SMART LIBRARY SYSTEM USING NFC TECHNOLOGY

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Abstract: IoT is an emerging trend at present. A concept of "Smart connected environment" is gaining ground in day to day life. Meanwhile, use of internet technology in library management system is also in rise. Earlier system predominantly used RFID or barcodes. These however, had their own limitations. Taking these drawbacks into consideration, we would like to propose a system based on the NFC technology. NFC tags are embedded on the books and are read with the help of NFC readers. This enables accurate, efficient and theft-controlled library operations. This system can also allow the user to read books from their phones, irrespective of their location. The system uses the data stored on the cloud. One of the major goals of this Internet based "Smart Library System" is simplifying the user's task of searching for the books and issuing books. It also ensures improved maintenance of the books.

IndexTerms - **Near Field Communication (NFC), Radio Frequency Identification(RFID), Internet of Things (IoT)**

I. INTRODUCTION

Internet on Things pertains to networking of physical objects or "things" embedded with electronics, software, sensors, and connectivity that enables objects to exchange data with the manufacturer, operator and/or other connected devices based on the infrastructure of International Telecommunication Union's Global Standards Initiative. The figure of online capable devices increased 31% over 2016 to reach 8.4 billion objects in 2017. Experts estimate that this number would touch 30 billion objects by 2020. In the existing system, barcodes and Radio Frequency Identification (RFID) have been used. The problem with the barcodes is that it is a technology that is image-dependent and less durable in comparison to Near Field Communication (NFC). NFC provides an advantage to RFID by peer-to-peer communication. NFC device can act as a reader as well as a tag. This feature of NFC has made it a popular choice.

NFC is a method of transmitting information or data from an NFC label, sticker or tag to an NFC enabled devices. Android phones also use NFC with the Android Beam service to share data between phones. NFC does not use WiFi, 3g, 4g, LTE or bluetooth to send or receive information – it is an entirely different technology.

In our project, we are using an NFC tag with the help of an NFC reader to read the relevant content pertaining to the book. NFC is a relatively cheaper solution to install as there is no additional technology required in case the use is promotional or for customer information purposes. The cost of using RFID tags can range anywhere between $4 and $20 depending on its variations. This means that these types of tags are usually assigned for tracking the high-value items such as shipping containers, machinery and tools, etc.

II. SYSTEM DESIGN

In our system, we have attached NFC tag to each book and to the student identity card to ensure that it uniquely identifies and communicates wirelessly. A computer is placed at a convenient location in library for the user to read the relevant details. The existing system also allows finding the book using RFID technology. However, the student or user has to open every book to read its content. This is not only time-consuming but also results in wear and tear of the books.

In our proposed system the user or student can scan the NFC card attached on the books and view the relevant content of the book such as the index or preface. Thus, the user can scan multiple books and view them on this computer in one go before deciding the final book that he/she would like to read. The technology also offers the benefit of being able to return the book by clicking the button return, thus saving librarian's work and the time in long queues. Furthermore, a user can access the content of the book from any remove location, using any internet enabled device by punching in book id and its author name. All e-books stored on the system will be available for the user, sitting at the comfort of his home. And when the user wishes to return the book, librarian will take the book using handheld reader and keep eye on data that would calculate fines. Librarian will also update book information and its location also.

III. SYSTEM COMPONENTS

Bluetooth

HC-05 module is Bluetooth SPP (Serial Port Protocol) module used to transmit and receive the data. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. It is used to allow two way transparent communications. It establishes a connection between PC and NFC Reader. The HC-05 Bluetooth Module has 6 pins.

Figure.1. Bluetooth HC-05

Features
- 5V power operation
- UART interface
- 10 meters range
- Minimum External Components
- Status LED

Specifications
- Bluetooth Protocol v2.0
- Range 10 meters
- Rate: 2.1 Mbps (Max)/160kbps
- Authentication and encryption

MLX90132 NFC Reader

The NFC reader is connected to the Buck boost and Bluetooth model. When NFC tag is tapped on NFC reader, the data fetched from the cloud is displayed on computer /mobile.

Figure.2. MLX90132 NFC Reader

The MLX90132 is a 13.56 MHz, fully integrated and multi-protocol NFC transceiver IC. It has been designed to support a range of protocols, thus facilitating the NFC functionality.

The MLX90132 supports Reader/Writer mode: to read-out NFC tags compliant to the technologies NFC-A, NFC-B, NFC-F and ISO/IEC15693

Card emulation mode: To emulate NFC tags compliant to the technologies NFC-A, NFC-B and NFC-F

Peer-to-Peer mode: To communicate with NFC compliant active devices such as smartphones.

Features:
- Conforms with ISO/IEC 18092 (NFC-F)
- Conforms with ISO/IEC 14443 (NFC-A and NFC-B)
- Conforms with ISO/IEC 15693 or ISO/IEC 18000-3 mode 1
- Standard SPI interface with 528 bytes buffer
- High speed communication up to 848 kbit/s
- Embedded RF field and TAG detectors

- Power supply from 2.7 to 5.5 Volts.

NFC card

NFC tag usually consists of EEPROM, processor or micro controller unit, anti-collision algorithm, authentication and cryptographic mechanism, RF interface circuit, etc. There are different types of tags developed based on various applications of use such as type-1 tag, type-2 tag, type-3 tag, type-4 tag and type-5 tag.

Figure.3. NFC Tags

Features:
• NFC Tag can be either active or passive device.
• Limit of memory storage
• Operation speed
• Data access mode read/write or read only.
• Collision mechanism.

LM2596 Buck Converter

It is a DC-to-DC converter with an output voltage magnitude - either greater or less than the input voltage. It is equivalent to a flyback converter using a single inductor. Buck–boost transformers can be used to power low-voltage circuits including control, lighting circuits, or applications that require 12, 16, 24, 32 or 48 volts, consistent with the design's secondaries. The transformer is connected as an isolating transformer. Boost converter is driven by the tendency of an inductor to resist changes in current by creating and destroying a magnetic field. The output voltage is always higher than the input voltage. A schematic of a boost power stage.

Figure.4. LM2596 Buck Converter

Specification:
- Conversion efficiency: 92% (highest)
- Switching frequency: 150KHz
- Input voltage: 4.75-35V
- Output voltage: 1.25-26V (Adjustable)
- Output current: Rated current is 2A, maximum 3A (Additional heat sink is required)
- Conversion Efficiency: Up to 92%

- Switching Frequency: 150 KHz

Handheld Reader:

Using above components, this handheld reader is constructed to read NFC tags**.**

Figure.5. Handheld Reader

IV. IMPLEMENTATION

The process is divided into five modules that are described as follows:

4.1 Initial Setup:

NFC tag is attached to the book's back cover as soon as the library procures a new book. This tag stores data such as the Book id. Other details of the book are also fetched from the cloud database. The same database also stores all information for the student. Each student also has a registered NFC card which is giving during the admission process. These cards store the information such as the student id number, address, roll no, name, branch, etc. Students will thus have to validate themselves through their NFC cards.

4.2 User Interface:

Student or members are only required to place their ID card on the NFC Handheld Reader in order to login to their Self-account. They can borrow material, browse the library, review their history, and return material.

Figure.6. User Interface

4.3 Issue Process

If the student wants the book issued, the handheld device will be tapped on the student's NFC tag. Then the NFC tag of the book is scanned and record will be updated in the system.

Figure.7. Book Issued

4.4 Return Process

When student wants to return books, admin simply places the book again in front of the handheld reader and then scans the student's ID card using same handheld reader. After scanning book id and student id, click on the Return button. Finally, a message is display "Book returned successfully".

Figure.8. Book Return

4.5 Fine calculation

Books are automatically returned against the student name when they are scanned. During the return process, librarian can inform the student of if any fine that may be payable by him.
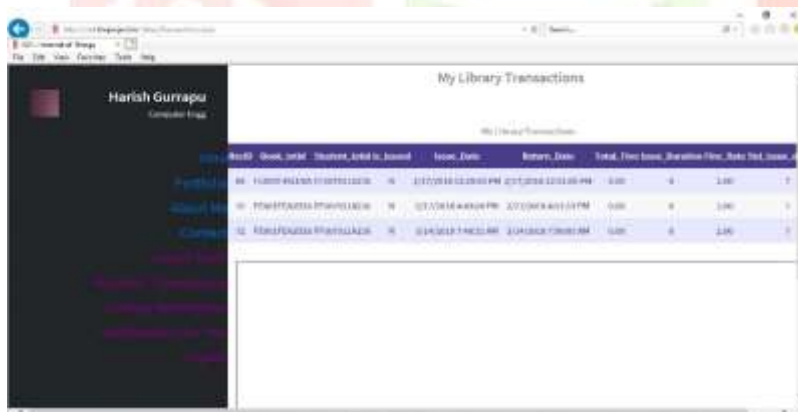

Figure.9.Admin can also do the fine calculation

V. ISSUES AND CHALLENGES

While developing the proposed system, below challenges were encountered.
- Proper synchronization of hardware and software to ensure the effective working of the library system.
- Careful connection the handheld reader.
- Sensing the tags, reading via reader and to get the appropriate output on the system screen.
- Ensuring compatibility in terms of frequency, standards and other parameters.
- High speed internet is required for effective working of this system.

VI. CONCLUSION

In this paper, we have implemented our Smart Library System. It helps avoid the books being misplaced and over-handled thereby reducing its wear and tear which otherwise increases the library's costs. NFC tags placed on the book helps the user with the handheld device to expedite the issue and the return process. Students can interact with the library server to view the content of the books required as well as its availability in the library. More complex and efficient security measures can be implemented to ensure safe transactions in the library.

REFERENCES

[1] "RFID Based Library Management System", Discovery,Volume 19, Number 55, pp. 6-5, 2014.

[2] Shawshank Agarwal and Dario Vieira, "A Survey on Internet of Things", Abacus, Belo Horizonte, Volume 1, Number 2, pp. 78–95, 2013.

[3] NFC Forum: Available at: http://nfc-forum.org.

[4] The academic library as an educational system Proactive Marketing for the New and Experienced Library Director, 2014, Pages 17-27 Melissa U.D. Goldsmith, Anthony J. Fonseca.

[5] Online Computer Library Center: Available at: http://oclc.org.

[6] "The extensible library" The Patron-Driven Library, 2013, Pages 179- 212,Dee Ann Allison.

[7] Andrea Zanella, Nicola Bui, Angelo Castellani, Lorenzo Vangelista and Michele Zorzi, "Internet of Things for Smart Cities".