ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 12, December 2016

An Innovative Idea for Management of Libraries Using A RFID Based Library Assistant Robot

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ABSTRACT:This paper demonstrates the application of Robots in library management systems.A robot is designed that follows a predefined line to keep track the library book shelf arrangements. The number of the book that has to be taken is given as input to the robot. Robot gets the data of book by comparing the saved RFID number with the books in the shelves. If the particular book which is to be found out by the robot matched with the saved book detail, then the robotic will send a notification to the shelf unit. The corresponding shelf tray will move forward and the book in the tray will deposit the book in the basket of robot. The robot will return the book to the collection centre. Thus the customer can deliver the book from the collection centre. This helps and simplifies the job of monitoring the arrangement of books and also reduces the manual routine work done by the library staff.

KEYWORDS:RFID, library management, shelf unit, shelf tray

I.INTRODUCTION

Robotics is a key technology in the modern world, a well-established part of manufacturing and warehouse automation, assembling cars or washing machines, or moving goods to and from storage racks for Internet mail order.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. Library staffs first need to perform shelf reading, i.e., manually search for books that are misplaced in the wrong book sequence, then pick up the book and insert it in the correct location.. 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.ie; what we are working towards here, is an autonomous robot that will help a library user to find a book and retrieve it from the shelf.

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II. LITERATURE SURVEY

In older days libraries required more manual power to manage, In particular, a library easily contains hundreds of thousands of books that are frequently borrowed and returned back to the shelves. Typically we need a librarian 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.i.e. Running of library manually is a difficult task. It is time consuming &laborious.We can overcome these drawbacks through our proposed paper. In this method we are going to maintain an autonomous service robotic assistant whose functionality includes the assistance of individuals within a library environment. The evolution of robotics started in the twenty first century. The 'robot' term was firstly coined in early 1920 by a Czechoslovakian dramatist, Karel Capek in his play entitles "Rossum's universal robots". Robota is the original term of robot that widely used since it has been introduced to the public. Robota is a czech word which means 'slave laborer'. On 1942 science fiction author Isaac Asimov used the term 'robotics' in his short story "Runaround". Robotics means study of robot. Three Laws of robotics have been introduced in "Runaround". It describes the three basic rules that robot should follow to operate without harming or cause injury. The laws are:

a) A robot is not allowed to harm a human or cause injury to a human being whatever be the condition.

b) A robot must always follow the direction or order given to it by the human being as muchas it does not contrast or conflict to first law.

c) A robot must protect its own existence as long as it does not make conflict to first and second law.

A) AuRoSS: an Autonomous Robotic Shelf Scanning System Renjun Li, Zhiyong Huang, Ernest urniawan, Chin KeongHo 2015 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) Congress Centre Hamburg Sept 28 - Oct 2, 2015. Hamburg, Germany.

This paper elaborates on the key enabling robotic technology for the fully autonomous system, 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 in a library show high accuracy in the scanning performance.

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 socalled call numbers. Library staffs have to ensure that the books are placed in order, which is an extremely labour intensive and time consuming process. Library staffs first need to perform shelf reading, i.e., manually search for books that are misplaced in the wrong book sequence, then pick up the book and insert it in the correct location. Radio Frequency Identification (RFID) technology has been introduced to ease shelf reading, such as by using hand held RFID readers nevertheless the task is still time consuming and the user still cannot easily interpret the RFID results to see if the books are sequenced properly. Smart shelf, on the other hand, uses many RFID antennas that are placed at many strategic locations so as to scan the RFID tags. The high infrastructure cost and implementation complexity remains a barrier for this technology to be widely adopted

B) A Research on Autonomous Position Method for Mobile Robot Manipulator based on Fusion Feature Mingfang Du, Junzheng Wang, Lipeng Wang and Haiqing Cao Jianjun Fang, Zongyu Gao, JiLv and Shide Zhang College of Automation College of Automation Beijing Institute of Technology Beijing Union University Haidian, Beijing City, China Chaoyang, Beijing City, China 2013 IEEE/RSJ Mechatronics and Automation Aug 47,Takamatsu, Japan.

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 in this paper. 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

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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, 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

The hardware is implemented as a robot unit and shelf unit independently. Firstly enter the name of book which we want to issue using keypad. The robot end sends a data to the shelf end using data modem. Line follower robot follows the track and reaches the shelf end. The IR sensor matches with the shelf unit. The RF reader scans for the RF tag and matches with the corresponding book. If both the robot and the shelf end get synchronised the arm in the shelf end pushes the book into the basket. Thus the robot unit follows the path back to home.

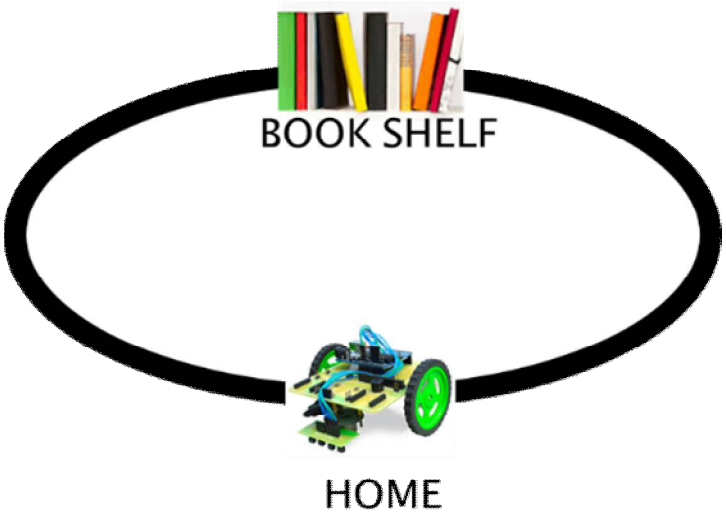

Fig. 1. PROPOSED SYSTEM

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A. SYSTEM BLOCK DIAGRAM

ROBOT END :

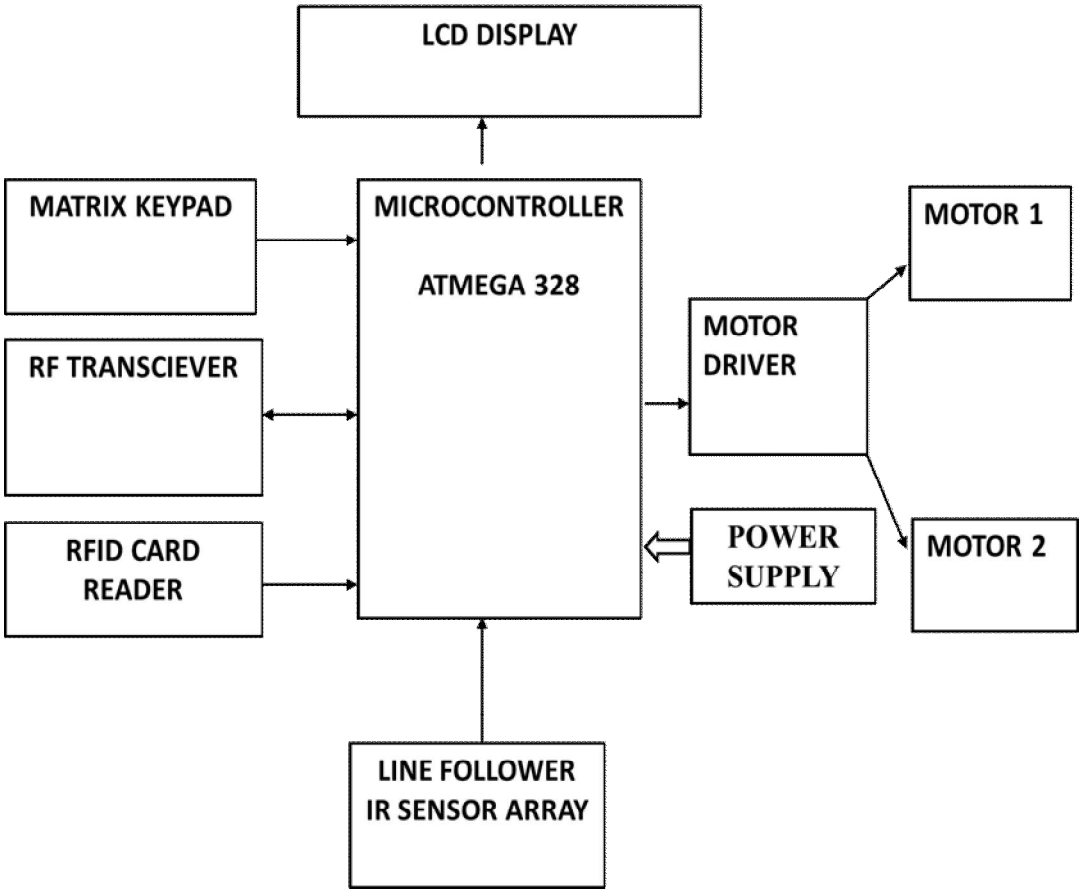

Fig. 2. ROBOT END BLOCK DIAGRAM

The robot end consist of a line follower robot which works with ATmega328 microcontroller. The input is given using a matrix keypad. The name of the book is displayed in LCD. The RFID card reader scans for RFID tag placed in each book and the RF transceiver used to communicate between the two ends.

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Vol. 5, Issue 12, December 2016

BOOK SHELF END

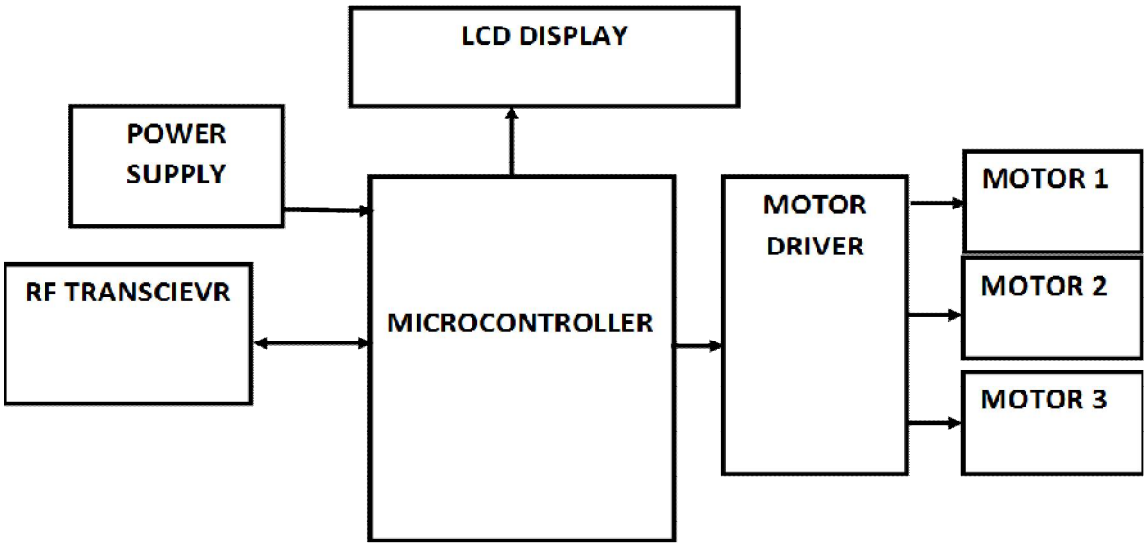

Fig. 3. SHELF END BLOCK DIAGRAM

The shelf end consist of three motors driven using a motor drive which is used to push the book from the shelf to the basket in the robot, all the control is done by the ATmega328 microcontroller which inter links with the other microcontroller using RF transceiver.

B. SYSTEM IMPLEMENTATION

a. CIRCUIT DIAGRAM

We are using ATmega328 microcontroller in our project. A 16 MHz crystal is used to provide clock for the ATmega328 microcontroller and 22pF capacitors are used to stabilize the operation of crystal. The 10µF capacitor and 10KΩ resistor is used to provide Power on Reset (POR) to the device. When the power is switched ON, voltage across capacitor will be zero so the device resets (since reset is active low), then the capacitor charges to VCC and the reset will be disabled. 30th pin (AVCC) of ATmega328 should be connected to VCC.

Here, we are using three analog IR sensors. All the three sensors will be placed in the front side of the robot and all will be pointing downward. IR TX and IR RX are to be soldered on small general purpose Grid PCB. From this module, 3 wires of sufficiently long length (say 1 ft.) are taken and connect them to VCC, preset and to ground. By adjusting preset, we can adjust sensitivity of the sensor. The VCC is connected to 5V supply

In 16x2 LCD there are 16 pins over all if there is a back light and if there is no back light there will be 14 pins. One can power or leave the back light pins. Now in the 14 pins there are 8 data pins (7-14 or D0-D7), 2 power supply pins (1&2 or VSS&VDD or GND&+5v), 3rd pin for contrast control (VEE-controls how thick the characters should be shown) and 3 control pins (RS&RW&E).The contrast bit and READ/WRITE are not often used so they are shorted to

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the ground. This puts LCD in highest contrast and read mode. We just need to control ENABLE and RS pins to send characters and data accordingly. The connections which are done for LCD are given below:
PIN1 or VSS to ground
PIN2 or VDD or VCC to +5v power
PIN3 or VEE to ground (gives maximum contrast best for a beginner)
PIN4 or RS (Register Selection) to PIN4 of ATmega328
PIN5 or RW (Read/Write) to ground (puts LCD in read mode eases the communication for user)
PIN6 or E (Enable) to PIN5 of ATmega328
PIN11 or D4 to PIN06 of ATmega328
PIN12 or D5 to PIN11 of ATmega328
PIN13 or D6 to PIN12 of ATmega328
PIN14 or D7 to PIN13 of ATmega328

We are using EM-18 RFID Reader in the project. EM-18 is a 125 KHz RFID Reader module and comes with both Serial and Weigand interfaces. In serial interface, the EM-18 RFID Reader provides a 12 byte data when it reads any RFID tag.

In our project we are making use of DC motors. The Motor Supply is given to the Vs pin of L293D and motor is connected to the first pair of drivers, which is enabled by connecting EN1 to logic HIGH. Vss pin is used to provide logic input to L293D. Control signals is given by using ATmega32 microcontroller which operates at 5V, hence Vss is connected to 5V

We are using a 12 keys keypad in our project. Keypad is nothing but multiplexed keys. Buttons are connected in a multiplexed form for reducing the pin usage of control system. The rows R0 to R3 are connected to Input lines of Microcontroller (Ro-pin14, R1-pin27, R2-28, and R3-17). The column C0 to C2 are also connected to MCUs i/o line (C0-18, C1-19, C223).

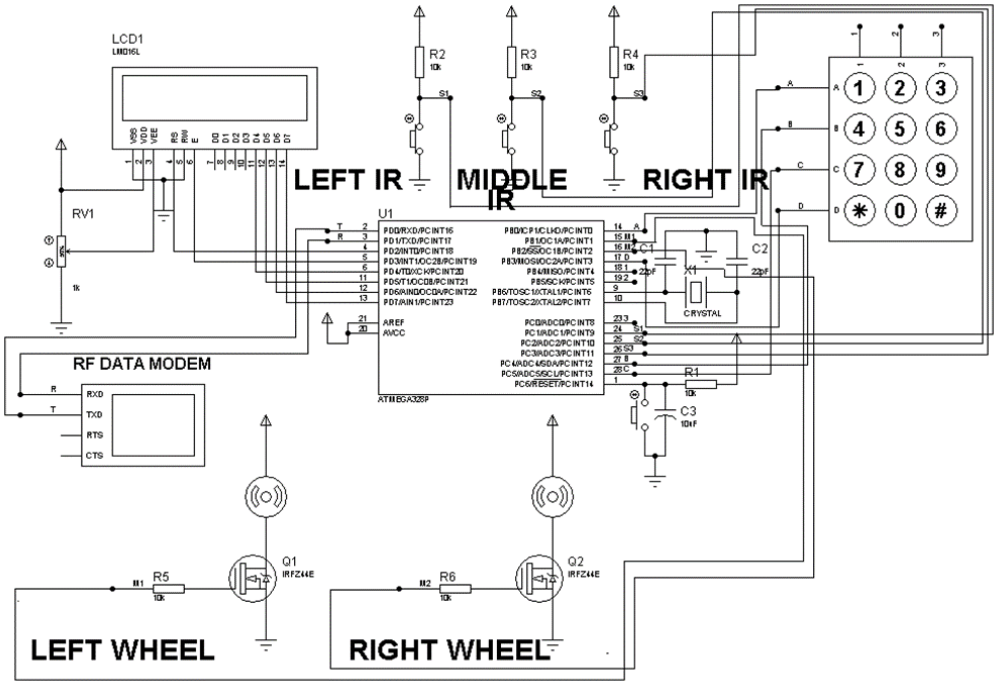

Fig. 4. Circuit diagram

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b. THE LIBRARY ASSISTANT ROBOT SYSTEM

Fig.5. Complete system

Fig.6. Robot end

V.SIMULATION RESULT AND DISCUSSION

The simulation is performed in PROTEUS. The Proteus Design Suite is an Electronic Design Automation (EDA) tool including schematic capture, simulation and PCB Layout modules. It is developed in Yorkshire, England by Lab centre Electronics Ltd with offices in North America and several overseas sales channels. The software runs on the Windows operating system. The Proteus Design Suite is a Windows application for schematic capture, simulation, and PCB layout design.

A. SIMULATION SETUP

Initially we are at the home position (000-blue, blue, blue).The required book's number is given as the input to the keypad (Say 101). 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 "SEARCHING." of the book. At once the book gets matched with the book in the shelf, the robot starts slowly from its home position. When a sensor is on black line it reads 1 and when it is on the bright surface it reads 0 and sensor module gives the value into the controller to generate control signal as per the program. When both right and left sensors are on bright surface (read 0) the wheels gain speed. When left sensors moves in black region then left motor stops while right motor continue to move so that left turn takes place and robot returns on black line. When right sensor comes in black region then right motor stops while left motor continue to move so that right turn takes place and robot returns on black line. By correcting the path robot moves to the destination i.e. the shelf end.

Then at the destination point or book rack, the detection become 111(red redred). The robot attains a slow movement and stops. The book is then pushed into the basket and the robot collects the book. Again when the black line gets detected, it reads 1 (010) and the robot returns to home position where again the condition is 000.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

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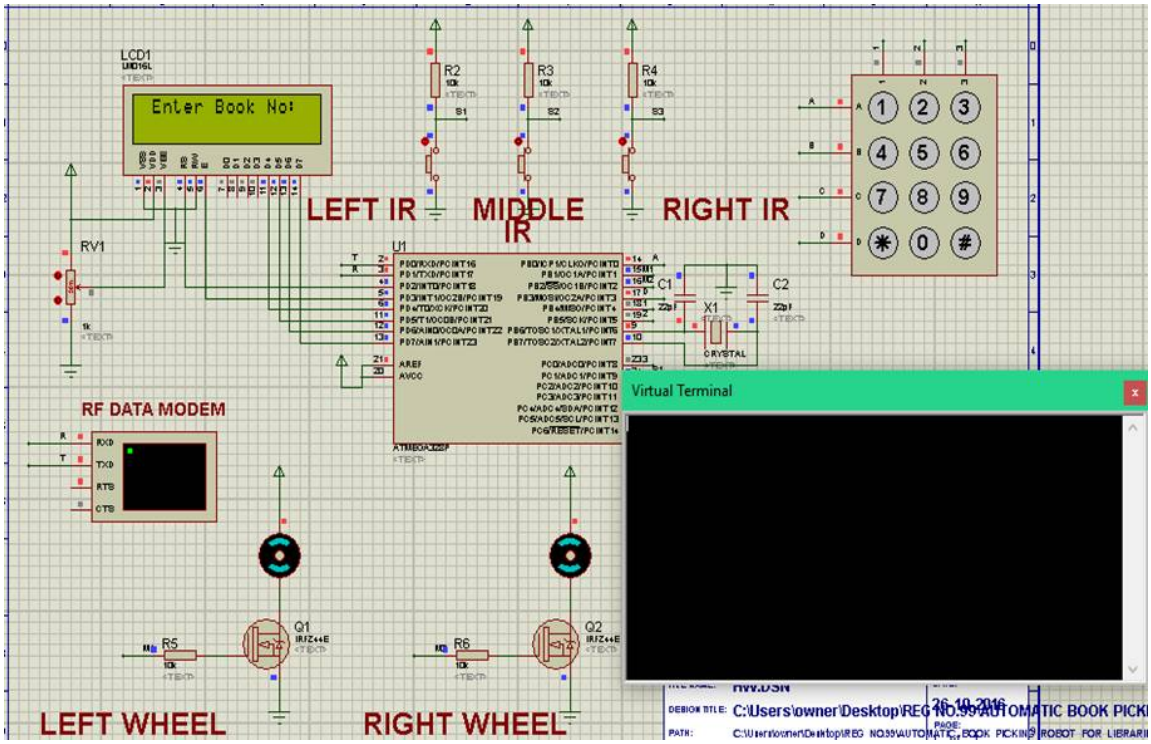

Fig. 7. Matlab simulation for robot end.

VI.CONCLUSIONS

The implementation of the robot end section in PROTEUS was successful. The desired results were verified in the simulation. The I R sensors navigated the Robot end from its home position to the book shelf end and back to home after the collection of required book. In this paper the proposed system give the result of find the book. It reduces the manual work. With the proposed architecture, if constructed with at most accuracy, the robot will find the book. If such a system developed, it will act as a basic platform for the generation of more such devices for the library management.

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