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ADVANCED DATA-ANALYTIC LIBRARY ASSISTANT ROBOT

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Abstract*— This paper shows the utilization of Robots in library the executives frameworks. A robot is planned that pursues a predefined line to keep track the library book rack courses of action. The quantity of the book that must be taken is given as contribution to the robot. Robot gets the information of book by contrasting the spared RFID number and the books in the racks. On the off chance that the specific book which is to be discovered by the robot coordinated with the spared book detail, at that point the robot will pick the comparing book with the automated arm gave in the Robot. At that point the robot will restore the book to the gathering focus. Hence the client can convey the book from the gathering focus. This aides and streamlines the activity of observing the plan of books and furthermore lessens the manual routine work done by the library staff.

Keywords*— RFID Tags and Reader, Robotic Arm, Microcontroller, Motor Drivers, 16*2 LCD.

I. INTRODUCTION

Robotics is a key technology in the modern world. Robots have taken their first steps into homes and hospitals, and have seen spectacular success in planetary exploration. In this paper the RFID technology is used. It is mainly focused on the book detection and reducing the human work. Robot technology has been widely deployed into various applications to improve productivity. Inventory tracking is a tedious but important process for inventory management. In particular, a library easily contains hundreds of thousands of books that are frequently borrowed and returned back to the shelves. To facilitate users to easily locate a particular book, books are placed in dedicated areas and sorted in a running sequence based on their so-called call numbers. Library staffs have to ensure that the books are placed in order, an extremely labour intensive and time consuming process. Typically they have to pick the books and hand it over to the person to whom the books are being issued. This might be an easy task in case the library floor area is small. Also, to search for the books by humans takes a lot of time as many a times the books gets overlooked by the human eye. To automate this process of book finding and picking we suggest a robot which will be able to find out the book with the required tag and then bring it to the desk. This is an autonomous robot that will help a library user to find a book and retrieve it from the shelf.

II. LITERATURE SURVEY

There are many conventional ways how a required book can be detected by a robot such as RFID technology, OCR etc. RFID is preferred because barcode has many drawbacks such as when barcode scanner starts scanning books, the system might not work because of other barcode interferences sent from multiple books placed closed to each other [7], [8]. But RFID requires portable RFID reader, and electromagnetic tapes is pasted on each book [4]. When it comes to OCR it is tough to make image processing fool proof [2], which needs a very high resolution image to detect the characters. As most of the libraries maintain database of all the books, it will be easy to give books some reference number and having the barcode generated based on that reference number pasted on the side of the book which will make it more accurate, easy and faster. When it comes to the way how the robot navigates, one can use continuous localization [3] but it will be very complex as we mainly plan to use this robot in huge libraries so if we use aforementioned system to make the robot navigate, it will increase the processing time and is also not accurate. Thus, using a dedicated path made of black line and a line following robot base will make it simpler, faster and accurate.

The elaboration on the key enabling robotic technology for the fully autonomous system[6], namely, a navigation system with surface tracking capability. A Radio Frequency Identification (RFID) reader is carried by the navigation system to identify the RFID tags embedded in each book. Based on the tag information, a tracking report that highlights missing and misplaced books is generated for the end users. To ensure successful identification, the surface tracking requires high accuracy, for which we propose a filtered Hough transform and a macro-mini manipulator structure. Tests of the AuRoSS system[6] in a library show high accuracy in the scanning performance.

The cooperative work process and the automation work flow of the no man keeping watch library which takes the robot as its centre and uses the internet of things technology are firstly introduced [5]. A new data format of the RFID electronic label for books is designed, and the robustness of positioning of the manipulator is improved by the

information fusion of the RFID label source and the CCD sensor source installed on the manipulator. A position method named THREE STEPS by the combination of fuzzy position, area position and accurate position is advanced, and the complex books positioning and grasping question is transformed into the world coordinate solving question of some point on the objective book. The fuzzy CMAC (cerebella model articulation controller) neuron network is adapted to realize the non-line relationship of fusion feature and manipulator position. And direct vision servo control architecture is used when designing the manipulator position system. The experiment result has proved this method can help the manipulator realize the accurate position and rapid catching.

In this system[5], the robot is a kind of mobile robot with wheels whose main part is an Automatic Guided Vehicle (AGV). A manipulator with a camera and a RFID reader at its front part is installed on the AGV. The road in the library is divided into some areas according to the types of books and every area has its road signs. The wireless image acquisition module on the AGV can acquire the road signs' picture and send them to the remote PC through wireless internet. The program in the remote PC will process the pictures and calculate the AGV's control parameters which are send to the robot controller's speed-governing system to realize the PWM speed-governing control of the direct-current dynamo.

III. SCOPE OF THE PAPER

This paper aims to build and design the Library Assistant Robot which has the capability to look for a specific book in a shelf, asked by any user, and when it is found, to deliver it as soon as possible to the user. Tracking of items on shelves is an important but time-consuming task in inventory control. In particular, books in public libraries are frequently borrowed and returned, even misplaced, and proves a challenge to be tracked on a daily basis. This Library assistant robot is an autonomous service robotic assistant whose functionality includes the assistance of individuals within a library environment.

IV. PROPOSED METHODOLOGY

ADLAR is a line follower robot to follow a line or path may be a physical mark, already predetermined by the user. IR sensor will trace a black line on white surface. The sensors give mobility of the robot, which works with analog signals from the microcontroller and the digital signal is used to drive the motors. The books are placed in the rack and all the books position will be tagged by RFID tags and a RFID reader will be placed in the robot. The robot will scan an each book and in case the book is found. Picking mechanism has to be introduced to pick the book from the rack and move back to the home or initial position.

The ADLAR system Web application is to assist the humans in order to pursue the objects from the library locations. These mobile manipulators can be remotely operated by the operator using the local internet or they can be accessed from the remote location using the wireless communication and they are made autonomous based on the multisensory and controller integrated in it. This controller plays a major role like brains for humans, controlling the robot to navigate all around the work space and to accomplish the given task automatically based on the sensor information and the inbuilt program.

Internet of things technology are being made suitable for improving and making library service effective to the user community as the manual service is time consuming. Using computer networks for resource sharing, enables library to obtain details from the library book collection, but to handle the materials, the designed robot assist in locating the position and collecting the books from the section of rack. The designed assistant robot is efficient in handling the book and is reliable to be adopted in library.

Here Web Application serves as the user interface. The entire Web Application was designed using html, CSS, JavaScript and PHP code. The users are supposed to initially registered to the database manually. Once the user is registered ,the user shall login to the system securely.

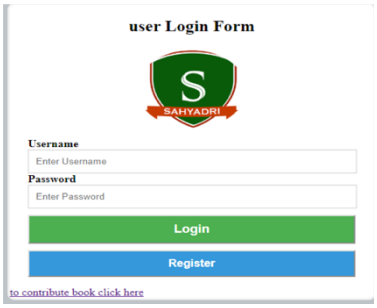

Fig.1. Login Page

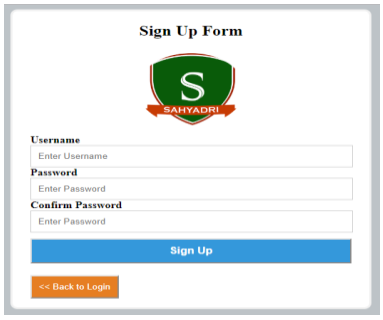

Fig.2. Registration Page

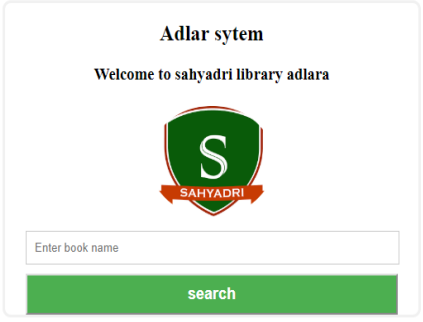

Fig.3. Search Bar

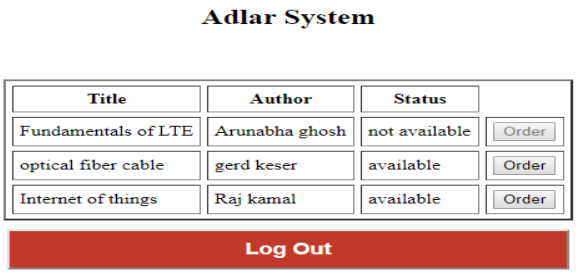

Fig.4. Order Page

When the user first opens the website, the login page (Fig.1) will appear where the user have to register (Fig.2), if the user is new user or he can just login. Once the user is successfully logged in then the next page will be the Search Bar page (Fig.3), where the user can search for required book. Then the user gets all information's about the searched book in the next page (Fig.4). The information's like Author of the book and Availability of the book. All the data's regarding book's and the user will be stored in the Database. Once the user finds the required book he can order the book by clicking the order button in the website. The ADLAR will go and get the required book for the user.

The hardware part of ADLAR consist of a four wheel bot with an Robotic Arm(Fig.6). The base of the robot is fixed with two motorised wheels and stepper motor is adjust the robotic arm for different self in a rack. Robot is controlled by Arduino Uno microcontroller. IR sensor's for line following motion. RFID scanner is EM-18 RFID Reader. The Operator sends the task to the mobile robot using wireless network system. This command consists of the information regarding the book id and the particular rack.

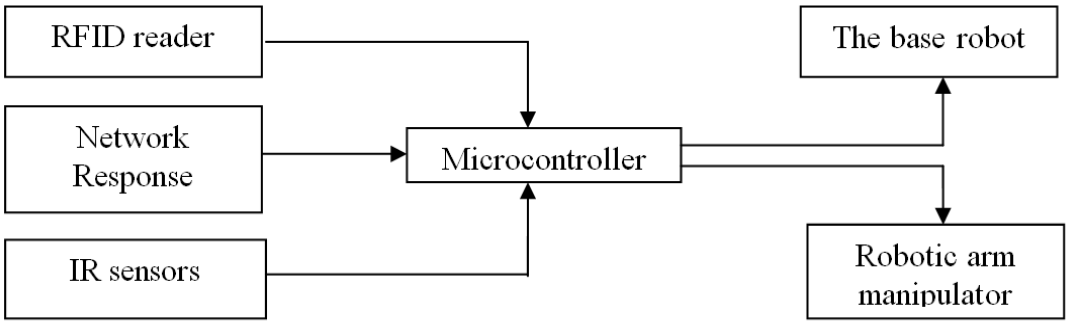

Fig.5. Block Diagram of ADLAR

The ADLAR consists of additional components like 16*2 LCD display (Fig.7) which displays the status of the Robot. It consist of two L293D motor drivers (Fig.8), where one is to control the 4wheel bot and other one to control the Robotic Arm. It consist of power distribution board (Fig.9) for dividing the input power to all the components.

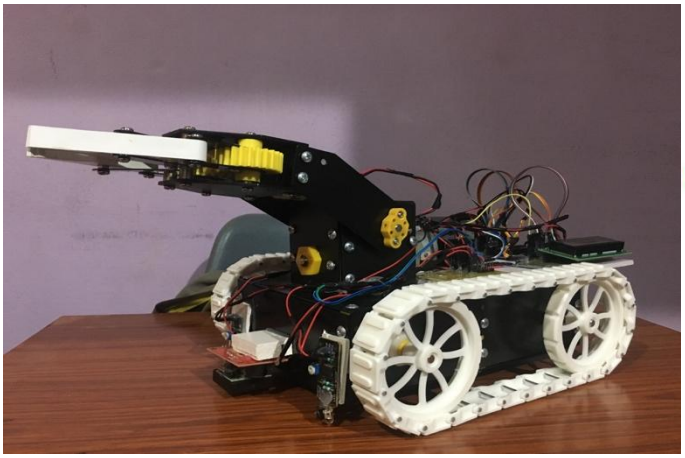

Fig.6. Four wheel bot with Robotic Arm

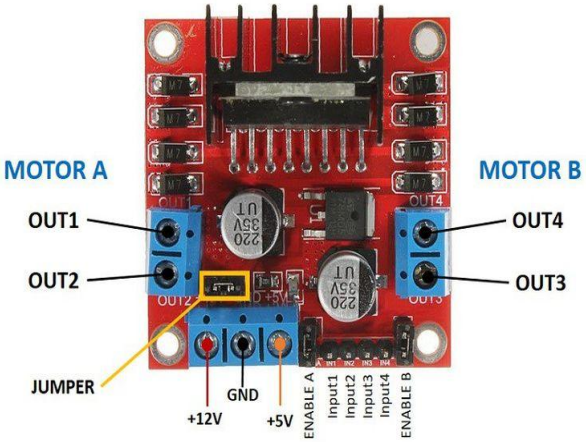

Fig.7. Motor Driver.

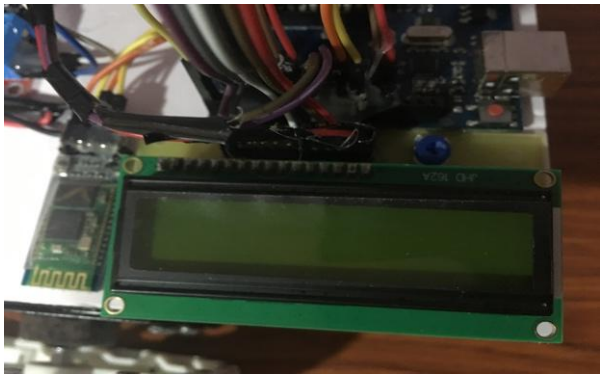

*Fig.8. 16*2 LCD Display*

The Power Distribution Board provides the input power for the components like Arduino, Sensors, Display and the Motor Drivers. The Block diagram (Fig.9)and the Circuit diagram (Fig.10) of Power Distribution Board is shown in the following figures.

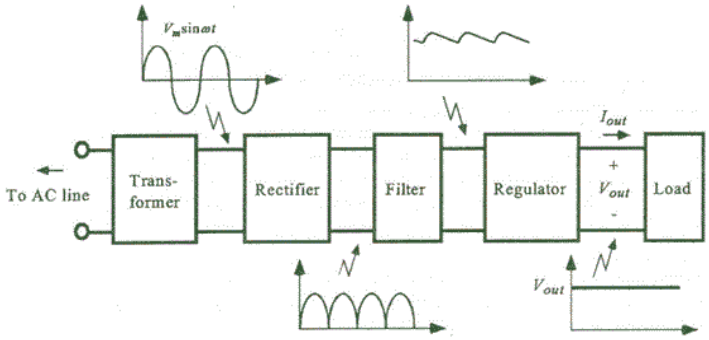

Fig.9. Block Diagram of Power Distribution Board

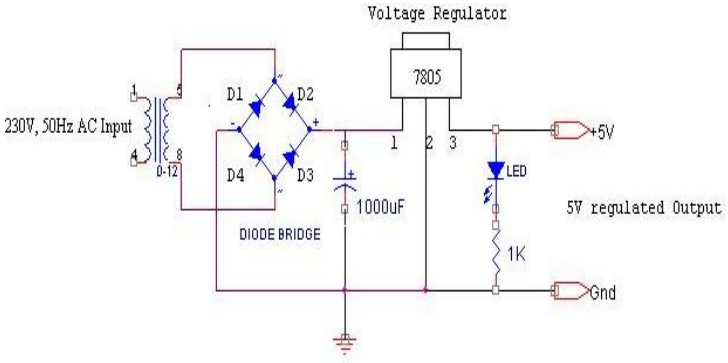

Fig.10. Circuit Diagram of Power Distribution Board

The base robot is responsible for the gross motion of the robot. The size of the chassis is 400 X 300 X 100 mm. The chassis consist of dual wheels and two supporting castor wheels with individual DC motor form the mobile platform that carries the manipulator arm over it. Front of the chassis having an IR sensor, used to track the path. based on the sensor output, Microcontroller give a signal to the motor driver L293D so as to move the motor accordingly.

The bot moves based on the RFID tags present in the path it travels. It makes the decisions whether to turn left or right. And also picks the respective book when it reaches the corresponding RFID tags.

V. EXPERIMENTAL OUTCOMES

Initially the bot will be at the home position (RFID 1).The required book's number is given as the input to the keypad (Say 1). The Name of the particular book will get displayed on the LCD. If the book number is wrong "INVALID BOOK NUMBER" will be printed. Next status printed will be will be "SEARCHING." of the book. At once the book gets matched with the book in the shelf, the robot starts slowly from its home position. The robot moves along the black line with the help of IR sensors until it reaches RFID 2.Then it takes the left turn and waits for the RFID 3.Thenthe Robotic arm picks the respective book and moves to the home position RFID 1.Then the LCD will print "BOOK DELIVERED". The robot will station at the home position till the next cycle begins. The robot is ready for the next task from the user.

VI. CONCLUSION

A prototype of Library Assistant Robot is developed. Its performance is tested in a real time library management system for searching and delivery of books and time required to delivery of book is calculated using Stopwatch. Table 1 shows the time taken by ADLAR to deliver the book to the user. It will prove as a very good substitute for the manual work done by the users in library. We can implement our proposed system in a very effective manner using Image Processing, with almost no change in the architecture of the library. With some modifications, the designed robot can also be used as a service robot such as teaching assistant robot, diet monitoring and management assistant robot using IoT, medical assistant robot, etc. in various real time scenarios.

Calculated Time	Actual time taken	Delay
150 secs	180 secs	30 secs

Table 1: Delivery time measured in Stopwatch

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