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Automatic Library Book Sorting Machine

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Abstract: ***A library is a place which has collection of books easily available for the public. In existing library system ,the book placement and sorting works are done manually by the staffs in the library. This results in employment of large number of staffs. It is also a time consuming and complex process. Thus an efficient and automatic book placement system is required to facilitate the people in locating the desired book in a short period of time. The automatic library book sorting machine will arrange the books and thereby it reduces the human effort. The barcode sensor collects the details of the book. The gripper will hold the book and the line follower moves along the track and sorts the exact position where the book needs to be placed. Then the gripper will place the book in the respective shelf. The whole action is operated by arduino UNO R3.Automating the library system will reduce the work of library staffs and complexity. It will improve the process of book sorting and replacement. This system reduces the error in placing the books.***

Keywords: Arduino uno R3 - book sorting - line follower -Barcode sensor

I. INTRODUCTION

Libraries are the source of knowledge and wisdom, but with the increasing education branches and new researches, million of the books are being added to libraries. Manual sorting and placement of these books in shelves is a time consuming and complex process for humans. This often results in incorrect placement of books on shelves.

Consequently people find it difficult to locate the book because the exact location of book returned by the database differs from its present location. Also large number of staffs need to be employed for arranging the books in the respective shelves and the amount spend for employing the staffs will also be high.

Thus an efficient and automatic book placement system is required to facilitate the people in retrieving the desired book in a short period of time. This book placement mechanism helps in correct replacement of the book in the correct shelf. Book sorting technique helps in retrieving the book as requested by the customer.

In this paper, book search is done through barcode sensor technique. Once the book is scanned by a barcode sensor, it will be detected by arduino which then controls the whole process.

II.EXISTING METHODOLOGY

Hideaki Araki has developed a library system augmented by ubiquitous computing. The system uses a combination of CCD cameras and infrared sensors to identify which book is removed from the shelf and updates the book storage database.

Shamsudin has proposed radio frequency identification (RFID) based intelligent shelving system as an efficient mechanism of books management monitoring through wireless communication between the RFID reader and the books to alleviate the intensive labors and efforts in shelving the books. RFID-based systems has also been used as tracking systems that combine security with more efficient tracking of materials throughout the library.

Markus Aittola has developed a location aware mobile library service, Smart Library that provides map based guidance to books and collections on PDA. But this will require the books to be correctly placed inside the shelves. Although efficient, these systems provide a costly solution for library book search and placement tasks.

The major drawback of this system is it takes lot of time to do the particular work. It needs more human effort. It requires new infrastructure for implementing this process.

III. PROPOSED METHODOLOGY

The main objective of automated library book sorting machine is to minimize the work of library staffs by maximizing the use of technologies.The proposed system will overcome the problems of existing systems. A supply of 12 v is reduced to 5v by voltage regulator and given to microcontroller in arduino.

The line follower carries robo arm and gripper which holds the book.

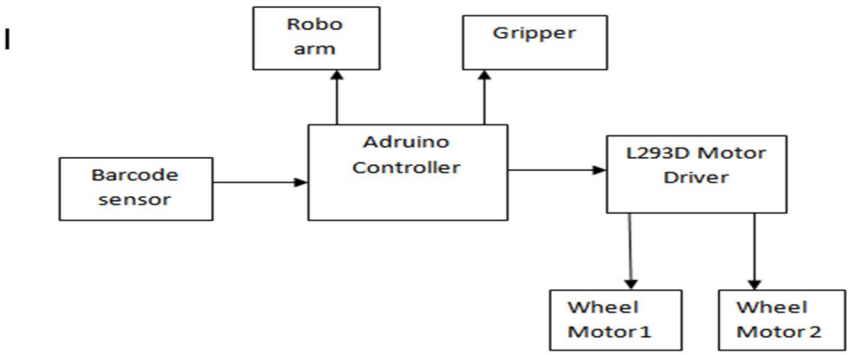


Fig.1: Schematic Block Diagram

The sensor tracks the path and sends signal to the arduino which inturn sent a signal to the driver as response to the signal sent by IR sensor. Thus the motor is driven through the path. The whole action is controlled by arduino uno R3.

IV. SYSTEM ARCHITECTURE

A. Power Supply

12 V battery is directly connected to regulator and L293 driver. In Voltage Regulator where 12V DC voltage can be stepped down to 5V DC voltage using voltage regulator IC7805. The first two digits „78" of IC7805 voltage regulator represent positive series voltage regulators and the last two digits „05" represents the output voltage of the voltage regulator. A regulated power supply of 5V is given to arduino UNO R3, motor driver and arm motor. The wheel motor requires a supply of 10V.

B. Arduino Uno r3

Arduino is an open-source electronics platform based on easy-to-use hardware and software. The Arduino Uno board is a microcontroller based on the ATmega328. It has 14 digital input/output pins, 6 analog pins, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack and a reset button. This contains all the required support needed for microcontroller. Arduino board can be powered by using the USB cable from your computer by power usb cord. Arduino boards can be powered directly from the AC mains power supply by connecting it to the Barrel Jack. It has a voltage regulator to control the voltage given to the Arduino board and stabilize the DC voltages used by the processor and other elements.

Fig 2: Arduino UNO R3

C. Arduino specifications

Dimensions (maximum):

2.96 x 2.1 x 0.59in

75.14 x 53.51 x 15.08mm

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 Ma
DC Current for 3.3V Pin	50 Ma
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

1) *Microcontroller Atmega 328:* Atmega328 is a very popular microcontroller chip produced by Atmel. It is an 8- bit microcontroller that has 32K of flash memory, 1K of EEPROM, and 2K of internal SRAM. The Atmega328 is one of the microcontroller chips that are used with the popular ArduinoDuemilanove boards. The ArduinoDuemilanove board comes with either 1 of 2 microcontroller chips, theAtmega168 or the Atmega328. Of these 2, the Atmega328 is the upgraded. The chip needs power so 2 of the pins, Vcc and GND, provide it power so that it can operate. The Atmega328 is a low-power chip, so it only needs between 1.8-5.5V of power to operate. The Atmega328 chip has an analog-to-digital converter (ADC) inside of it. This must be or else the Atmega328 wouldn't be capable of interpreting analog signals. Because there is an ADC, the chip can interpret analog input, which is why the chip has 6 pins for analog input. The ADC has 3 pins set aside for it to function- AVCC, AREF, and GND. AVCC is the power supply, positive voltage, that for the ADC. The ADC needs its own power supply in order to work. GND is the power supply ground. AREF is the reference voltage that the ADC uses to convert an analog signal to its corresponding digital value. Analog voltages higher than the reference voltage will be assigned to a digital value of 1, while analog voltages below the reference voltage will be assigned the digital value of 0. Since the ADC for the Atmega328 is a 10-bit ADC, meaning it produces a 10-bit digital value, it converts an analog signal to its digital value, with the AREF value being a reference for which digital values are high or low
2) *SRAM 2KB(AT mega328):* A typical SRAM cell is made up of six MOSFETs. Each bit in an SRAM is stored on four transistors (M1, M2, M3, M4) that form two cross-coupled inverters. This storage cell has two stable states which are used to denote 0 and 1. Two additional access transistors serve to control the access to a storage cell during read and write operations. In addition to such six transistor (6T) SRAM, other kinds of SRAM chips use 4, 8, 10 (4T, 8T, 10T SRAM), or more transistors per bit. Four-transistor SRAM is quite common in stand-alone SRAM devices (as opposed to SRAM used for CPU caches), implemented in special processes with an extra layer of poly-silicon, allowing for very high-resistance pull-up resistors. The principal drawback of using 4T SRAM is increased static power due to the constant current flow through one of the pull-down transistors
3) *EEPROM 1 KB (ATmega328):* Microcontroller on the Arduino and Genuino AVR based board has EEPROM: memory whose values are kept when the board is turned off (like a tiny hard drive). This library enables you to read and write those bytes. The supported micro-controllers on the various Arduino and Genuino boards have different amounts of EEPROM: 1024 bytes on the ATmega328, 512 bytes on the ATmega168 and ATmega8, 4 KB (4096 bytes) on the ATmega1280 and ATmega2560. The Arduino and Genuino 101 boards have an emulated EEPROM space of 1024 bytes.

D. Ir Sensor

An array type of IR Sensors is setup on the Line Follower Robot such that the two IR Sensors are on the either side of the black line. When the robot moves forward, both the sensors wait for the line to be detected.

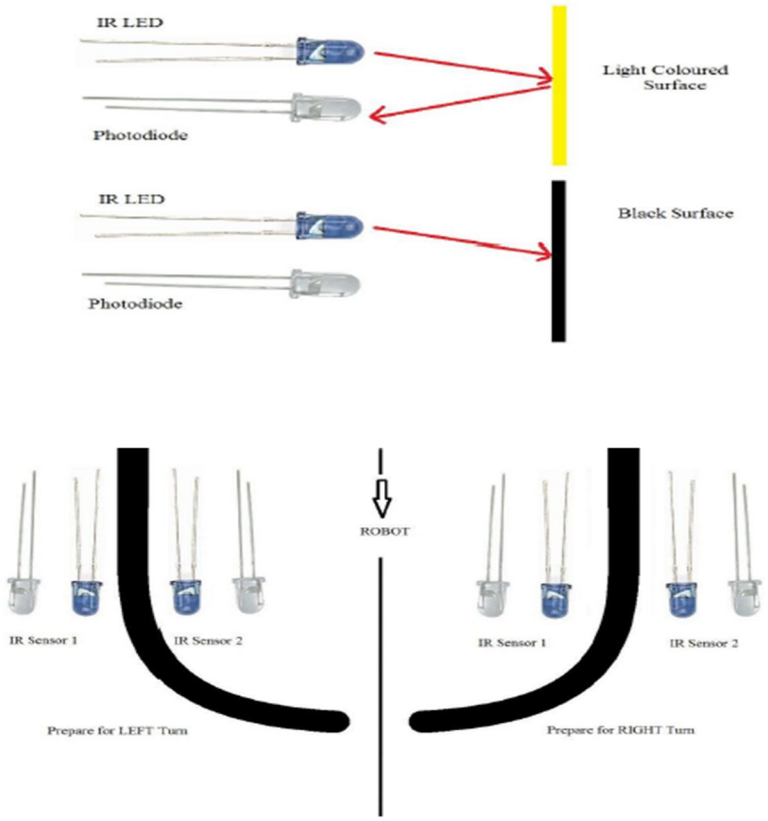


Fig 3: IR Sensor

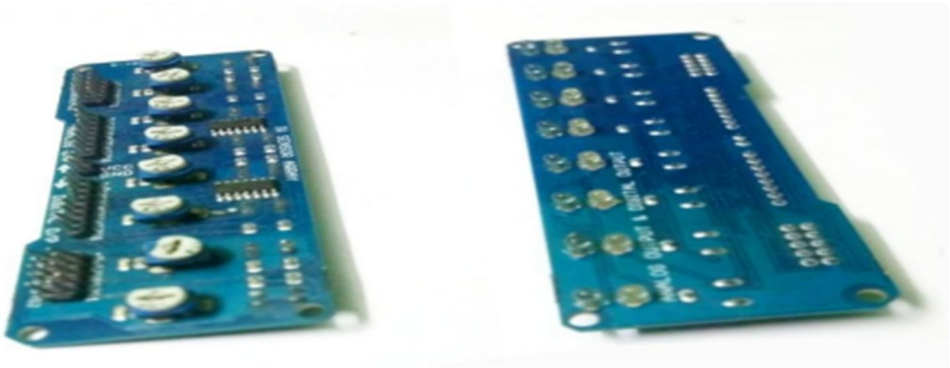


Fig 4: Array type IR sensor

For example, if the IR Sensor 1 in the above image detects the black line, it means that there is a right curve (or turn) ahead. Arduino UNO detects this change and sends signal to motor driver accordingly. In order to turn right, the motor on the right side of the robot is slowed down using PWM, while the motor on the left side is run at normal speed. Similarly, when the IR Sensor 2 detects the black line first, it means that there is a left curve ahead and the robot has to turn left. For the robot to turn left, the motor on the left side of the robot is slowed down (or can be stopped completely or can be rotated in opposite direction) and the motor on the right side is run at normal speed. Arduino UNO continuously monitors the data from both the sensors and turns the robot as per the line detected by them.

E. Line Follower Robot

A Line Follower Robot, as the name suggests, is an automated guided vehicle, which follow a visual line embedded on the floor or ceiling. Usually, the visual line is the path in which the line follower robot goes and it will be a black line on a white surface but the other way (white line on a black surface) is also possible. Certain advanced Line Follower Robots use invisible magnetic field as their paths.

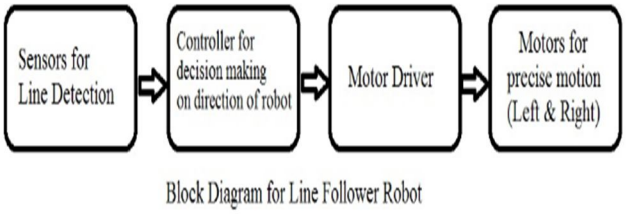


Fig 5: Block Diagram

F. Robo Arm

A robotic arm is a type of mechanical arm, usually programmable, with similar functions to a human arm; the arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of the manipulator is called the end effector and it is analogous to the human hand.

G. Microcontroller Atmega 328

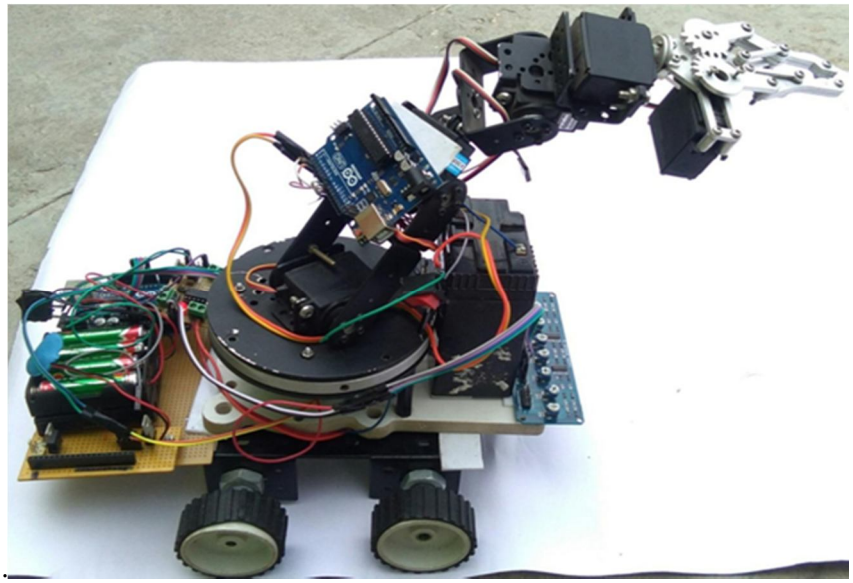
The Atmega328 is a very popular microcontroller chip produced by Atmel. It is an 8-bit microcontroller that has 32K of flash memory, 1K of EEPROM, and 2K of internal SRAM. The Atmega328 is one of the microcontroller chips that are used with the popular Arduino Duemilanove boards. The Arduino Duemilanove board comes with either 1 of 2 microcontroller chips, the Atmega168 or the Atmega328. Of these 2, the Atmega328 is the upgraded.

V. MOTORS

Two geared motors have been used at the rear of the line follower robot. These motors provide more torque than normal motors and can be used for carrying some load as well. Helical geared motors have been used. Helical geared motors are the conventional solution for your drive application. Helical gear units are coaxial units where the gear unit output shaft is in-line with the motor shaft. A solid shaft is always used as output shaft Solutions utilizing helical geared motors are capable of an extreme variable speed range. In many cases, helical geared motors represent the most cost effective solution for your drive task.

VI. RESULTS AND ANALYSIS

The developed system is checked in practical condition. The system is tested with different books and . It is found the system has remained successful in placing books in the shelf. It has been observed that the line follower tracked the path rightly using IR sensors. This system was able to place the books of weight about 500 grams.



VII. SUMMARY AND CONCLUSION

In this paper, design of book placement in the respective shelf is presented. When the book is placed in the robo arm, it will move to the respective shelf. The movement is caused by the line follower, following its track. The track is detected by IR sensors. Then the signal from the sensor is sent to arduino which inturn sent a signal to driver as aresponse to the signal sent by IR Sensor. Thus the motor is driven through the path. The whole system is controlled by arduino UNO R3. Thus this system helps in placing the book in the respective shelf.

VIII. FUTURE SCOPE

The present system only places the book in the respective shelf. In future, retrieval of book can also be done by enhancing the present system. However, the details of the book will not be sensed by the present system. This could be done automatically by using Barcode sensor if equipped with barcode detector. Instead of using barcode sensor we can also use image processing techniques or receiver and transmitter set to identify the title of the book or its author name.

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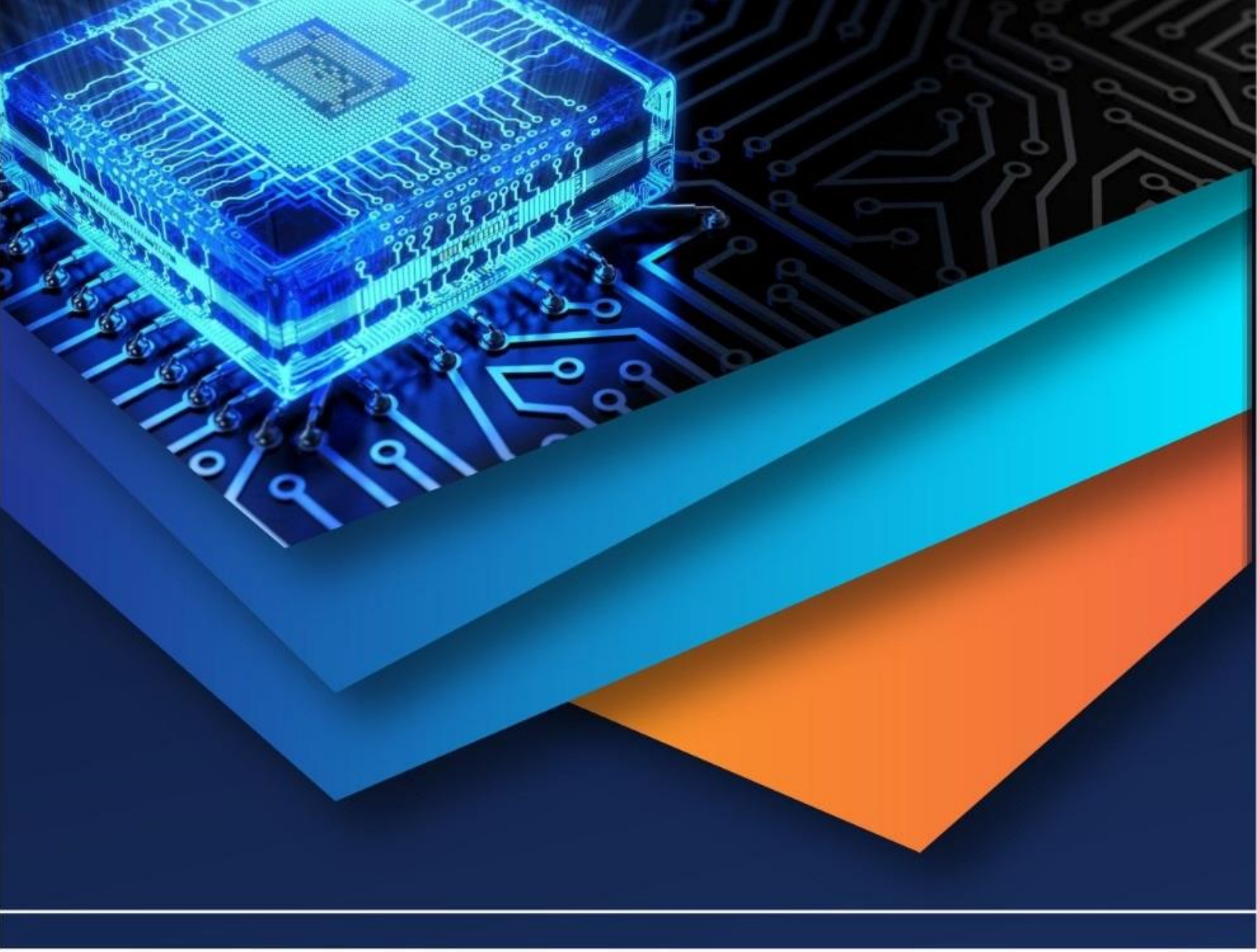

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