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Internet of Things Approach in RFID based Secured Library Management System

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Abstract: In recent days, Internet of Things has an essential influence in all elements of human life. The proposed system aims to implement the RFID based Library Management System with the Internet of things approach. This is achieved by hosting an application specific webpage of a library. Students can get access to the webpage with the help of any internet enabled device and avail the information regarding the availability of required book, anytime, anywhere. Along with this, the updated accessibility status of the book, whether it has been issued or not can also be availed. Student can also get access to the contents of the books, which may help them to compare the contents and select the required book. Moreover, the face detection feature implemented using raspberry pi will ensure that the book transaction process is carried out in a secured environment.
Keywords: Internet of Things, Face Detection, Library Management System, Raspberry Pi, RFID.

I. INTRODUCTION

The term "Internet of Things" is attributed to Kevin Ashton of Procter & Gamble, who in 1999 article used the phrase to describe the role of RFID tags in making supply chains more efficient. The Internet of Things (IoT) is a network of physical objects capable of gathering and exchanging electronic information, with the help of Internet connectivity [7]. The libraries have always been seeking help of the technological advancements to improve their services to the patron. Internet of things approach can also be implemented in the today's Library Management System. Implementation of Radio Frequency Identification technology in libraries is becoming a common scenario these days. The proposed system highlights the advantage of implementation of RFID technology in management of library resources and carries out book transaction process. RFID provides a quick, flexible, and reliable way for electronically detecting, tracking and controlling variety of items. They are thus exhaustively used in inventory management. RFID systems use radio transmissions to send energy to a RFID tag while the tag emits a unique identification code back to the RFID reader linked to the system. This data can be stored to the host computer to be retrieved back when required. Thus, Internet of things approach can easily be deployed when the libraries use RFID based Library Management System. Face detection feature enables secured access to the library resources.

II. LITERATURE REVIEW

The primary objective of a library is to facilitate access to information for knowledge, education, research and learning purpose. With the advent of technology, traditional libraries are converting into smart libraries. Barcode technology is one such tool used over years to manage the resources by the academic libraries. However, Barcode technology has certain limitations. Major functions of the Barcode technology based library require manual control. Barcodes, which are printed on a piece of paper using barcode printer and posted on library books, get impaired with the course of time and lose their readability. The bar-code readers have a very small read range of about very few centimetres. Also, the bar-code reader should have direct line of contact with the bar code while issuing or returning books.

These demerits are overcome by the introduction of RFID technology. RFID technology is found to be more comprehensive than barcode technology. Muhammad Rafiq [1], presented an in depth analysis of RFID use in libraries with implementation roadmap, its impact on libraries. Narayanan A. et.al [2] discussed the RFID technology, its components, implementation methodologies, advantages and disadvantages in library. Dwivedi, Y et.al [3] stated that, in order to increase efficiency of library operations, many libraries are moving towards automation of majority of their activities and are deploying RFID technology as a substitute for barcode systems. Majid Bayani et.al [4] proposed an implementation framework for employing the IoT in renovating the conventional library systems to become smart online library schemes. They concluded that the IoT-based library management systems will be a promising structure that can play a vital role in the human data organization and knowledge access by helping researchers, designers, and administrators in a more efficient and smarter manner.

III. PROPOSED SYSTEM
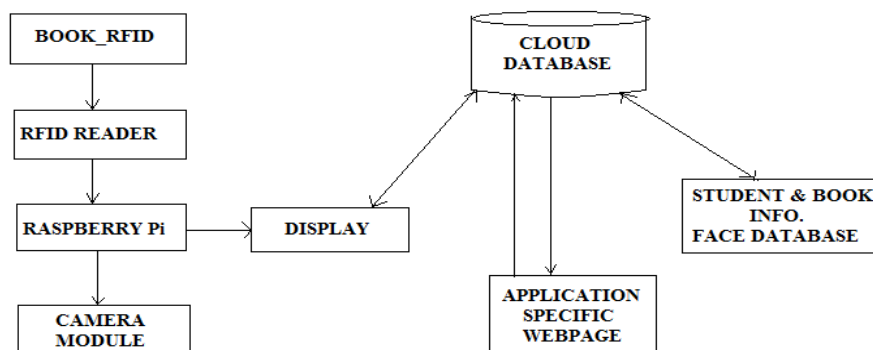
A. Block diagram of the Proposed System

Fig 1. Block schematic of the proposed system

B. Block Diagram Description

The proposed system comprises of RFID system i.e. RFID tags which are attached to the library books and an RFID reader which is connected to the Raspberry Pi. A camera module is connected to the Raspberry Pi to capture the images of the students. Also a display unit, here in this case, a monitor of a computer is used to display the book transaction options and related messages to the student. The student information along with their face database is stored in the cloud database which can be accessed during book transaction process and verification of student. Also the information of library books uploaded and saved to the database can be availed by the student using the application specific webpage.

IV. SYSTEM TOOLS

A. Raspberry Pi3 Model B+

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV using HDMI, and uses a standard keyboard and mouse. It can run a host of operating systems, such as Raspbian (Debian Linux), Android, Windows 10, IoT Core, etc.

Specifications of ModelB+ [8] include

1) *Processor:* Broadcom BCM2837B0, Cortex-A53 64-bit SoC @ 1.4GHz
2) *Memory:* 1GB LPDDR2 SDRAM
3) *Connectivity:*
a) 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.2, BLE
b) Gigabit Ethernet over USB 2.0
c) 4 × USB 2.0 ports
4) *Access:* Extended 40-pin GPIO header
5) Video and Sound:
a) 1 x full size HDMI
b) MIPI DSI Display Port
c) MIPI CSI Camera Port
d) 4 pole stereo output and composite video port
6) Multimedia: H.264, MPEG-4 decode (1080p30); H.264 encode (1080p30); OpenGL ES 1.1, 2.0 graphics
7) SD card Support: Micro SD format for loading operating system & data storage.
8) Input Power:
a) 5V/2.5A DC via micro USB connector
b) 5V DC via GPIO header
c) Power over Ethernet (PoE)–enabled (requires separate PoE HAT)
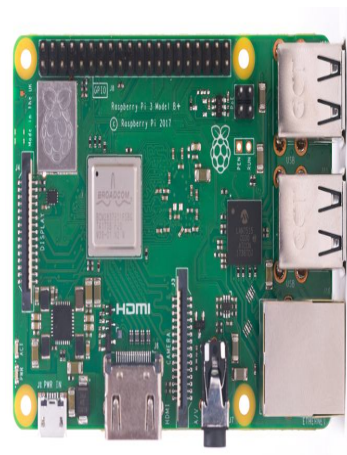
B. RFID Card

RFID card includes microchip with radio antenna mounted on substrate which carries 12 Byte unique Identification number. RFID cards are contactless and can be read from a distance. These cards are extensively used for identification and authentication purposes in various industries

Specifications

1) Storage capacity: 8Kbit
2) Operating frequency: 13.56MHZ
3) Reading and writing distance: 2.5-10CM
4) Reading and writing time: 1-2MS
5) Number of erase cycles:> 100000 times
6) Data retention:> 10 years

C. RFID EM-18 Reader Module

It is used to read unique ID from RFID tags. Whenever RFID tags comes in range, RFID reader reads its unique ID and transmits it serially to the Raspberry Pi. RFID reader has transceiver and an antenna mounted on it. It is mostly fixed in stationary position.

Specifications of EM-18 Reader Module

1) Operating voltage of EM-18: +4.5V to +5.5V
2) Current consumption:50mA
3) Can operate on LOW power
4) Operating temperature: 0ºC to +80ºC
5) Operating frequency:125KHz
6) Communication parameter:9600bps
7) Reading distance: 10cm, depending on TAG
8) Integrated Antenna

V. SYSTEM IMPLEMENTATION

A. Initially images of students are captured using camera connected to the Raspberry pi. These images will be saved as student's face database in the server which can be accessed later at the time of student verification.
B. RFID cards are to be attached to all the books, magazines and other library resources before they are arranged in their respective shelves.
C. An application specific webpage is hosted with the help of a DigitalOcean; a Cloud Service platform to store and access the data of students as well as library books

In the proposed system, the RFID tags are attached to each book for unique identification. There will be options displayed on the screen whether the book is to be issued or returned. After selecting one of them the student will be asked to enter his username as well as roll no. This will activate the camera module. The camera connected to the Raspberry Pi module will capture the image and compare it with the face database, further the message will be displayed whether or not the face of the student is recognized. This ensures security while accessing the library resources even without the use of Identity Cards. This feature forbids the otherwise possible misuse of Identity Cards used in the libraries.
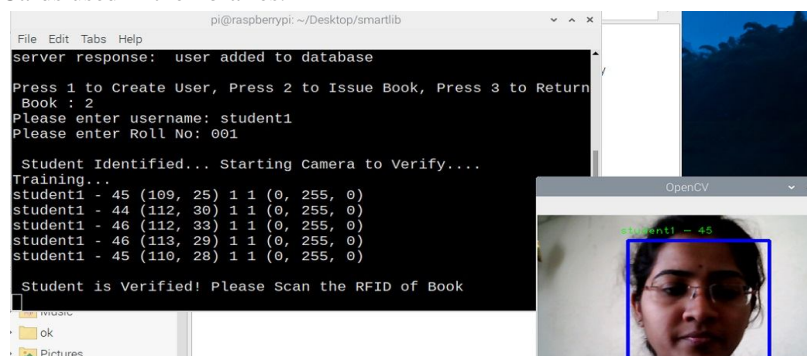

Fig 2. Face detection before the book transaction process

After student's identity is verified, further process such as issuing or returning of books will be implemented according to the need of the student, merely by scanning the RFID card attached to the book in front of RFID reader. Therefore, there is no need to spend time standing in long queue for issuing book. Also, librarian's work gets saved. There will be computers allocated in the library for patrons use. New users can be added by selecting the first option, after which basic student details such as Roll number, branch, user id and password has to be entered. This will create a new student account and get saved in the database.

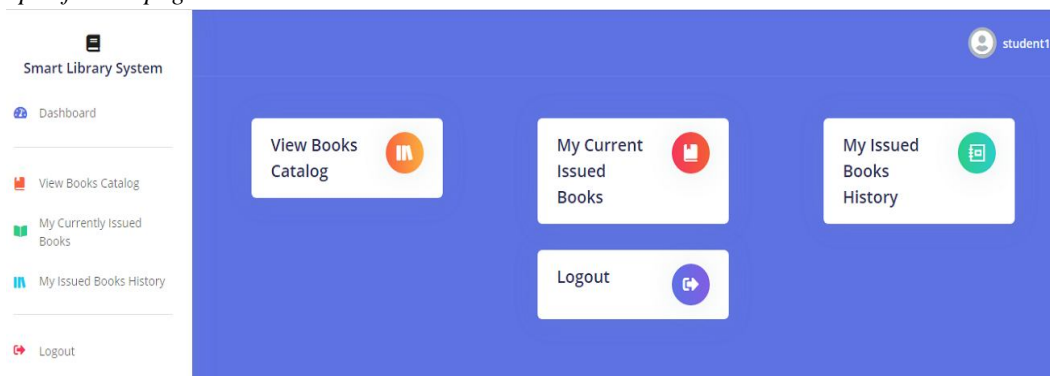*1) Application Specific Webpage*

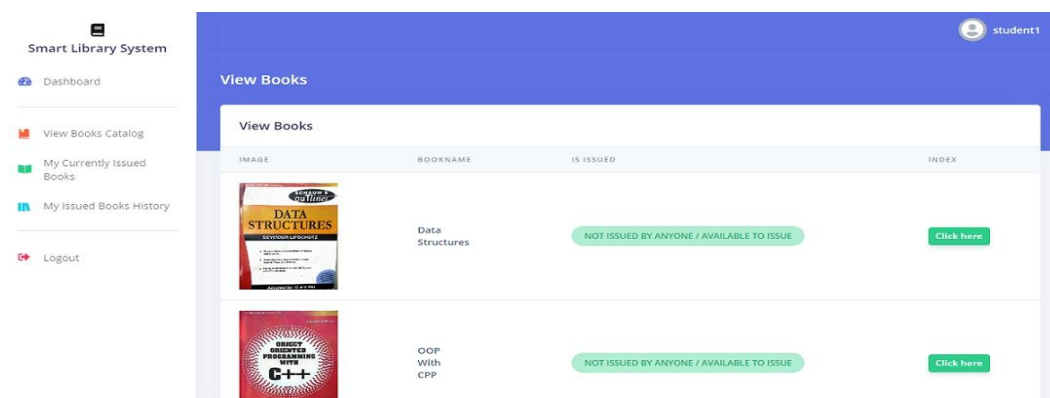Fig 3. Dashboard of Student's Account

Fig 4. Status as well as contents of the books

With the help of application specific webpage, student can access his/her account using any internet enabled device and can search for the book using its name, author and whether it is issued already by someone. The library data can be accessed not only within the college campus but from anywhere with the help of device having internet connectivity. Students can have access to their self accounts using their user id and password. Information such as book issue history, availability of books, etc. can be seen on the student's dashboard. Students can also read the contents of books in PDF format, so as to decide the selection of books among the available books.
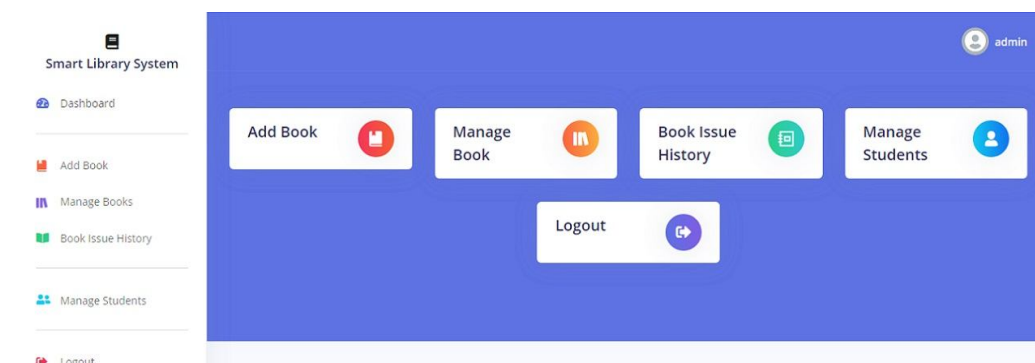

Fig 5. Dashboard of Admin's Account

The librarian will be the admin of the webpage. He will have a unique username and password to access and control the whole process of library management system. Admin can manage the books database by adding or removing books from the database, admin has access to the book issue history of students. He can also manage adding or removing of student accounts. When the book gets issued or returned by the student, the status of the book instantly gets updated and saved at the database. This makes possible for other students to get the correct information regarding the availability of required book when they login into their accounts.

VI. CONCLUSIONS

The proposed Library Management System facilitates the students to avail the updated information of the library resources at the reach of a single click; thus saving their precious time and energy. It aims to automate the book issuing as well as returning process. The face recognition feature ensures that only authentic students, whose face database is already uploaded to the server, will be given access to the further process of book transaction. This will eliminate the use of separate library identity card, as well as prohibit the misuse of identity cards. Since many institutions are switching from barcode technology to RFID based management these days, deploying the Internet of Things approach becomes easy. It can be said that applying the Internet of Things approach in the implementation of library management systems is promising for the upcoming future.

VII. ACKNOWLEDGMENT

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