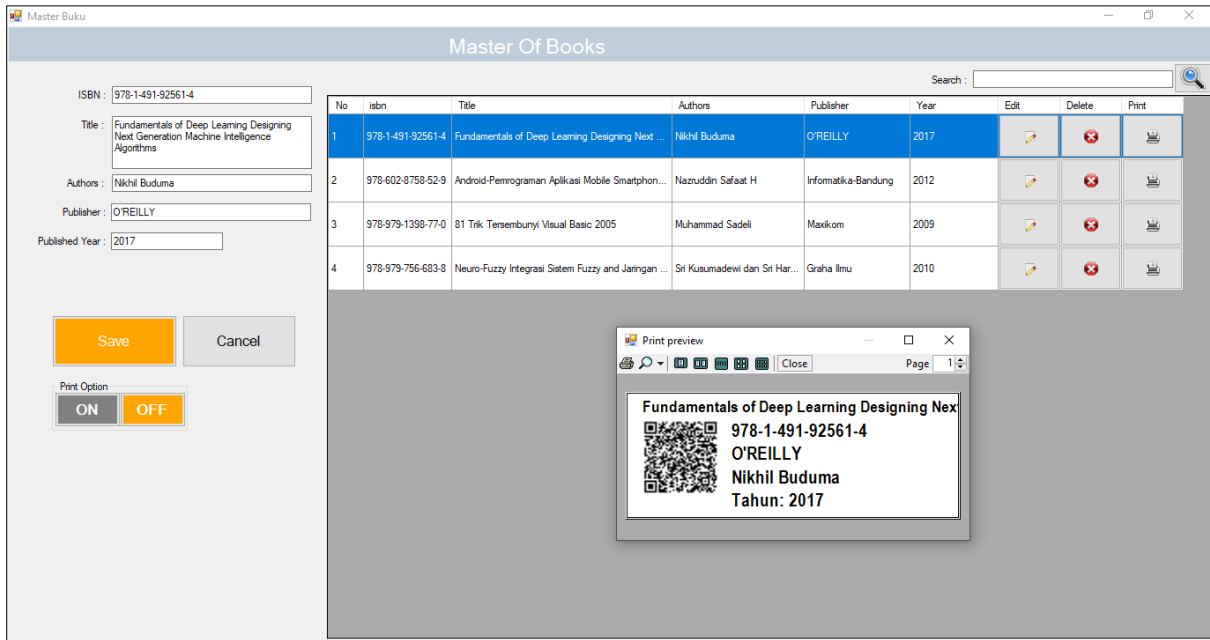


Figure 8 Master Books

Figure 8 shows master books module. Master books is used to store information of books, while the application create QR Code label represent book id and this put in each book.

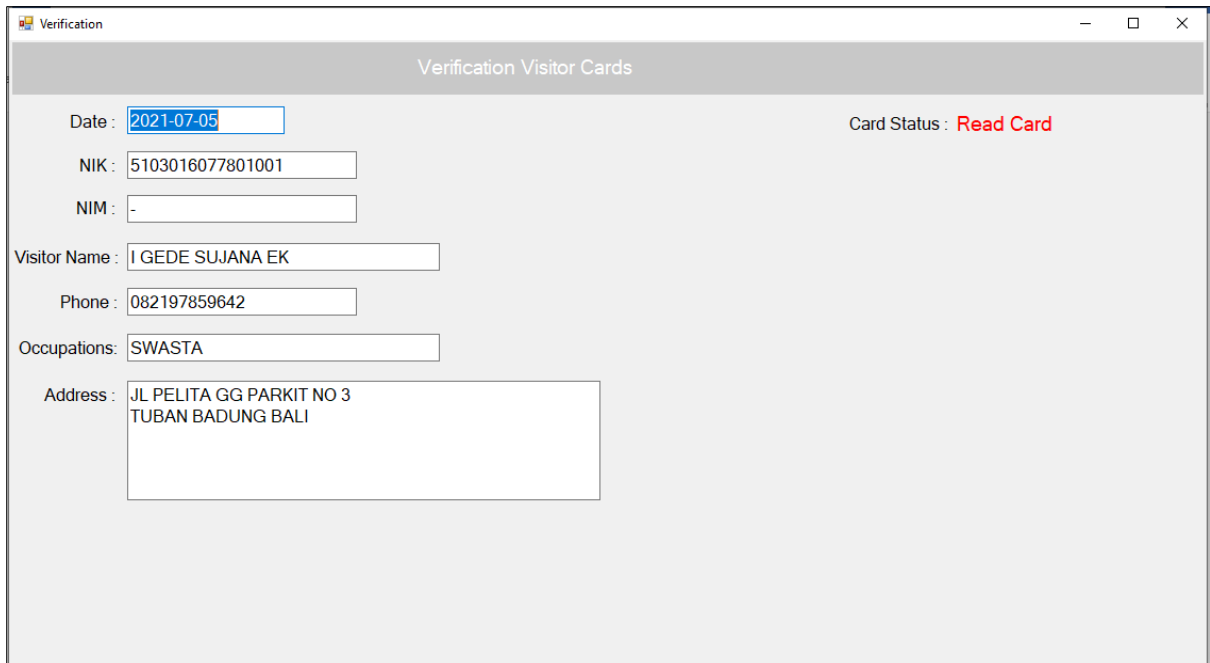


Figure 9 Verification Visitor Card

Figure 9 shows module for verification visitor card. This module is used to verify the visitor NFC Card, to make sure once the visitor data has been stored into the card.

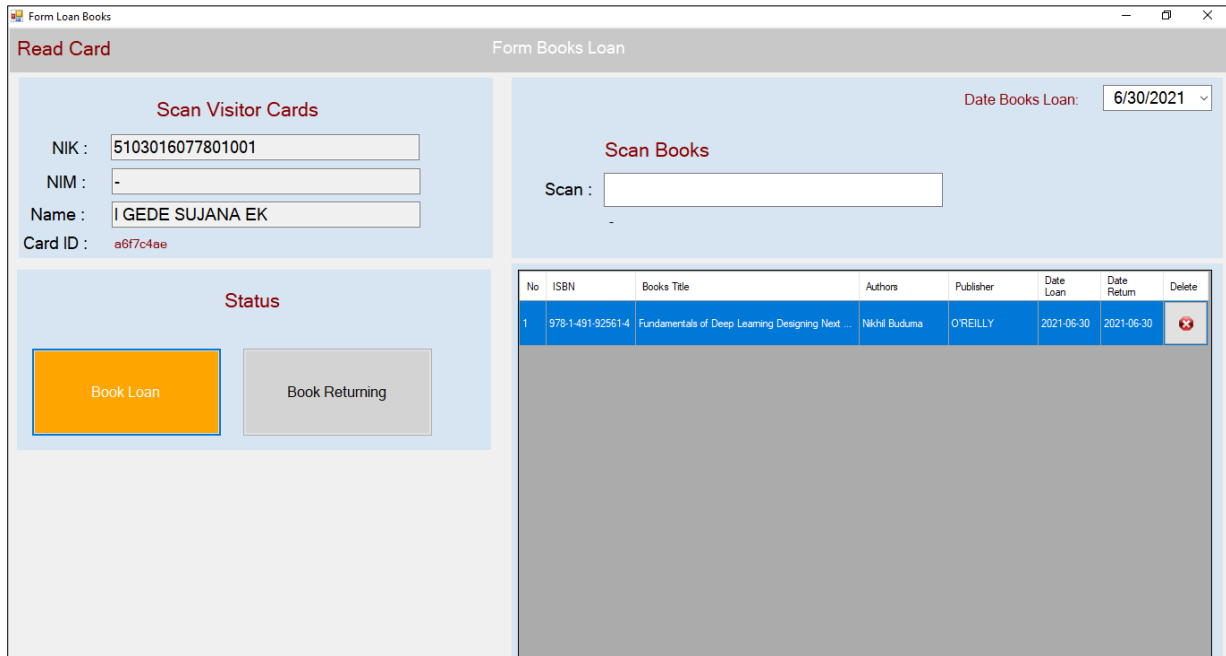


Figure 10 Books Loan Module

Figure 10 shows module for books loan. The librarian tapped NFC Card member into reader device, and then scan each books label to record book loan. By using label scan, it has more practical and speed up to record data.

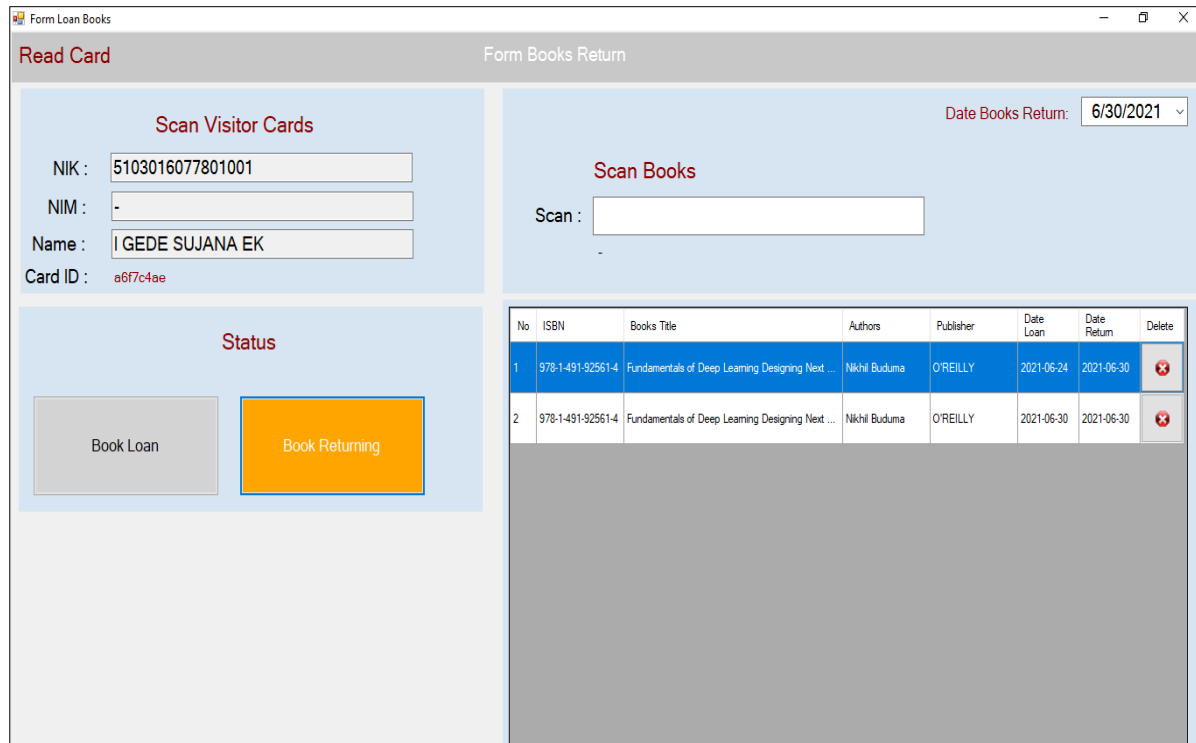


Figure 11 Books Return Module

Figure 11 shows module used to return books by visitor. Reporting module as shown in Figure 12 is used to generate report of loan and returning books, which has 3 option report. Figure 13 shows example report of recapitulation of books loan and return. The report shows recapitulation data for book loan and return, make easy for librarian to reconcile book loan and return transaction.

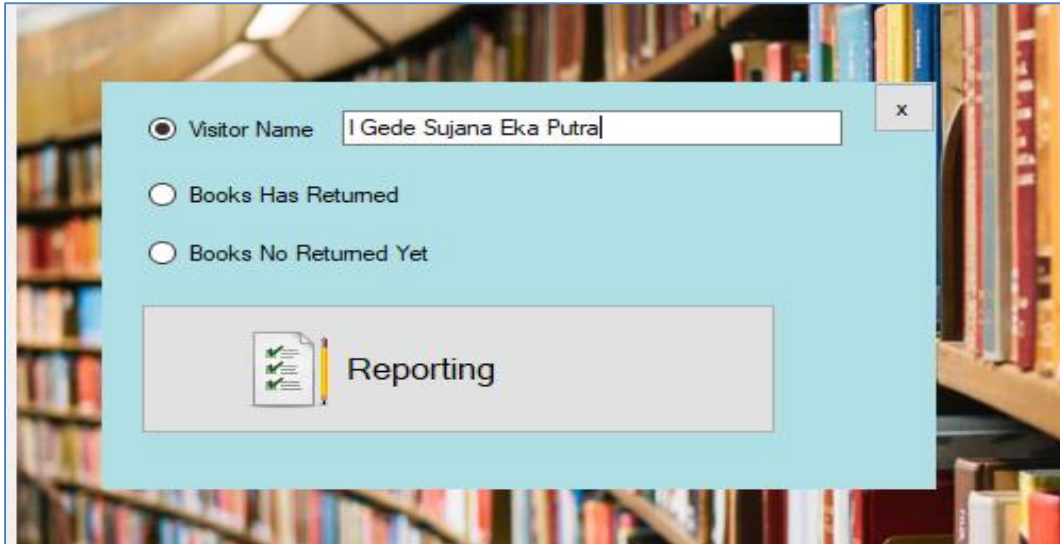


Figure 12 Report Loan and Returning Books

RECAPITULATION OF LOAN AND RETURN BOOKS						
Visitor Name I GEDE SUJANA EKA PUTRA						
5103016077801001 -						
No.	Book Title	ISBN	Authors	Publisher	Loan Date	Return Date
1	Fundamentals of Deep Learning Designing Next Generation Machine Intelligence Algorithms	978-1-491-92561-4	Nikhil Buduma	O'REILLY	24-Jun-2021	30-Jun-2021
2	Fundamentals of Deep Learning Designing Next Generation Machine Intelligence Algorithms	978-1-491-92561-4	Nikhil Buduma	O'REILLY	30-Jun-2021	30-Jun-2021
3	Neuro-Fuzzy Integrasi Sistem Fuzzy and Jaringan Syaraf	978-979-756-683-8	Sri Kusumadewi dan Sri Hartati	Graha Ilmu	24-Jun-2021	
4	Android-Pemrograman Aplikasi Mobile Smartphone Dan Tablet PC Berbasis Android	978-602-8758-52-9	Nazruddin Safaat H	Informatika-Bandung	24-Jun-2021	24-Jun-2021
5	81 Trik Tersembunyi Visual Basic 2005	978-979-1398-77-0	Muhammad Sadeli	Maxikom	24-Jun-2021	24-Jun-2021

Figure 13 Example Report Recapitulation of Books Loan and Return

RECAPITULATION OF BOOKS RETURN						
No.	Books Title	ISBN	Authors	Publisher	Return Date	Borrower Name
1	Fundamentals of Deep Learning Designing Next Generation Machine Intelligence Algorithms	978-1-491-92561-4	Nikhil Buduma	O'REILLY	2021-06-30	2021 I GEDE SUJANA EKA PUTRA
2	Fundamentals of Deep Learning Designing Next Generation Machine Intelligence Algorithms	978-1-491-92561-4	Nikhil Buduma	O'REILLY	2021-06-30	2021 I GEDE SUJANA EKA PUTRA
3	Android-Pemrograman Aplikasi Mobile Smartphone Dan Tablet PC Berbasis Android	978-602-8758-52-9	Nazruddin Safaat H	Informatika-Bandung	2021-06-24	2021 I GEDE SUJANA EKA PUTRA
4	81 Trik Tersembunyi Visual Basic 2005	978-979-1398-77-0	Muhammad Sadeli	Maxikom	2021-06-24	2021 I GEDE SUJANA EKA PUTRA

Figure 14 Example Report Recapitulation of Books Return

Figure 14 shows example report of recapitulation of books return. The report shows recapitulation of all information regarding books return.

5. Discussion

Based on testing result, we found that NFC Card have sensitivity level to read /write data from NFC reader device. The testing results of the read/write NFC Card into NFC device are shown in Table 1.

Table 1 Testing Result of Tapping NFC Card into NFC Device

Tapping distance (cm)	Position	Can Be Read?	Can Be Write?
0 cm	Stick to NFC device	Yes	Yes
1 cm	Upright	Yes	Yes
2 cm	Upright	Yes	Yes
4 cm	Upright	Yes	Yes
7 cm	Upright	Yes	Yes
8 cm	Upright	No	No
1 cm	Sideway	No	No
7 cm	Sideway	No	No

Based on the test results from Table 1, it can be observed that the NFC Card could be read/write at least at 7 cm distance from NFC reader/writer device in the upright position. While in the sideway position, NFC Card could not be read/write by NFC reader/writer.

Table 2 Testing Result of Scanning QR Code

Label Position	Scanning Distance (cm)	Can Be Read?
Flat	10 cm	Yes
Flat	20 cm	Yes
Flat	40 cm	Yes
Flat	50 cm	No
Folded	10 cm	Yes
Folded	20 cm	Yes
Folded	40 cm	Yes
Folded	50 cm	No
Flat	10 cm	Yes
Flat	20 cm	Yes
Flat	40 cm	Yes

Based on the test results from Table 4, it can be observed that the QR Code label could be read at maximum distance 40 cm in label position either in flat position or in folded position by using Xenon Honeywell QR Code scanner. This QR Code has high sensitivity to read QR Code label it also could read for folded label position.

6. Conclusion

The conclusion of this research are the development stages of library management system consists of direct observation, literature study, and data collection, system design and hardware analysis, database and user interface design, system development, and system testing. NFC Card (RFID) could be read or write at the maximum distance up to 7 cm from the device. While QR Code label could be read using scanner device at a maximum distance of 40 cm either

in a flat or folded label position. Library management may become easier by implementing the NFC Card as RFID technology adoption.

Compliance with ethical standards

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Disclosure of conflict of interest

There is no conflict of interest at this manuscript.

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