

An Autonomous Assistant Robot for Book Manipulation in Library

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Abstract: Library contains hundreds of thousands of books which are frequently borrowed and returned to the shelves. Searching of books in the library is a time consuming and difficult task. To automate the process of book finding and picking we suggest a robot which will be able to find out the book with required tag and then bring it to the desk. The name of book is given as input to the robot. Line follower robot moves through the predefined path. RFID technology is used to find the book. The robotic arm is used to pick the book. The simulation is performed in PROTEUS. ZigBee module is used for communication between robot and the PC. 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 users.

Keywords: Line follower, RFID, ZigBee module

1. 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. Here we use RFID technology which mainly focuses 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. A library is a collection of information resources; it provides invaluable service to its members, to a wider local community. Typically, we need a librarian to pick the book and handover it 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 take a lot of time as many a times the books gets overlooked the human eye.

To overcome this problem, we introduce automation in library to fast diction of books and for picking we suggest a robot with an arm with some degrees of freedom which will be able to find out the book with the required tag and then pick it and place it on the table.

2. Literature Review

We have introduced a system which is highly improved and the most upgraded version in the existing ideas which have been put forward. There have been many approaches regarding library assistant robot. We made sure to make an up-gradation from the previous proposed projects.

Deepthi Unnikrishnan and Aswani C.R [1] developed "Library Assistant Robot". Robot is a line follower robot and books are tagged with RFID tags. The book number is given as input to the robot. If the particular book which is to be found out by the robot matched with the saved book detail, then the robot will sent notification to the shelf unit.

P.Y Lau, K.O Yung and E.K.N Yung [2] developed "A Low cost printed CP patch antenna for RFID smart bookshelf in library. It consists of small wideband circularly polarised patch antenna printed on the low cost FR-4 material for radio – frequency – identification. The RFID system provides solution to effectively collect, manage and distribute books.

J Lang and L. Han [3] developed "Design of library smart bookshelf based on RFID ". The misplacement problem in library has been for long time resolving this problem. Hardware of system composed by UHF tags worked at frequency range of 920MHz, RFID readers, antennas. Software includes two parts : inventory check, misplacement check. It can complete the statistical work of available and borrowed books, find those misplaced books and check their corresponding correct place. The test results suggest that the system is running stable , the accuracy of data read is relatively high, the find and compare results are according with expected results. This system can save labour and improve work efficiency

R.-C Hua and T.-G Ma [4] developed " A printed dipole antenna for ultra-high frequency (UHF) radio frequency identification (RFID) handheld reader." A novel a simple antenna applicable to active RFID tags is designed. The designed antenna has being skilfully integrated with the active RFID tag circuit. The antenna consist of two parts, one part comprises stacked shorted patches and a ground plane. The other one is an active tag circuit mounted on the bottom of the antenna. By using the offset shorting posts technic, the proposed antenna can achieve an enhanced operating bandwidth with a small size. The measurement results reveal that the antenna has return loss less than -10 dB within the bandwidth of 42 MHz, which totally covers the 5MHz bandwidth from 920MHz to 925 MHz (T requirement for active RFID inChina.

Meghadas K, Salas K Jose, Athira Mohan N [5] developed "Library Service Robot Using QR Code Technology". Combined pressure of providing digital and print-based resources to the readers has led to severe space constraints for many libraries, especially in academic research libraries. By the automation of library this problem can be solved to

an extent. So an innovative mobile robot is introduced that aids the comfort, convenience and efficiency in libraries. In this work, we propose a three-stage approach for the automation of library. In the first stage, a baseline QR code with reliable decodability with visual content is first synthesized based on the Gauss-Jordan elimination procedure. In the second stage, the QR code is recognized using raspberry pi module. In the third stage the book is identified and picks the book to place in to the corresponding shelf.

Vipulata M. Lande, Shraddha S. Chauhan and Ashwini S. Kalbande [6] developed “Automated Library System Using Robotic Arm”. The goal of this project, library automation is to automatically issue books and important fact is that it provide security against theft. Robotic arm picks the book and put it on the conveyor system then carries the book to the issue counter. To pick the specific book and place it on the conveyor, this was the first objective of this project. This project implements the concepts of embedded system, robotics and RFID communication. The idea of library automation was achieved with the help of this project.

3. Block Diagram

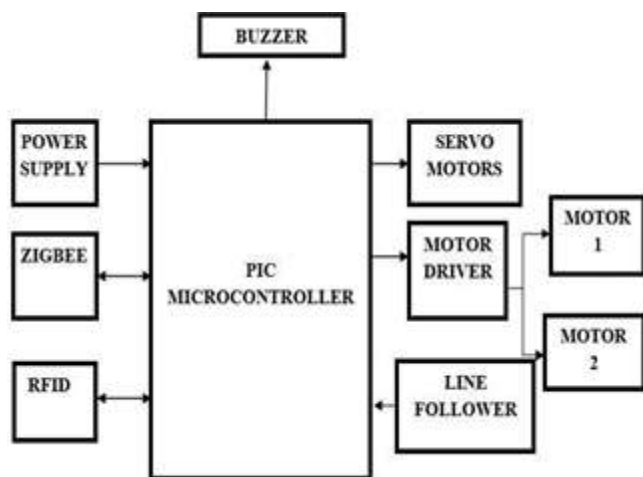


Figure 1: Block diagram of hardware

Fig 1 shows block diagram of hardware section of library assistant robot and that is the robot end. The robot end consist of a line follower robot which work with PIC 16F877A microcontroller. Here a 12v power supply is given to the robot for its proper working. ZigBee is used for wireless communication between the PC and robot. It is similar to the Bluetooth technology and here pairing of PC and robot is takes place. The RFID reader scans the RFID tag placed in each shelf. If both the robot and shelf get synchronized the robotic arm moves and retrieve the book from the shelf. In this robot 6 servo motors are implemented for the proper movement of the robotic arm. L293D motor driver is used here for driving the DC motors. Here 2 DC motors are used for the movement of the robot. Line follower IR array is used for correcting the path of the robot throughout the task.

4. Methodology

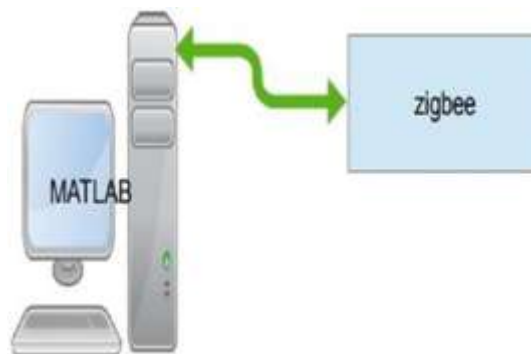


Figure 2: Block diagram of PC section

Fig 2: shows the block diagram of PC section . MATLAB software is used for programming the autonomous library assistant robot. A ZigBee is connected to the PC. The ZigBee is used for the wireless communication between PC and robot. It is specially designed for sensors and control devices that employ low cost connectivity and widely used for several applications.

5. Working

The hardware is implemented on the robot unit. Firstly, the user using the PC system enters the name of book which the user wants to issue. If the particular book is available then the PC using zigbee wireless network sends the data to the robot unit. When the robot gets the instruction it moves on the mechanism of line follower. Line follower mechanism is done using IR sensors that are placed at three places on robot unit facing the path. For the movement of the robot two DC motors are used. Robot follows the track and reaches the shelf end. The RF reader placed on the robot scans for the RF tag and matches with the corresponding book. If both the robot and the shelf end get synchronized then the arm in the robot side picks the book and puts it in the basket. Thus the robot unit follows the path back to home i.e, destination referred here as stop tag.

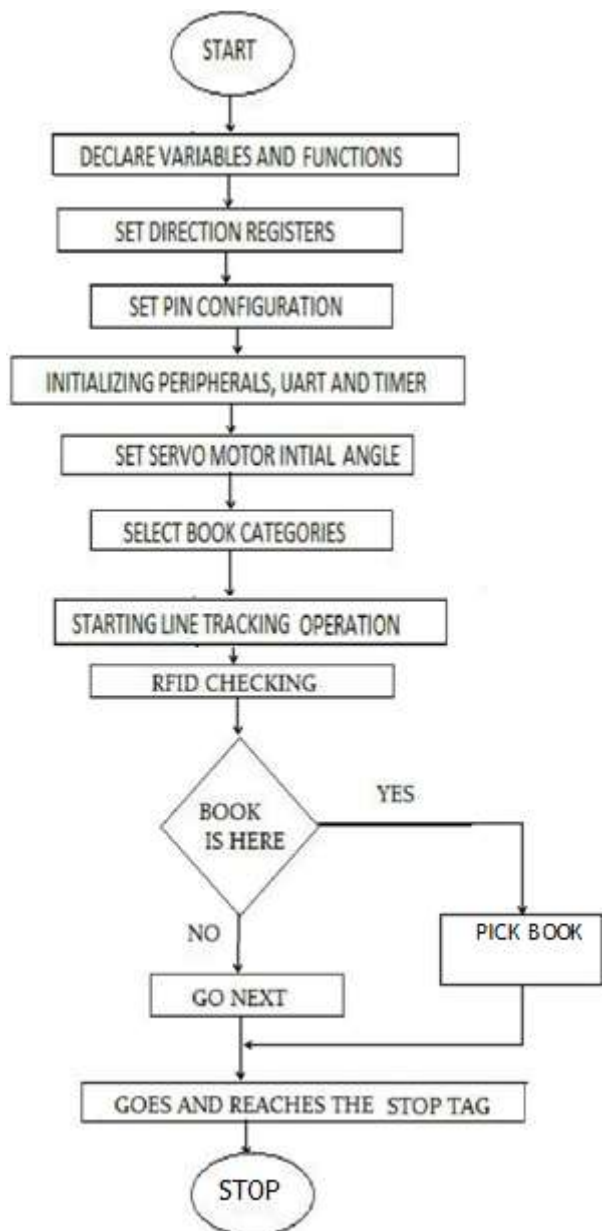


Figure 3: Flowchart

6. Applications

- Used in supermarkets as automatic item collector.
- Used in libraries of school, colleges.
- Big book stalls in malls.
- Newspaper printing press for picking bundles of papers.
- Used in paper mills.
- Book exhibition and sales.

7. Future Enhancement

- Obstacle detection can be included to avoid collision of robot with things around.
- Book placing system can also be implemented.

8. Result

Initially we are at the home position. The required book's name is given as the input to the keypad. The robot starts slowly from its home position. The sensor module provides

the value into the controller to generate control signal as per the program. By correcting the path robot moves to the destination i.e. the shelf end. When the RFID code of the book and the tag present on the shelf matches the robot using its arms picks up the book and puts it in the basket. The robot will station at the home position till the next cycle begins. The robot is ready for the next task from the user.

9. Conclusion

This project is an effective system for automatic library manipulation, it reduces the manual work. The system acts as a basic platform for the generation of more such devices for the library management. The implementation of the robot end section in PROTEUS was successful. The desired results were verified in the simulation. The IR sensors navigated the robot end from its home position to the book shelf end and back to home after the collection of required book. it reduces the manual work.



Figure 5: Robot References

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