RFID Based Cyber Secured Library Management System

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Abstract—RFID (Radio Frequency Identification) Based library management system is one of the more important system using in now a day in modern libraries and warehouses. The libraries, warehouses, shopping malls, industries, using RFID system to secure their items for purpose of theft control, Ease of accessibility and traceability, each available item in store, library or warehouses. are properly tagged with RFID tags, and programmed with its item basic info like serial number, stack info, author, barcode number etc. after this programming the items status changed to secured in RFID field, now whenever anyone pass this item from the RFID based security gates it will give alarms to librarians or system owner. This alarm may be sound alarms or desktop notification. In this paper the proposed system consists of cyber security based, the programmed info will be unable to read by any user without knowing the encryption key using in encoding process during programming (storing the new information in RFID tags), similarly any user will be unable to issue the assets without selecting the same encryption key used during in programming the RFID tags.

Index Terms— AFI (Application Family Identification), Cyber Security, Encryption and Decryption, HF (High Frequancy), ILS (integrated library System), LMS (Library Management System), RFID (Radio Frequency Identification), RFID Tag, UHF (Ultra violet high frequency)

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1 INTRODUCTION

RFID (Radio Frequency Identification) devices have importance in our daily life, and its use is increasing in our day to day life, because of its great features like feasible to each suitable environment, effort able less price and compatible with most of using systems. Have lot of applications like using in libraries, warehouses, shopping malls, showrooms etc. RFID is an electronic technology where the system works in operating frequency 13.56 MH. [1] [4] The items information is encoded to RFID tags, this info should be serial number, authors, parts, stack number or barcode number etc. to encode this information using a special designed software for this purpose, which have also the features of encryption and decryption the original data, once the system user entering the original information in RFID tag by using the programming software, that user will need to select an encryption key, now for reading that inserted information user must provide that key which used in programing session, and then the user will be able to read the programmed data. Along with special developed software for above purpose we are using a hardware device named "staff-station" having antenna, RFID reader and cable connection with PC which have that specified software and its 2nd end is connected to power. Once the librarian/admin receive new itoms (stock) he needs to do programming once for secure its information in RFID tag, which having the 4-byte memory. Below is a breaf sptes which showing the flow work for insterstion/programming new records.
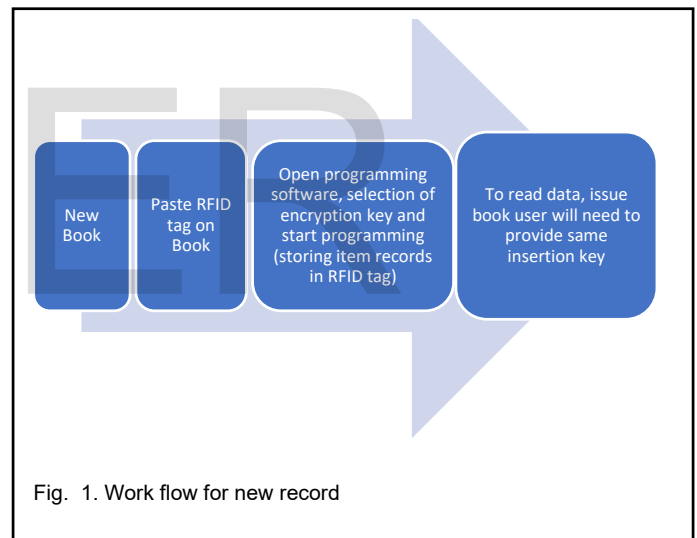

Fig. 1. Work flow for new record

In hardware case using a device called staff-station consist of RFID reader, antenna and power supply. Once RFID tag programmed, paste this tag on assets (book, magazine, manuscripts, frame, panting, CD, DVD etc.) this asset change to secure mode, on each exit of building (library, showroom, warehouse) there will be a security gate installed, once pass this item through this gate it will start the alarms. These alarms should be in voice alarms and desktop notifications to system users. If the system user wants to issue any specific items to any member, user will use another software for issue and same for return called circulation. The system user will provide the encoded

key and then user will be able to issue the item. The RFID system do not require any line of sight to tags, for read/write the data in RFID tags.

In practical a brief application of the proposed RFID based cyber secured assets management system each item will be properly tagged with RFID tag, this tag will be programmed with item information, for cyber security purpose the encryption and decryption protocols are used in programming software, no one will read/write or issue/return the item without providing the encryption key, if anyone pass this tagged item from building exit where the RFID security gates installed this gate will start alarms and send notifications to system user. If the item properly issued so there will be no alarms from gate and desktop notification will be shown as issued item.

2 RELATED WORKS

As from last few years all ever the globe most of the industries, educational organizations, public and private sectors are moved very fast towards the RFID technology. Each organization takes befits according to their needs. The focus of this research is to make limitations for data access in RFID tags. Therefor, we are going to discus some prominent works in this (library management system) domain and will share some limitations for these works.

Library management system using barcode thechnology: in this work librarian is using barcode technology for issuing and return the books, its disadvantage is barcode can program one time, so if the librarian needs to change the code, he must remove 1st one and then print new barcode, For barcode reader it has the capability to read just one book at a time. So, in this this type of Library management system the system admin or librarian need to do manual work for each step. [5]

Library managent system using RFID (Radio Frequancy identification) is one of the more important system using in now a day in modern libraries. The RFID tage programmed by using the programming tools, the itme (book or manuscripts) information recorded in RFID tag. And librarian using simple alarming tools tool for detection of items. But it's limitiation is each student or user can change the security status to issue and can pass from detection exit without any alarms. [1]

A Security Solution for LMS (Library Management System) with Low Cost RFID (Radio Frequency Identification) Tags proposed a suitable and low-cost solution for library management solution. Each item in library are properly tagged with HF/UHF tags with programmed the item info. Because the features of low cost and easy to use with less technical knowledge it's have very large application in general uses. In this system each student has their registration with library management system with specified id, once the book is issuing to end users like student or visitor's RFID tag will transfer all user information to OPAC (Online Public Access Catalogue). Here in this section the confirmation and verification of student done, the valid student is able to process the request as per library issue and return policy per transaction and due clarification fee. If

any one student taking a book from library the RFID based Secured Gate will immediately respond with notifications and alarms.[4] but in this case librarian/admin facing the issue of date security any one can acces easily to modity the status form nonissued to issued and the security gate will not give any alarms.

There are many other concepts used by researchers in this domain but not speccefic on data security. So here our main concern is data security to give less access to end user for modifications, and assets will be secured and trackable for admin/librarian

3 SYSTEM DESIGN

RFID based secured library management system full setup contains, RFID tags using for data security, inventory using for creation of full inventory report, searching for specific record, arrange the files or books in shelve, Self-check device using for issue and return the book without involving the librarian, security gate using on exits of library for giving notification to librarian if some one bringing out the book from library which is not properly issued and staff-tagging using for registered new records, or issue and return the books. [8]

Below image is representing a collection of all items which full fill a complete library requirement.
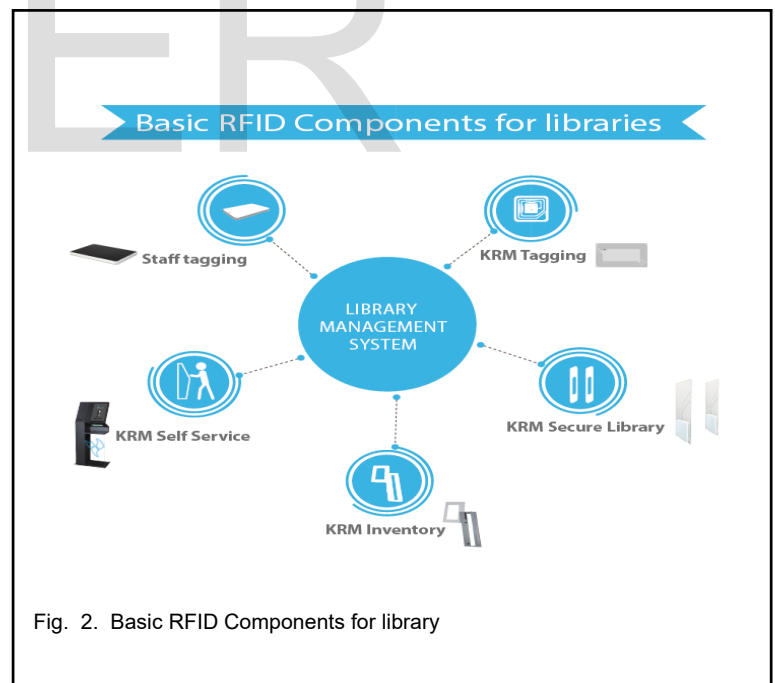

Fig. 2. Basic RFID Components for library

Each item will be properly tagged with RFID tags, and its communication will be wirelessly with RFID security gate sensors. The RFID security gates will be installed on each exit of building, whenever someone passes any tagged item from these exits it will start notifications and alarms depends on status of items (issued or non-issued). The RFID gate will read AFI

value, for check in and check out items the AFI values are different, so based on this information gate will alarm. More ever as this purposed system is cyber secured so whenever someone want to read or issue the item, he/she must know the encryption key of desired item for process.
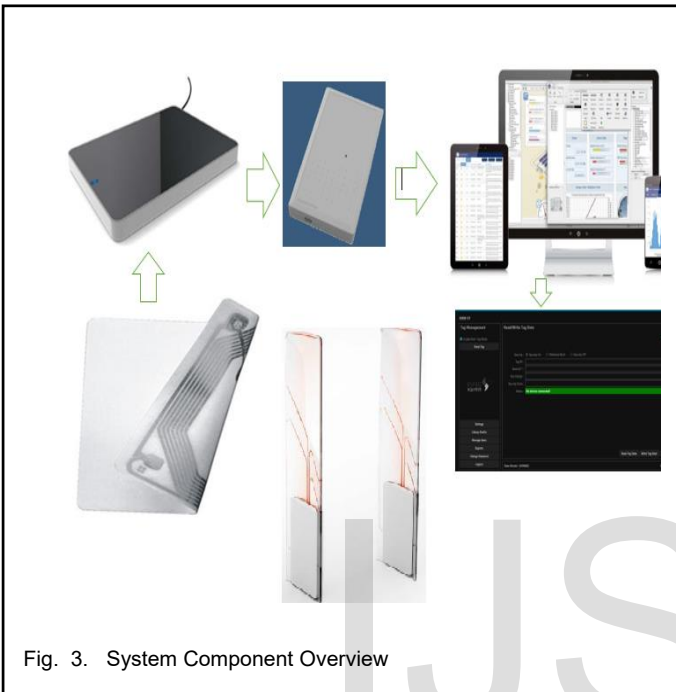

Fig. 3.   System Component Overview

The system consists on the following components.

3.1 RFID Tag

In each secured asset management system, the RFID tag is core component. Without this RFID tag the rest of the component cannot operate. Because each item should have properly tagged with full information about item.

The standard RFID tag should complaint with ISO standards 18000-3 and 15693 (Air Interface Protocol) & for enough capable storage location SLI-X chip in industry standard iso 28560 format. Its operating frequency is 13.56 MHZ, with 1024-bit memory. The operating temperature is -25C to 70C

Fig. 4. RFID Tag

3.2 Antenna

Antenna is the basic part of RFID based security system, there are two antennae used in RFID based security system, 1st one in staff-station using for programming and 2nd one in RFID security gates for detection of passing each tagged item from exits of the buildings.

Antenna used in RFID gate produce the electromagnetic field whenever any tag come to the range of antenna, in this range it gets activated, and it is able to write/read the desired information in tag by producing a radio wave, antenna behave like a communication bridge between reader and tags. Antenna used in staff station is using for programming a new tag, once the RFID tag programmed its status change to secure mode.

3.3 HF Reader ID ISC.MR 102/ID ISC.LRM2500

The HF Reader ID ISC.MR102 using the protocol 15693 to identify the transponder, with the operating frequency of 13.56MHz. this reader is suitable to all middle range values. The ID ISC.MR 102 has the range up-to 40 CM depends on used antenna. The HF Reader ID ISC.MR102 have multiple interfaces (USB, Ethernet, Serial, USB as Serial, Ethernet as Serial) so it's more suitable to use in field applications like library, logistics and industries and it's easier to integrate with nearly all existing systems as per requirements. The ID ISC.MR102 have the capability to read up-to 30 transponders with its anti-collision's functions. From the antenna output a switchable DC voltage can supply a LED inside connected antenna.

The ID ISC.MR102 can connected through interfaces RS232, Ethernet (TCP/IP), USB 2.0, operating frequency13.56 MHz, transmitting power 1.2 W +- 1 DB, supported transponder ISO 15693, Reader mode ISO Host mode, Scan Mode and Notification Mode. Power Supply 12-24 V DC or PoE

While the 2nd reader ID ISC.LRM2500 used in RFID gate which is center of RFID gate, once antenna read the information

from RFID gate, the reader has to decide as the item is issued or not, reader get this decision based on AFI value from RFID
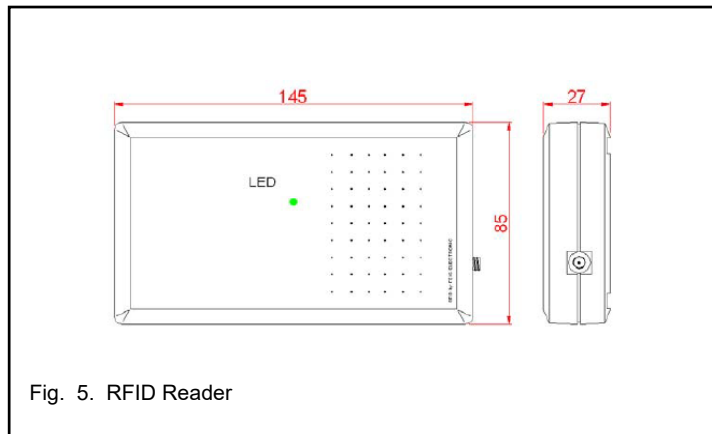

Fig. 5. RFID Reader

3.4 RFID Gate

Security gates are providing the 24/7 security with high speed detection of assets (books, manuscripts, magazine, CD or DVD etc.) below are some major benefits of RFID security gate.

- Accurately identify and tracking the tagged items
- Have 3D dimensions for identify the tagged items
- Have built-in counter, using for people counter for in-out the students or library users
- Have the ability of reporting for check-in checkout
- items and people counter in library secure software.
- Using advanced 3D digital signal processing to patented three dimensions.

Fig. 6. RFID Security Gate

4 IMPLEMENTATIONS AND RESULTS

When a new item comes to showroom, warehouse, store or library etc. in 1st phase the user need to make properly tag it

with RFID tag, after tagging in 2nd phase need to use the staff station and staff station manager software to program it, in programming process the actual information about the item is stored in RFID tag which have the memory. Now this item is secured, once someone passing this item form RFID based security gate it will starts alarms.

For purpose of issue and return the system user need to the Circulation software, the system user needs to put the desired items on antenna and can issue the items after the selection of proper encryption key.

Below is a breaf introduction with their key features of used PC softwares which is specially develeploed for this purpose.

4.1 Staff Station Manager

Staff-Station manager managing by two different desktop applications, both have their own use to complete their tasks, once is Staff-Tagging Manger and 2nd one is Circulation Software.

The staff tagging program is independently running program to insert the item information on RFID tags, this software providing the features to users about reading, writing the item information's. once the RFID tags programmed then this information can read by all staff stations. In this software the encryption protocol is used the main purpose of this protocol to make the programmed data more secure, for read the programmed data the user must provide the encryption key then he will be able to read the actual data.

The Circulation software provide the facility to librarian to issue and return books or any tagged items, this action can perform multiple time for single tag. On each circulation desk there will be a librarian PC who will perform this task, in one time the librarian can issue up to 10 books, this is very user-friendly software any technical and non-technical user can use it very efficiently. In this software also encryption protocol used, once any user wants to issue the item, he will need to provide the encryption key.
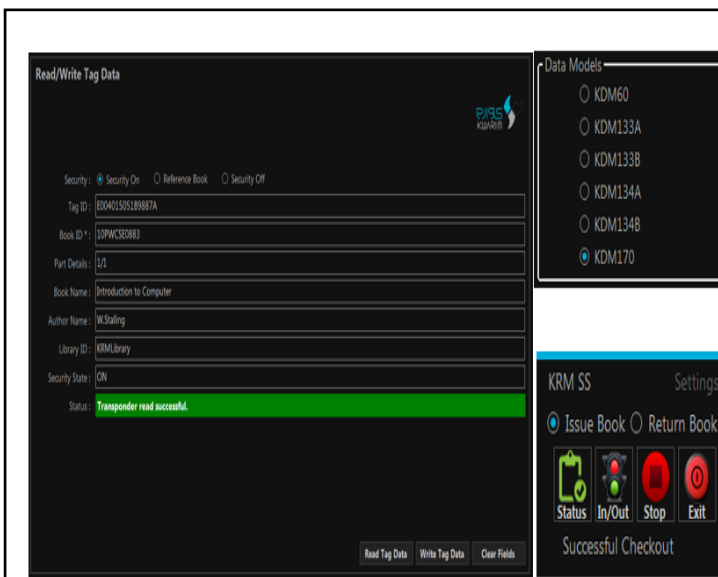
Fig. 7.   Read, write & Issue the item with selection of correct encryption key
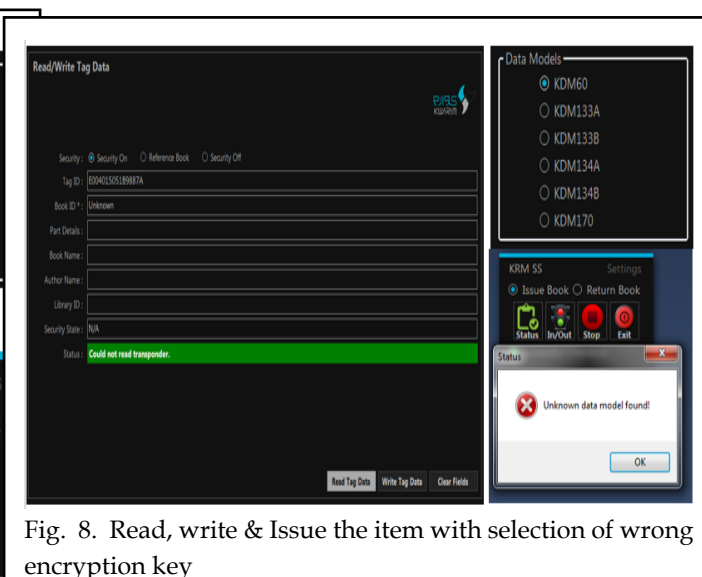

Fig. 8. Read, write & Issue the item with selection of wrong encryption key

2 Secure Library Manager

The Secure Library Manger software is using for RFID security gate to show the desktop notifications for librarian. This notification contains the information about gate exit

number, book ID, title, status (issued or non-issued), people counter index, reports about check-in check-out and people counter report.

Once the RFID gate read the information it through this information to system user PC, both PC and RFID gate are connected through internet of same subnet mask. The software running in user PC will show info like below
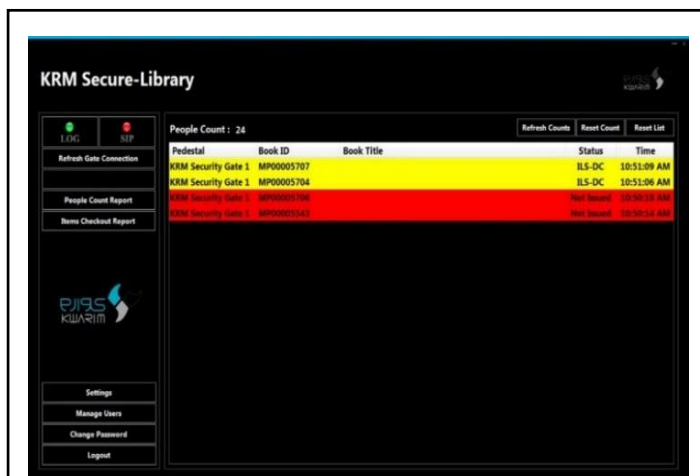

Fig. 9. Front View of Secure Library Manager

4.3 Circ-Manager

Circ Manager is desktop software which use for issue and return (check-in/check-out) purpose. The librarian or the authorized user will need to provide the desired encryption key. Without that key user will not be able to issue/return the book. Basically, the on backend this software is changing the AFI value for RFID, for check in and check out books the AFI values are different and based on these values' RFID gate giving status and alarms, below is front view of Circ Manager application
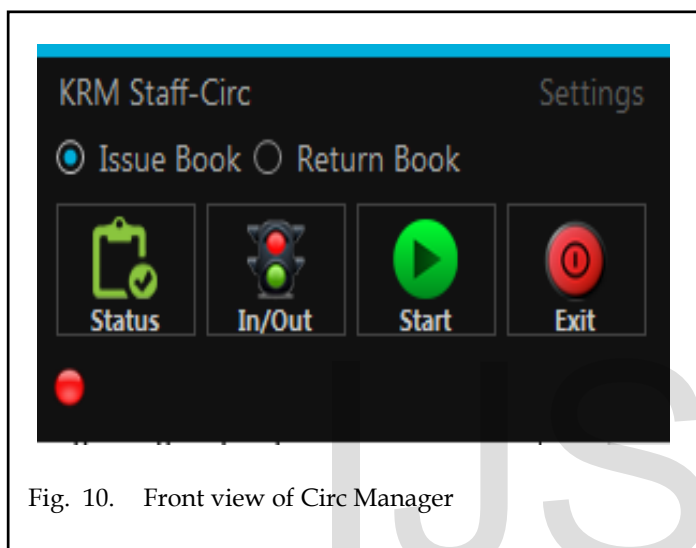

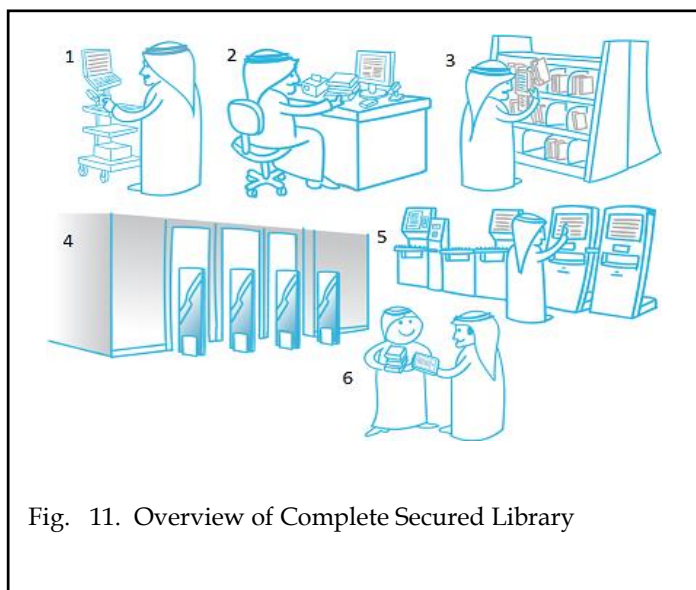Fig. 10.   Front view of Circ Manager

5   SYSTEM OVERVIEWS

Fig. 11. Overview of Complete Secured Library

In above figure (11) icon number 1st the librarian is busy to program the new items using staff station with staff station manager software, in 2nd the librarian is busy to print the barcode according the LMS, in 3rd the librarian is busy in shelving, counting or searching using inventory device, in 4th the installed RFID security gates are shown, in 5th The user using self-check for issue/return the book, in 6th the librarian is discussing the security system to the student

6   CONCLUSION AND FUTURE WORK

The RFID based library management system is very unique and easy to implemented system. Using proposed solution most of manual tasks are reduced, so it is make this system more time saving and fast transactions, in staff-station librarian can issue return more than 10 items at a time, in inventory device can arrange the shelves, from self-check system the end user is able to issue and return the items, and from RFID based security gate provide the feature of theft control. Most important is data security; no any one can access to read the data with out having the encryption key info and same for issue the item.

However, in future many amendments can be done to make the final system more secure, feasalbe and user friendly in scence of encryption decryption algorithims, alarms notifications, web based centerlized system etc.

ACKNOWLEDGMENT

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