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AUTOMATED LIBRARY ASSISTANT ROBOT

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Abstract: This innovative project leverages automation to streamline library management [1]. A robot, guided by a pre-established path, tracks shelf layouts in the library. Controlled by an Arduino UNO, it receives input from a PC regarding the desired book. Upon reaching the designated shelf, the robot compares saved RFID tags with the books present. Once the match is found, its robotic arm retrieves the book [2]. Remarkably, it can also return books to their shelves autonomously. This integration of robotics and technology not only enhances efficiency but also minimizes manual labour in library operations.

Keywords: Arduino UNO, RFID, Robotic arm, Automation.

I. INTRODUCTION

Libraries are magical places filled with books, knowledge, and adventures waiting to be discovered. But behind the scenes, there's a lot of work that goes into managing all those books and resources. That's where librarians come in—they're like the wizards of the library, using their expertise to organize, locate, and provide access to the treasures within. However, even the most skilled librarians can sometimes feel overwhelmed by the sheer volume of tasks they have to juggle. Finding specific books among the countless shelves, helping patrons with research inquiries, and ensuring everything is in its proper place can be a daunting challenge. This is where technology, specifically robotics, can lend a helping hand [3]. Enter the library assistant robot—a friendly, helpful machine designed to assist librarians in their daily tasks. These robots are equipped with advanced sensors and navigation systems, allowing them to move around the library autonomously. They can follow pre-established paths and navigate through aisles.

One of the primary functions of these robots is to help patrons locate books. Using a combination of RFID technology and database integration, the robot can quickly search through the library's inventory to find the exact location of a requested book. This not only saves time for both librarians and patrons but also ensures greater accuracy in book retrieval. But the library assistant robot doesn't stop there. Once it has located the desired book, it can use its robotic arm to retrieve it from the shelf [4].

This eliminates the need for librarians to physically search through shelves, reducing strain and improving efficiency. Additionally, the robot can also return books to their proper places, further streamlining the shelving process. By integrating robotics into library operations, libraries can improve accessibility and service quality for patrons. People with disabilities or mobility issues may find it difficult to navigate the library or retrieve books on their own. With the assistance of a robot, these individuals can enjoy greater independence and access to library resources.

A. MOTIVATION

Technical requirements, performance tracking, and career promotions are all problematic for libraries. Numerous books may be found in the library, and many of them are regularly checked out and put back on the shelves. It takes a lot of time and effort to look for books in the library. Workers must guarantee that the books are arranged in a certain order.

We've presented a library assistant robot that uses its understanding of embedded systems, RFID, and robotics to automate the process of discovering and returning the book to the user [5]. The necessary book is identified by the robot using its RFID tags, and it returns it to the user. It makes the task quicker and simpler by lowering the effort and time needed for the reader or librarian to locate the books.

B. OBJECTIVES

The project's major goal is to automate the process of finding and giving patrons access to books in the library. In order to accomplish this, a robot with a base and a robotic arm that is controlled by an Arduino UNO are introduced. By installing this robotic system in libraries, the labour and time-consuming tasks performed by the librarians are decreased. The library assistant robot is made up of different parts that work together to locate, issue and return books [6][7].

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A number of the problems that librarians encounter will be lessened with the arrival of the library assistant robot. As a result, searching, selecting, and giving the book back to the user need less human labour. Finding the books and bringing them back takes a lot of work for the librarian. With the employment of robots, the task will be faster and more accurate.

II. METHODOLOGY

The library assistant robot is equipped with several hardware components, with the Arduino UNO serving as the central interface. ZigBee technology facilitates wireless communication between the robot and the system. When a user inputs information about a desired book into the system, the robot analyses the library database to determine the book's availability and location [8][9]. Upon confirming the availability of the requested book, the system transmits this data to the robot via ZigBee. Following this, the robot follows a predefined path to navigate the library shelves and retrieve the book. Utilizing an arm with a gripper mechanism, the robot picks up the book and verifies its identity by comparing it with RFID tags. If the RFID tag matches the requested book, the robot then delivers it to the user [10][11]. This integrated system optimizes the book retrieval process, ensuring efficiency and accuracy in providing library services.

The interfacing of the components inside the robot is discussed with the help of the Fig 1 below.

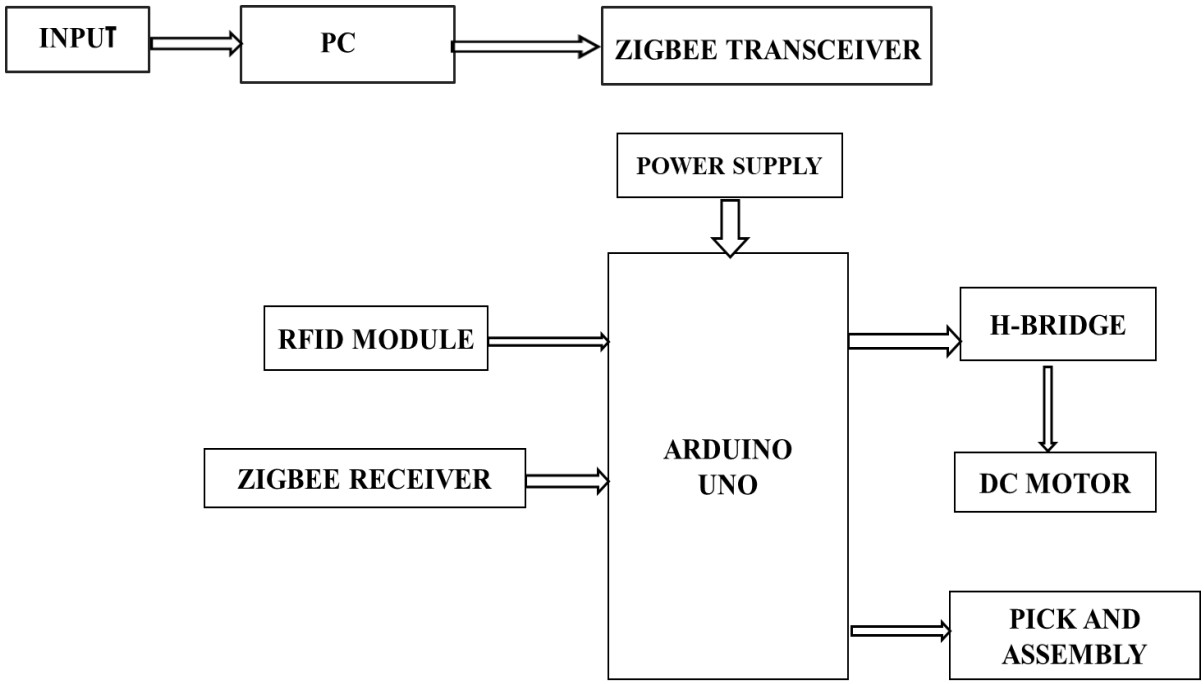

Fig 1 Block Diagram

The Fig 1 shows the block diagram of automated library assistant robot which consists of the following blocks:

Zigbee: It is a wireless communication standard designed for low-power, short-range communication between devices.

Arduino: Boards are equipped with microcontrollers that serve as the brain of the projects. In our project, Arduino is present in the robot which acts as interface between all the components and system.

H-Bridge: An H-bridge is an electronic circuit that switches the polarity of a voltage applied to the load. These circuits are often used in robotics and other applications to allow DC motors to run forwards or backwards.

DC Motor: A DC motor is an electrical machine that converts electrical energy into mechanical energy through the interaction of magnetic fields.

RFID Module: Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. An RFID system consists of a tiny radio transponder called a tag, a radio receiver, and a transmitter.

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III. IMPLEMENTATION

The proposed system consists of a user module, serving as the platform for users to interact with the robotic module. Users input their details via this module, which includes a web page requiring a login ID and password. Upon logging in, users can search for and request specific books [12]. The PC processes this request, checking the availability of the requested book in the library's inventory. If the book is available, the PC displays its availability, and the data is transmitted to the robot.

The robotic module receives this data, mapping the rack's location through a predefined path where the book is stored. Using RFID technology, the robot efficiently picks up the requested book and delivers it to the borrower's table. Upon the user's return of the book, the robot replaces it back onto the shelf and returns to its initial position. Before the due date, the system sends an alert message to the user via an Android device, reminding them to return the book [13][14]. If the book is returned after the due date, the system facilitates fine collection through a displayed QR code.

This integration of user input, PC processing, and robotic automation streamlines the borrowing and returning process while ensuring efficient book management and user communication.

The flow chart of the implementation is shown below:

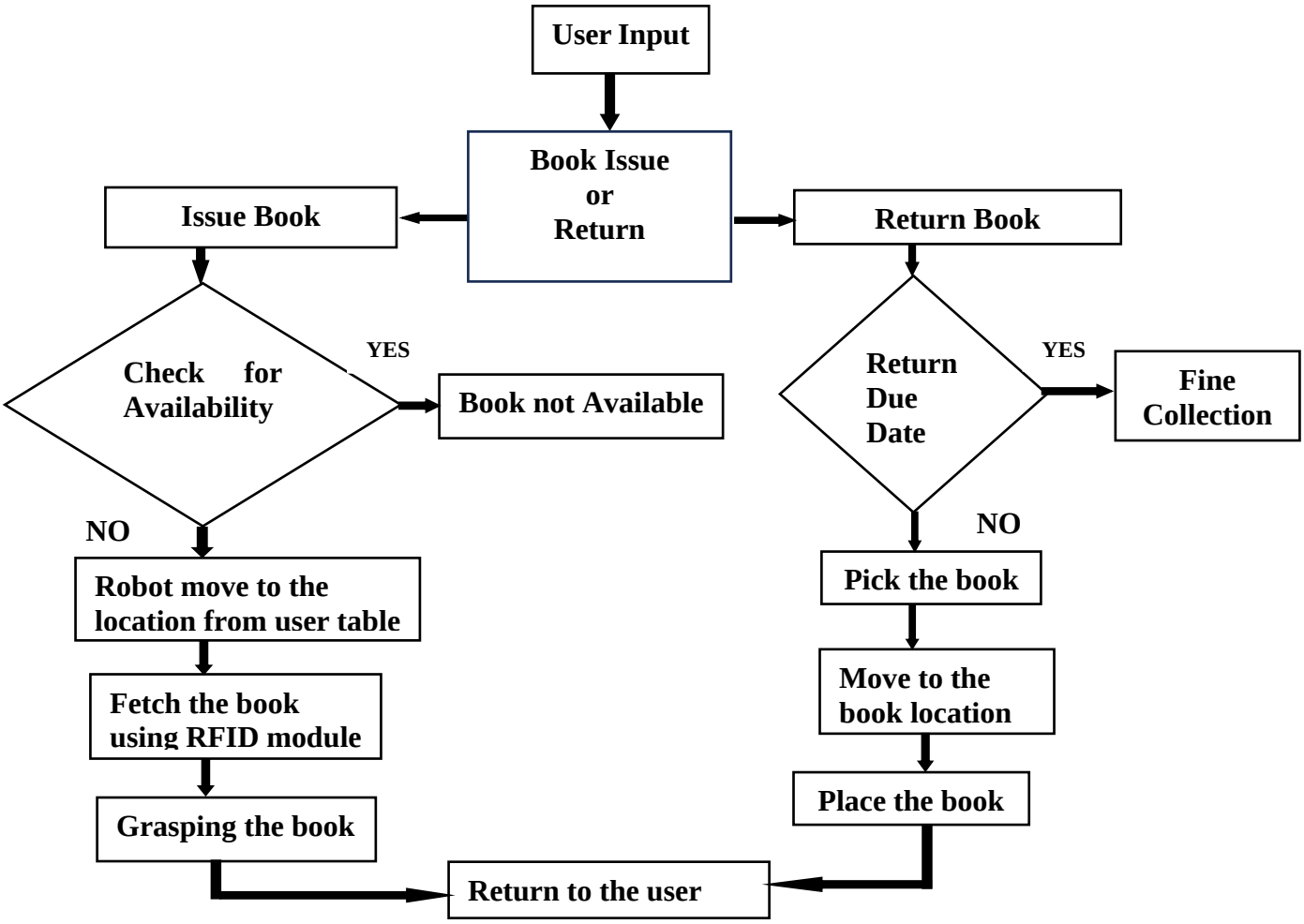

Fig 2 Flow Chart of proposed model

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IV. RESULTS

As discussed above initially the proposed model will be helpful in automation in library management. The main intention is to issue and return the book to the shelves. Fig 3 shows the library assistant robot leveraging embedded systems, RFID, and robotics automating the book discovery and return processes is a promising solution to address the challenges libraries face with technical requirements, performance tracking, and efficiency in operations. By utilizing RFID tags, the robot can swiftly locate and retrieve books, reducing the time and effort required by both readers and librarians.

Fig 3 Automated Library Assistant Robot

In this proposed method a website is built to store list of available books. In this website user can login to it through his login id and password is shown in the Fig 4.

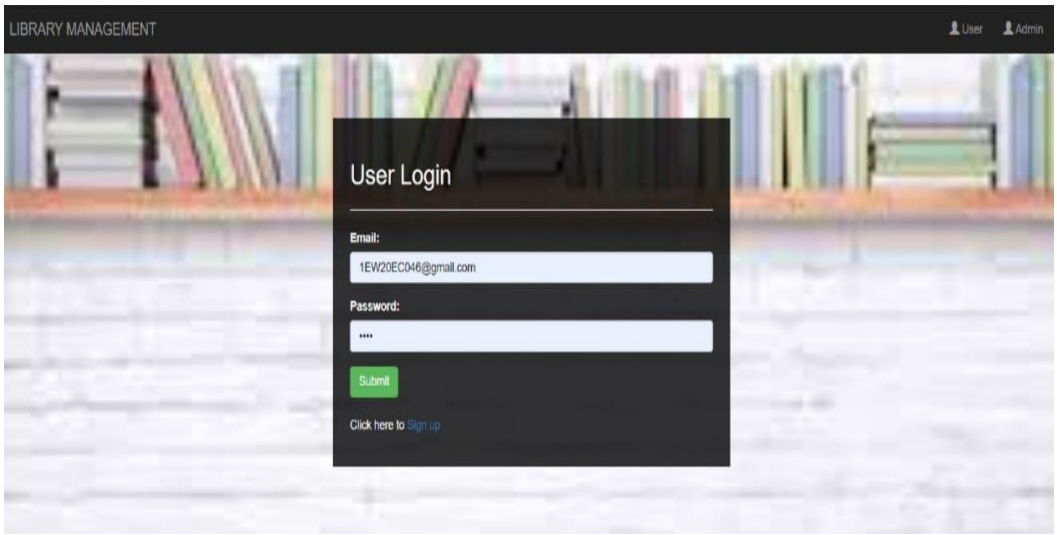

Fig 4 User login through library website

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The details of each library books are preloaded in database such as book title, book id and so forth. After login to the website, he/she can enter the name of the book that he/she wants to borrow is shown in Fig 5. According to the input data of the user pc process the availability of the books. If the book is available in library the pc displays availability of the books.

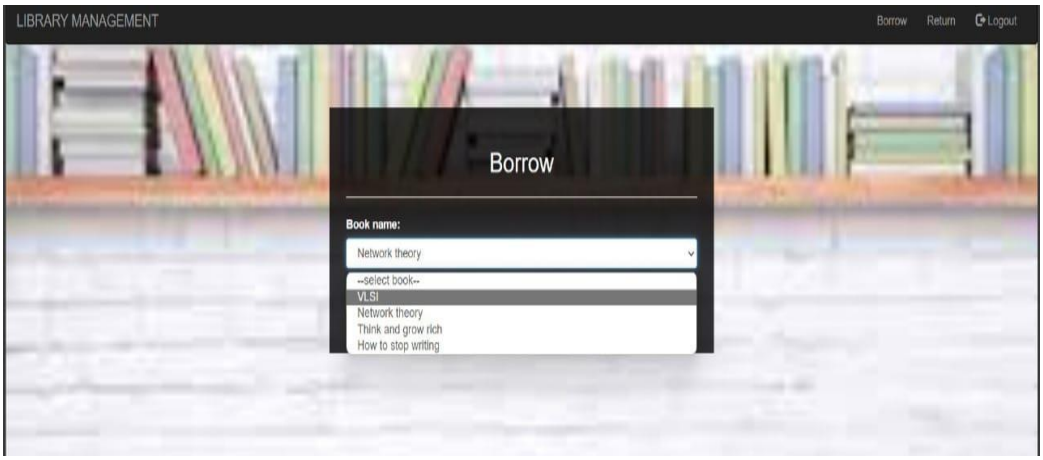

Fig 5 Selecting the required book by user

If the book is available then the data is transmitted to robot. The robotic module receives the data from user module. Robot maps the rack in which the book is present. Then it follows the predefined path to reach the rack. The RFID tags are embedded on every book of library and information related each tag is preloaded in database. The required book is identified using RFID and picked efficiently is shown in the Fig 6 and dropped at the borrower's table.

Fig 6 Robot picking a book

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If user returning a book after the due date, it collects a fine from the user by displaying the number of due days is shown in the Fig 7.

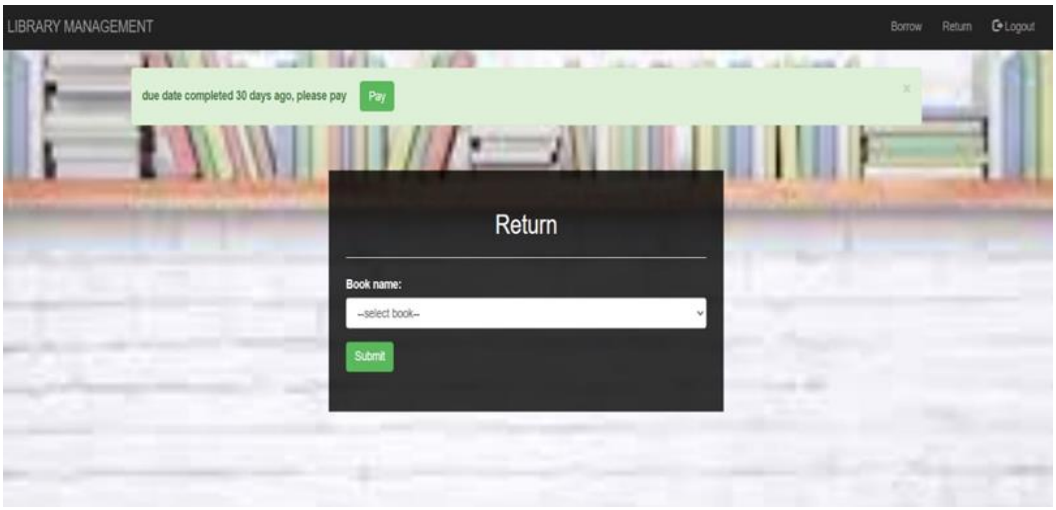

Fig 7 Returning a book after due date

Before the due due date, the system sends an alert message to the user via an Android device, reminding them to return the book is shown in the Fig 8.

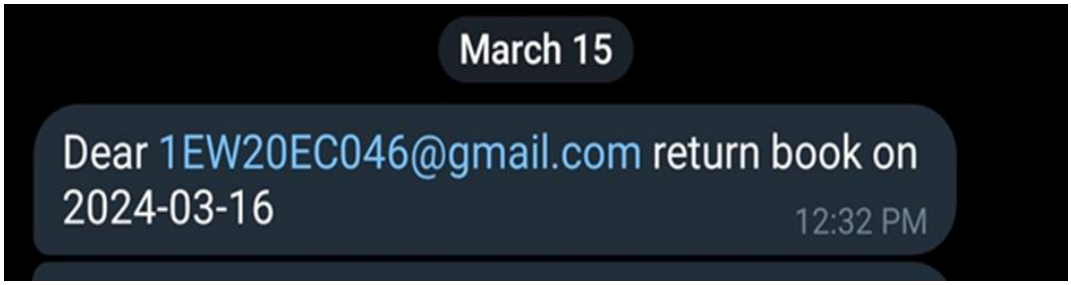

Fig 8 Alert message to user through android

If the book is returned after the due date, the system facilitates fine collection through a displayed QR code with the amount is shown in Fig 9.

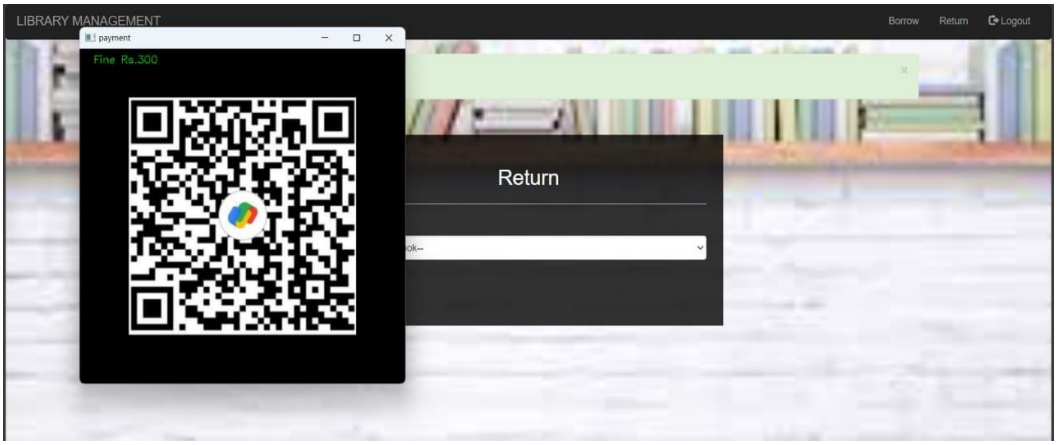

Fig 9 Fine collection through QR code

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V. CONCLUSION AND FUTURE SCOPE

AUTOMATED LIBRARY ASSISTANT ROBOT is a prototype for the library system's automation. Employees of the library will not have to spend as much time browsing through books. A library employee's primary responsibility can be carried out by robot more precisely and consistently. It also aids in lowering labor costs, time commitments, and library administration expenses. We utilize this robot to pick books automatically; it will select the books from the designated areas and return the book to the rack.

FUTURE SCOPE:

- We can improve the features of library robot like arranging the misplaced books, finding the damages of books and improve the efficiency by performing more than one book at a time.
- Reservation policy like reserving a book.
- It can be extended to other applications like in medical shops, factories, grocery stores and supermarkets.

REFERENCES

[1]. Design of Library Robot using IoT K.Sitarama Sastry, 2023 International Journal for Multidisciplinary Research (IJFMR)
[2]. Library Intelligent Book Return Robot Design Zijie Ji, Zhaoji Li Liang Li, 2022 4th International Conference on Robotics, Intelligent Control and Artificial Intelligence (RICAI)
[3]. Self-Navigating Library Assistance Bot Sabin Sabu Naveen Kumar S N and Vigneswari Gowri, Solovyov Studies ISPU 2022
[4]. AUTOMATED LIBRARY ASSISTANT ROBOT Satyendra Varma Nadimpalli, Bheemudu Neelapu, 2021 International Research Journal of Engineering and Technology (IRJET)
[5]. Robotic Library Assistant Sai Praneeth Animireddy; Kanak Prabha Singh; Neha; V. Natarajan2020 second International Conference on Inventive Communication and Computational technologies (ICICCT) year: 2020
[6]. Implementation and localization of the library assistant robot with Robotic arm controlling based on a neural circuit and Signal Processing and Control, Volume 55, January 2020, Article101640Hui Wei, Yijie Bu, Ziyao Zhu
[7]. Wizard of oz for Designing Hand Gesture Vocabulary in Human-Robot Interaction Nguyen Thi Thanh Mai; Tranthi Thanh Hai; Nguyen Viet Son 2019 Third International conferenceon Knowledge and Systems Engineering Year 2019
[8]. Library assistant robot, IJERTV8IS060, Volume 08, Issue 06 (June 2019) Apoorva G Archana Y, Bindu B, Sumalatha N, Prof. Suma V Shetty.
[9]. Automation in library management using Lab VIEW, Anita Gade, Yogesh Angal, International Conference on Intelligent Computing and Applications, vol. 632, pp. 387,2018.
[10]. Robotic library assistant: Sai Praneeth Animireddy; KanakL Prabha Singh ; Neha ; V. Natarajan2018 Second International Conference on Inventive Communication and Computational technologies (ICICCT)Year: 2018, Page s: 1443 – 1447
[11]. Barcode fingerprinting: unique identification of commercial products with their JAN/EAN/UCC barcode. Rina Ueno ; JinMitsugi2018 IEEE 4th World Forum on Internet of Things (WF-IoT) Year: 2018 Page s: 416 – 420
[12]. A low-cost platform based on a robotic arm for parameters estimation, Volume 110, November2017, Pages 257-262Juan Botero-Valencia, David Marquez- Viloria, Luis Castano-London, Luis Morantes-Guzmán.
[13]. Design optimization of industrial robot arm to minimize redundant weight Engineering Science and Technology, an International Journal, Volume22, Issue 1, February 2019, Pages 346-352MustafaBugday, Mehmet Karali L. Besra, M.Liu.
[14]. Library Assistant Robot, Robots in Library Management System, Vol. 6 Issue 01, January-2017; Deepthi Unnikrishnan, Aswani C R.