Asian Journal of Applied Science and Technology (AJAST)
(Open Access Quarterly International Journal) Volume 2, Issue 2, Pages 707-715, April-June 2018

Library Management System to Issue and Retrieve Books from User Using Autonomous Robot

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Article Received: 01 March 2018 *Article Accepted: 09 April 2018* *Article Published: 28 April 2018*

ABSTRACT

Library Management System using an Autonomous robot for the applications of book management in library, it avoids a librarian to search the book manually. Automation of the library allows for the improvement in variety of book collection and management systems. A robot is designed using sensor operated motors to keep track the library book shelf arrangements. The proposed system aims to provide automation in library for issuing the book to the user using robot with the help of information stored in the database. Robot get the data of book which going to be search from the PC through Zigbee. The books are carried from one place to another with the help of line follower using IR sensor. The robotic arm picks the book and handover it to the user. 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: Line follower, Robotic arm, Arduino mega, Zigbee.

1. INTRODUCTION

A library is a collection of books, it provide service to members. There is a need of librarian to pick the book and handover it to the person. This might be easy task in case the library 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. Solution to this problem is a robot which will help to pick the book place it on the table. The pick and place processes are the primary requisite for many of the industrial and house hold application for such applications there is a need to automate the pick and place process basically comprising of picking the intended objects, possibly performing certain tasks and placing them to desired location[6]. In this project robotic arm pick and place system utilizes dc motor, grippers, microcontroller and software's such as arduino for programming.

The main concept of this project is to deliver the book to the students using a robot in a library. This project is essential in order to increase the efficiency of delivering books to the student in library. In other words, it decreases the waiting time during peak hours. The robot uses a Arduino to run a program with array of IR sensors for detecting the path, a simple gripper [7][10]. The information about the book will be stored in the database itself. The robot will deliver respective book to the student based on the book entered. The existing method is that to keep track the library book shelf arrangement [4]. It is mainly used for searching purpose. Robot get the data of book from pc through zigbee. The robot carries a barcode reader which collects the barcode data from the books. It compares the decoded barcode data with the input. If the particular book is found out by the robot, then the robot gives location of the book to the librarian's system.

2. RESEARCH OBJECTIVE

The main aim of this project is to deliver the books to the students using a robot in a library. This project is essential in order to increase the efficiency of delivering books to the student in library.

3. PROPOSED WORK

Arduino v1.6.5 is used for programming and Arduino Mega is used to implement it in hardware.

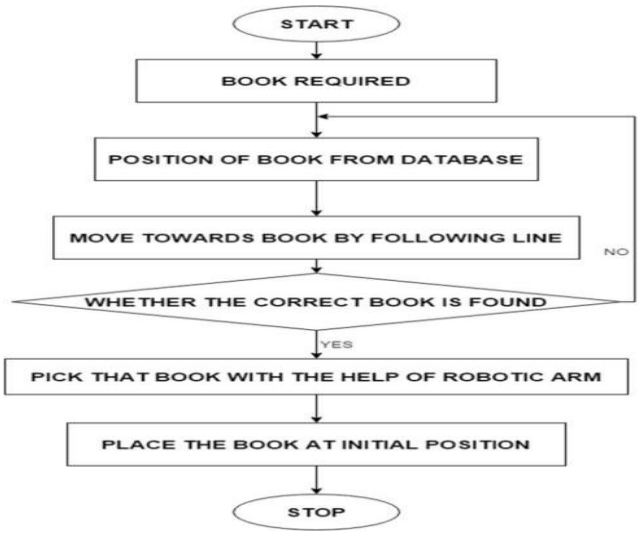

Fig.1 General flow of working

The above flow chart fig 1 describes the general flow of working of robot in library.

3.1. SYSTEM SIDE

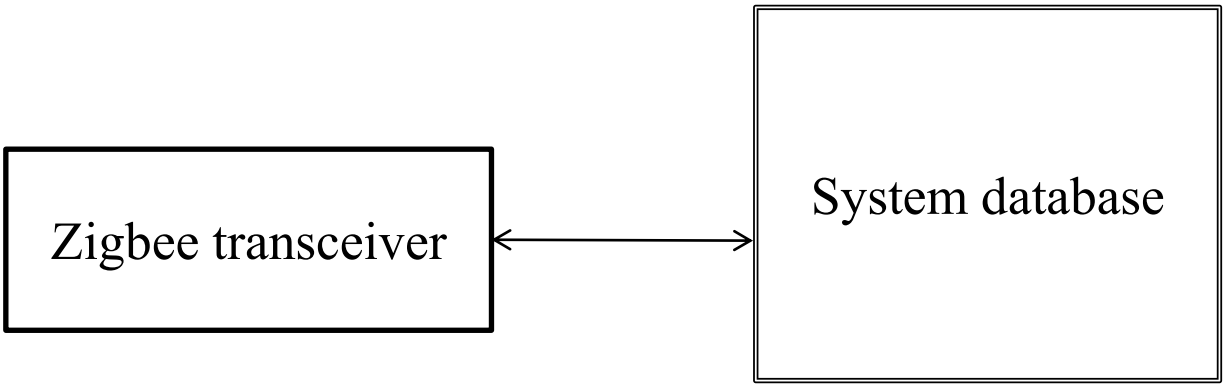

Fig.2 System side

After entering into the library enter the name of the book what user needs. The input is give through the pc. This information provides to the microcontroller Arduino mega using Zigbee transceiver. According to the information provided motor is moved and because of motor movement whole robotic structure is moved. Robotic arm picks the book and carries the book to the issue counter.

The system database contains the information about the books. The name and author information of the book will be stored in the database. After the book name has been entered in the system, the data about the book to search will be transmitted to robot by zigbee as shown in Fig.2.

3.2. ROBOT SIDE

Fig.3 shows the block diagram of robot side. Zigbee transceiver receives the information about the book to search and then the robot moves towards the respective rack of the station. The robotic arm lifts and then it fetches the respective book in the rack and place it in the table. After picking the book, the robot moves towards the initial position i.e counter section.

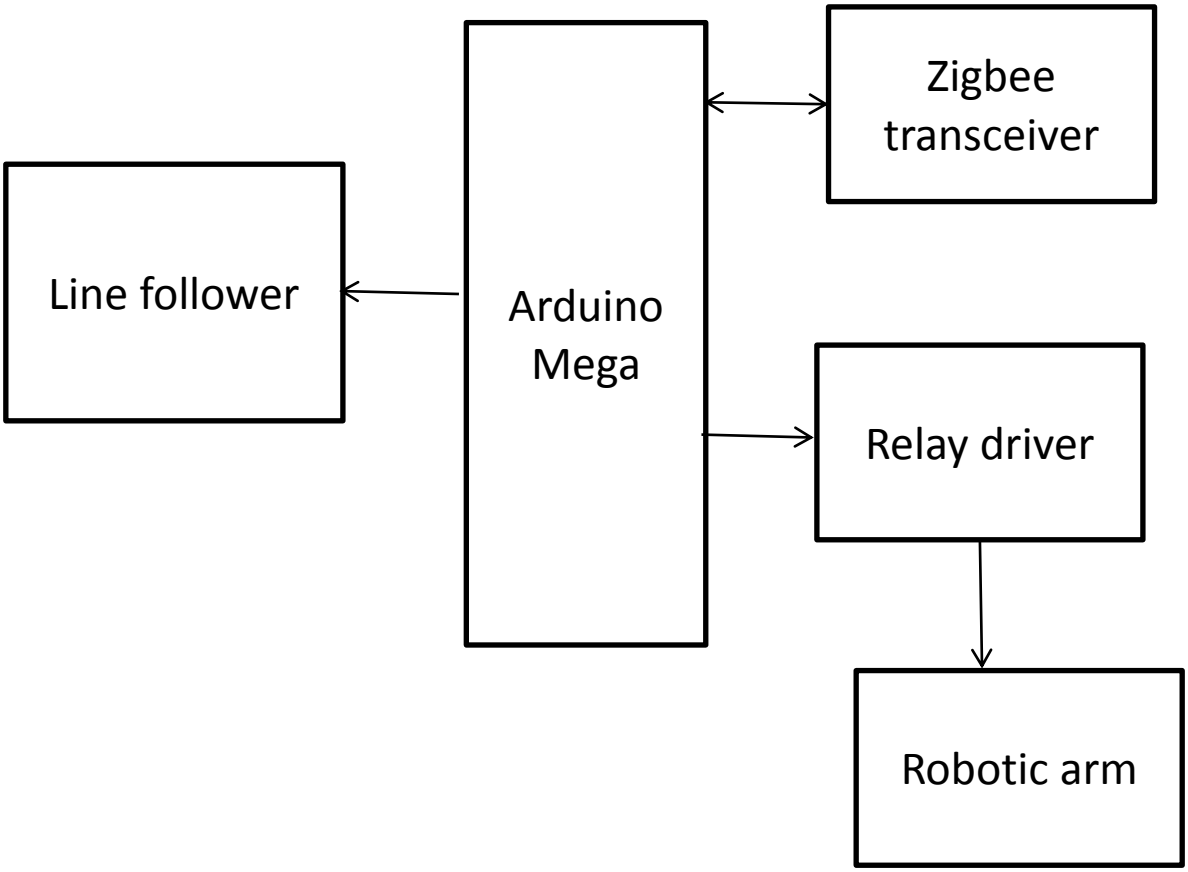

Fig.3 Robot side

A Line Follower Robot is an automated guided vehicle, which follow a black line embedded on the floor or ceiling. The visual line is the path in which the line follower robot goes and it will be a black line on a white surface. An array of sensor is used to detect the black line. According to the status of sensors, special circuit or controller decides the position of line and also the required direction of motion required to follow the line. Motor driver circuit is used to control the motors of the robot to provide desired motion.

3.3. COMPONENTS REQUIRED

1. Arduino UNO
2. L293D Motor Driver IC
3. Geared Motors x 4
4. Robot Chassis
5. IR Sensor array
6. Black Tape (Electrical Insulation Tape)

7. Connecting Wires
8. Power supply

The Arduino Mega is a microcontroller board in view of the ATmega1280 .It has 54 advanced information/yield pins (of which 14 can be utilized as PWM yields), 16 simple sources of info, 4 UARTs (equipment serial ports), a 16 MHz gem oscillator, a USB association, a power jack, an ICSP header, and a reset catch. It contains everything expected to help the microcontroller; just interface it to a PC with a USB link or power it with an AC-to-DC connector or battery to begin.

Microcontroller	ATmega1280
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	54 (of which 15 provide PWM output)

TABLE.1 SPECIFICATION OF ARDUINO MEGA

3.4. BLOCK DIAGRAM

The line follower robot built in this project is divided in to 4 different blocks. The following image shows the block diagram of line follower robot.

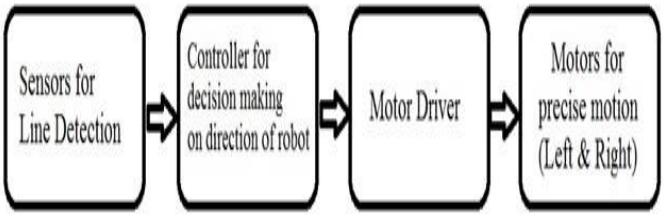

Fig.4 Block diagram of line follower

The working of the project is pretty simple and detect the black line on the surface and move along that line. The detailed working is explained here. As mentioned in the block diagram 4, it need sensors to detect the line. For line detection logic, uses two IR Sensors, which consists of IR LED and Photodiode. They are placed in a way side by side so that whenever they come in to proximity of a reflective surface, the light emitted by IR LED will be detected by Photo diode. In black surface, which has a low reflectance, the light gets completely absorbed by the black surface and doesn't reach the photodiode. Using the principle, the project is setup with the IR Sensors on the Line Follower Robot such that the two IR Sensors are on the either side of the black line on the floor.

When the robot moves forward, both the sensors detects the line. For example, if the IR Sensor 1 in the Fig 5 detects the black line, it means that there is a right curve (or turn) ahead.

Fig.5 Sensor path detection

3.4. CONTROLLER (ARDUINO MEGA)

Arduino MEGA is the main controller in the project. The data from the IR Sensors will be given to Arduino and it gives corresponding signals to the Motor Driver IC.

3.5. MOTOR DRIVER (L293D)

L293D Motor Driver IC is utilized as a part of this undertaking to drive the motor of the robot. IR sensor provides information to arduino and then to Motor Driver IC

3.6. MOTORS (GEARED MOTORS)

Used four geared motors at the rear and front of the line follower robot, Fig 6 shows the gear motor. These adapted motors can give more torque than ordinary motors and can be utilized for conveying some heap too.

Fig.6 Gear motor

3.7. ZIGBEE TRANSCEIVER

ZigBee is a particular for a suite of abnormal state correspondence conventions used to make individual zone systems worked from little, low-control advanced radios [4]. ZigBee is based on an IEEE 802.15 standard. Despite

the fact that low-controlled, ZigBee gadgets frequently transmit information over longer separations by going information through middle gadgets to achieve more far off ones, making a work arrange; i.e., a system with no brought together control or high-control transmitter/recipient ready to achieve the greater part of the organized gadgets. The decentralized nature of such wireless ad hoc networks make them suitable for applications where a central node can't be relied upon.

ZigBee is utilized as a part of uses that require a low information rate, long battery life, and secure systems administration. ZigBee has a characterized rate of 250 Kbit/s, most appropriate for occasional or discontinuous information or a solitary flag transmission from a sensor or info gadget.

Applications incorporate remote light switches, electrical meters with in-home-shows, activity administration frameworks, and other shopper and mechanical hardware that requires short-go remote exchange of information at generally low rates. The innovation characterized by the ZigBee determination is planned to be less complex and more affordable than different WPANs, for example, Bluetooth or Wi-Fi.

3.7.1. Features

1. Low current consumption & low data rate
2. Efficient SPI interface (CC2500)
3. High sensitivity
4. Long battery life
5. Operating voltage :1.8 ~ 3.6 Volts
6. Available frequency : 2.4-2.483 GHz
7. Secure networking
8. Easy for application

4. RESULTS AND DISCUSSION

The robot is able to get data from user and deliver the respective book to the student. The robot moves itself to fetch the respective book by following the line on the ground. The gripper mechanism is simple in design and properly handle the books. The experiments were conducted to evaluate the performance of the proposed method. The results presented in this project mark the beginning of efforts to build a robot for fetching the books and deliver it to the user.

The system provides automation in library for issuing the book to the user using robot as shown in Fig 7 with the help of information stored in the database. Robot gets the data of book which going to be search from the PC through Zigbee. The books are carried from one place to another with the help of line follower using IR sensor.

Fig.7 Book picking Robot

The robotic arm as shown in Fig 8 picks the book and handover it to the user. This helps and simplifies the job of monitoring the arrangement of books and also reduces the manual routine work done by the library staff. If the book is not available in the library it will display it on the librarian system.

Fig.8 Robotic Arm

4.1. TABULATION

Table.2 Distance and time measurement of station A and B

DISTANCE (m)	TIME (s)	SPEED (mm/s)
2	33s	60.6
2.7	47s	61.7

The above Table 2 shows that the robot takes 33seconds to cover station A of 2meters distance and 47seconds to cover station B of 2.7meteres.

4.2. CALCULATION

Total time taken to lift the book = 9s

STATION A without lifting:

Total time taken = book picking time + time taken to cover full path of station A

= 9s + 33s

= 42s

STATION A with one lift:

Total time taken = book picking time + time taken to cover full path of station A + lifting time

= 9s + 33s + 11s

= 53s

STATION B without lifting:

Total time taken = book picking time + time taken to cover full path of station B

= 9s + 47s

= 56s

STATION B with one lift:

Total time taken = book picking time + time taken to cover full path of station B + lifting time

= 9s + 47s + 11s

= 1m 7s

4.3. ADVANTAGES AND DISADVANTAGES ADVANTAGES

1. Reduces human effort.
2. Reduces human error.
3. Makes the management of the library, easier than ever.
4. Saves time.

4.4. DISADVANTAGES

1. Problems of mechanical functioning may occur.
2. Capability of lifting the book has limitation.

5. CONCLUSION AND FUTURE ENHANCEMENTS

In conclusion, the robot is implemented using arduino to pick and place books more safely without incurring much damage. The robotic arm used here contains a soft catching gripper which safely handle the book. In olden days man power are major constraints for the completion of a task. By the use of this project the operations can be done easily and safely in a short span of time.

The use of soft catching gripper and low power wireless communication technique like Zigbee makes the system more effective when compared to other systems. The proposed system is capable of lifting only small weights, by introducing high torque providing motor large weights can be picked.

There are several future recommendations that should be considered. In this project, the capability of lifting the book has some limitation and also the size of the rack should be large because every book is placed separately by certain space in order to avoid book mismatching. So in future to avoid this limitation, every book is identified by its barcode number. Camera will be placed in front of the robotic arm.

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