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Autonomous Integrated Library

Prakash Sinha[1], Dileshwari[2], Balamdina Ekka[3], Aman Yadav[4]

B.E. Final Year Student, Computer Science and Engineering, Government Engineering College, Bilaspur, India[1-4]

Abstract: The libraries are an organized collection of different sources of information where an individual can easily borrow the information in the form of a book/journals or can refer to the sources there itself. Modern libraries simply work using manpower and are time inefficient. But the use of the digital library makes the performance of using the library to be more efficient by providing quick access to services and information. This project aims to design and implement a digital and virtual access library for monitoring and controlling transactions in the library. Autonomous Integrated Library (AI-L) is a next-generation library for non-academic or academic libraries in which every single task will be done digitally i.e. by using an android application by the user and web application by the administrator. Both interface will share common centralized real-time cloud database. Autonomous Integrated Library will be a paperless library system in which there will be no complexity for the librarian to maintain records of the borrower manually rather all the information is saved digitally in cloud and the information is also available in real-time.

Keywords: AI Library, Cloud Library, Virtual Library, Remote Access Library, Digital Library, E-Library, Smart Library, Automated Library, Library Management System, Cloud Application, Android Application

I. INTRODUCTION

In this era where science and technology are growing at a higher pace, one requires to maintain themselves to be able to compete with the present time. So a library which is a good source of information and knowledge requires to compete with the present world and to maintain its accessibility among user in requires or to say need to be automated. Therefore keeping in mind today's technology, Autonomous Integrated Library (AI-L) is being designed to overcome the time and efforts being required in issuing and submitting of book, keeping track of data and books, etc. Our main goal is to make all library resources accessible from the remote area. Students and professors can find a correct book based on their curriculum, make borrow requests from anywhere, and anytime, no physical presence is required for requesting library resources, also reduce the human effort of the librarian, we want to develop complete virtual and remote access library system. AI-L is a library where all actions will be done by autonomous devices such as computers and mobile devices. There will be no requirement for any librarian for issuing of books, maintaining records in the registers, etc. AI-L will be a digital library that requires a less human interface for maintaining records, the transaction of books, etc. AI-L will be a paperless library which also saves time and effort.

Software requirement specifications for Autonomous Integrated Library are specified as below:

A. Administrator Requirements

- In AI-L, the administrator works on the administrator interface which is a web application that can easily run on web browsers
- The main role of the administrator is to manage and keep track of records of libraries such as books and journal records, students' and professors' records, etc.
- Using AI-L, only the administrator can return/submit the book borrowed by the borrower.
- The administrator will be able to register, delete or manage records of the borrowers, books, and journals by using the AI-L
- Work like No-Dues of any books, journals, and borrowers will be done only by the administrator
- The protocol for accessing library will be decided only by the administrator, and AI-L will work accordingly
- Allow/Deny of a new request for registration of borrowers will be done by the administrator by using an administrator interface

B. Borrower Requirements

- The borrower could easily interact on library via borrower interface, which is available only on the android platform that requires the use of an android mobile
- The borrower could register themselves in AI-L for accessing the content of a library
- A borrower can only access library resources if and only if they will be allowed by an administrator
- A borrower should have their user account for accessing the resources of the library using AI-L
- The borrower could easily view the list of available books in a library in AI-L application
- The book issuing processes will be done via borrower interface using the AI-L application

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- In AI-L application, the borrower will be able to track their transaction history
- The borrower could manage and update their registered records on library easily

II. LITERATURE REVIEW

We had been gone through 50+ research papers, and meet many experts for developing such a library system, which will be cost-effective, easy to deploy and maintenance, user-friendly environment. The result as a literature review or related works is further described.

Library management using voice recognizer robot system, in this library system robot is used for only searching the book by using the laser pointer, in this system the requirement of hardware such as RAM, Robot and other hardware is high and costly [1]. RFID based library management system, an automatic identification technique RFID tag is placed in every book and borrowers' ID card, this project challenges for frequency reading accuracy of the tag and chances of damage the RFID Tag [2]. Li-Fi based library management system, this technology makes a LED light bulb emit pulses of light that are undetectable for the human eye and within those emitted pulses, data is transmitted through the light rays, need to maintain the light source without light source we can't access the data, required light source, photodiode and other costly hardware [3]. An advanced library management system using an android device, all the process is done through the smartphone, here the data stored outside of the institution on an online database server which cause data leak and theft, working continue through a smartphone can irritate the librarian [4]. Advanced library management system, in their library barcode technology is used for issuing and returning the library resources, after scanning the barcode, students and book details display in librarian's pc, human interaction is required to scan a barcode, and at a time they can only read/scan one barcode [5]. Development and implementation of smart RFID Based library management system using raspberry PI and µfr Nano with android OS, SQLite database performs database operations on android devices such as storing, manipulating, or retrieving persistent data from the database, require a huge amount of financial investment [6]. Enhancing library services using a barcode, QR scanner, and RFID technology, the library put two barcodes in each book, and a QR code is placed in the student's ID card to get its details if someone removes the RFID tag than it becomes very big security problem [7]. A java based university library management system, this library system used MYSQL database, the complete project is based on the local server and required physical presence and more human efforts [8]. Smart library system using IoT, they use the Arduino mega, RFID, LCD, Buzzer, GSM technology, and NodeMCU, RFID is used to check the availability, misplacement of book, provide antitheft system and location of the book, system crash due to any damage in the interconnection [9]. Library management using real-time face recognition system, library system having two databases that are student and library database, and the camera is used for face-recognizing, there is any variation in the human face and is more sensitive to environment condition, require a huge amount of data storage [10]. Smart basket for the library, the RFID reader is attached with the basket, the issuing and returning of the book done through the smart basket, the RFID reader is attached to every bucket that increase capital cost, and causes to damage of barcode and basket by miss handling [11]. An IoT based secured smart library system with neck based book tracking, in this library near field communication and local positioning system is used, authentication is done through the biometric fingerprint, error in fingerprint reader will affect the proper scanning of fingerprint [12]. Library management and access system using Bluetooth, where Bluetooth is a wireless technology standard for exchanging data over a short distance in a very efficient way, sometimes the Bluetooth device does not recognize the sender and the receiver, the low range device will cause the slow transfer of data [13].

III. ARCHITECTURE

Principle of working: Autonomous-Integrated Library working principle is defined in the given diagram. In AI-L, there will be two interfaces, administrator interface, and student interface. Both interfaces share a centralized cloud database. Student interface will be used for tracking book availability in the library and accessing them, the administrator interface will be used for submission of books, registration, and management of books/journals/borrowers records. AI-L used a real-time cloud database i.e. firebase real-time database. Firebase database store data as JSON format. Both interface, borrower interface, and administrator interface use data, stored in the cloud. While the user makes any request for library resources, the administrator can keep track. While administrator update or insert new records borrower can saw them. Or we can say that any kind of modification of data on a real-time cloud database can be shared and accessed by both interfaces. Only some of the task, for example, taking the book/journals from the library requires physical access. But maximum work is done digitally in AI-L. Autonomous Integrated Library will be a paperless library system in which there will be no complexity for the librarian to maintain records of the borrower manually rather all the information is saved digitally in cloud and the information is also available in real-time. Thus, saving time and efforts.

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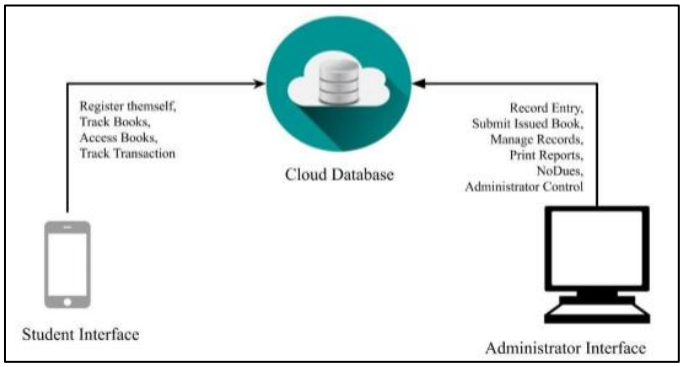

Fig. 1 Principle/Block Diagram of Autonomous Integrated Library

Administrator Interface: Administrator interface is a web application that will be run on a web browser. It is compatible with both, desktop/laptop browsers and mobile web browsers. Administrators have to open the interface for only submitting issued books, record entry, and manipulation of records. The task issue book, search book, maintains record registers, etc. are reduced by AI-L. The following figure will describe the flow of the administrator interface.

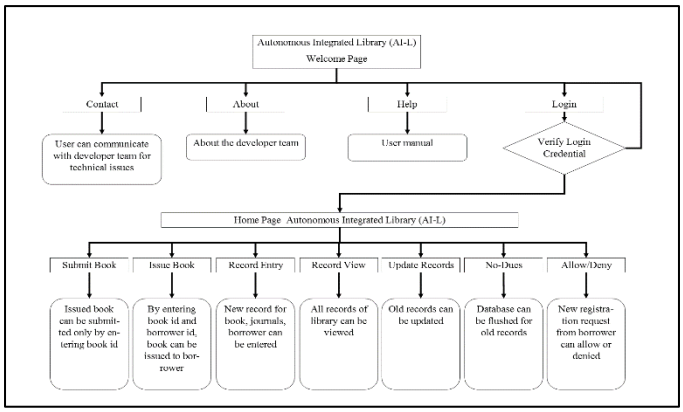

Fig. 2 Functions/Flow of Administrator Interface

Here is a table with a brief description of the functions of the administrator interface.

TABLE I FUNCTIONS OF ADMINISTRATOR INTERFACE

Page/Function	Description
Welcome Page	Welcome/Start page, where admin has login, help and other options
Login Page	The administrator can be login using their credentials into the administrator portal
Home Page	After login, the home page will appear where quick buttons are available for performing actions by administrator
Record View	Here the administrator can view all registered record of books, journals, issued books and borrowers
Issue Book	An administrator can issue books to borrowers by entering book id and borrower id. This is an optional task for administrators. In case of the borrower have no android phone then they can issue book by administrator
New Record Entry	For new record entry i.e. new books, new journals can be done using this page. Borrower record also can be registered using this page
Submit Book	By entering only book id, the administrator can submit book issued by the borrower
Allow/Deny Request	A new user can only access library resources after allowing it by the administrator. This can be done using the allow/deny page
No-Dues	No-Dues for both books/journals and borrower can be done using No-Dues page
Update Records	Old records can be updated by using this page

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Borrower Interface: Borrower can access all library resources available in AI-L, for such thing borrower have to install AI-L Borrower interface on their android mobile, then he/she have to register themselves. After allowing by the administrator, the borrower can log in with their provided credentials. The borrower can track the availability of books in the library. Also, borrowers can provide feedback for any book, and suggest to others. The following figure will describe the flow of the borrower interface.

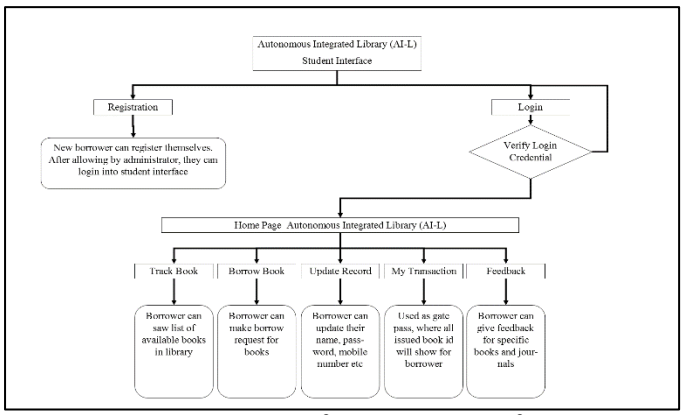

Fig. 3 Functions of Borrowers' Interface

Here is a table with a brief description of the functions of the borrower interface

TABLE II FUNCTIONS OF BORROWERS' INTERFACE

Page/Function	Description
Registration Page	A new borrower can register themselves by entering the required information. They can only access library resources after allowed by the administrator
Login Page	The borrower can log in using their login credentials provided by AI-L, they have to change their password while the first-time login
Home Page	After login, the home page will appear which has quick buttons for performing actions such as book track, borrow the book, update his/her records, etc.
Track Book	The borrower can saw a list of books and their availability before making borrow request of book
Borrow Book	By entering the book id, the borrower can make borrow request for the book, Borrower has to collect requested book before allotted time expire
Update Records	The borrower can update their registered record like name, mobile number, password, etc.
My Transaction	This page will be used as a gate pass. Here all book id will show that the borrower makes an access request
Feedback	The feedback page which allows the borrower to give feedback about library resources

IV. Result And Discussion

Autonomous Integrated Library is a next-generation library which provides a better way to borrow the book or see the availability of books online. All the work will be done automatically and there will be no requirement for keeping the records in big registers rather than it will keep track of all the books digitally. Details of the students and professors borrowing books are kept in a register and when the time of submitting book comes, it requires a lot of time to search for such candidate and the details are being matched then only the books are being submitted. But in Autonomous Integrated Library, there is no need to keep records of such things in the register rather all the records are maintained in the cloud database and one can easily track the availability of books, update its details in no time and borrow books easily. As a result, there is less time consumption in issuing of books. Also by using mobile, one can search the availability of books and the number of books, they will be able to borrow. For such kind of information, one does not require to open the register of the library but by one click they will be able to get all the required information easily.

Performance Analysis: We had been gone through two working libraries, one from our college government engineering college, Bilaspur (C.G.), where library manage by manual work, and another library from government polytechnic, Kabirdham (C.G.), where library manage by the computerized library. We compare both libraries with our AI-L and analyze the following result-

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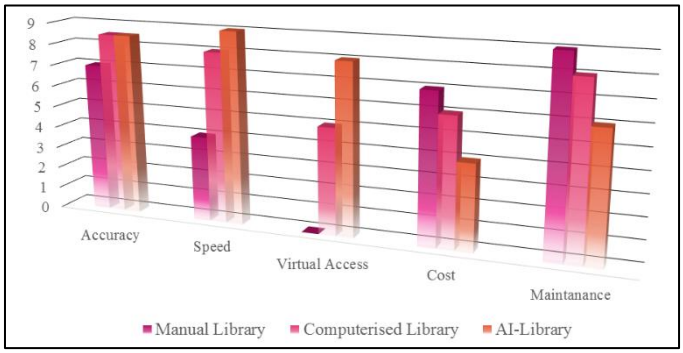

Fig. 4 Comparison of AI-L with Manual and Computerised Library

- Autonomous Integrated Library reduces the time consumed in checking and tracking the books. Finding the details of students or professors is quite easier in Autonomous Integrated Library.
- In Autonomous Integrated Library, there is less or to say no human effort is required. All the work is done automatically.
- The Autonomous Integrated Library requires paperless works. So there is no need for any kind of Pen, Papers or Registers, etc.
- Speed is one of the important things in the AI-L. It is quite fast in terms of the normal Library System being used nowadays.
- Using Autonomous Integrated Library provides virtual access, so the updating of details is quite easier and does not require the involvement of librarians for some simpler task but the user can easily modify some of their details from their mobiles.
- The maintenance in AI-L requires less effort and less cost. It provides high accuracy.

V. CONCLUSION

The Library system needs to acquire digital technology, to compete with all requirements of the user. Unlike the modern library, today the library is being automated to maintain the time being wasted in the borrowing of books. The place with which the world is being run requires the work to be done as fast as possible. So to maintain such place AI-L will be quite helpful. AI-L is a highly integrated, user-friendly, and compatible system for complete computerization of all the in-house operations of any size or type of library. The library management software requires to be efficiently compliant and initiative. The right way to handle and maintain a large number of books requires an automated system that could easily keep track of books and also of the borrower who had issued that particular book. An Automated Integrated Library would provide better library services to its users and will be able to maintain the library more accurately which a manual library can't do. When using an automated library system, it usually becomes very easy to maintain the records of particular activities, and also the generation of the reports becomes easy. To make a library system work smoothly, it requires a proper execution with proper planning. The application based on cloud-based that are used by academic library users are not limited to resource databases but also other applications that students regularly use in conjunction while reading references and writing assignments therefor libraries need to leverage the increasing end-user information literacy levels. This Automated Integrated-Library will completely automate all the activities of the library. By using AI-L one will be able to find the books accurately, issue/reissue books easily and can maintain their data orderly and efficiently.

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BIOGRAPHIES

Mr. Prakash Sinha pursuing Bachelor of Engineering in Computer Science and Engineering from Government Engineering College, Bilaspur (C.G.) Affiliated to Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.) in 2020. He also completed his diploma in Computer Science and Engineering from Government Polytechnic, Kabirdham (C.G.) in 2017. He also completed his industrial trainings is Networking from AAI Mana (Raipur C.G.), and CCNA – Cisco from (CRISP, Bhopal, M.P.).

Ms. Dileshwari pursuing Bachelor of Engineering in Computer Science and Engineering from Government Engineering College, Bilaspur (C.G.) Affiliated to Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.) in 2020. She also completed her industrial training in Core and Advanced Java from CRISP, Bhopal, M.P.

Ms. Balamdina Ekka pursuing Bachelor of Engineering in Computer Science and Engineering from Government Engineering College, Bilaspur (C.G.) Affiliated to Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.) in 2020. She also completed her diploma in Computer Science and Engineering from Government Polytechnic, Jashpur (C.G.) in 2017. She also completed her industrial training in Core and Advanced Java from CRISP, Bhopal, M.P.

Mr. Aman Yadav pursuing Bachelor of Engineering in Computer Science and Engineering from Government Engineering College, Bilaspur (C.G.) Affiliated to Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.) in 2020. He also completed his industrial training in Core and Advanced Java from CRISP, Bhopal, M.P.