

AUTOMATIC LIBRARY ROBOT USING IOT

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Abstract— This project's major goal is to automate the library's current system, which includes functions like search, detect, pick, and put books from shelves. By doing this, readers will be able to find books more quickly and effectively. The project's main focus is on how a robot can check out and check out books from a library. A robot that can be accessed from anywhere on campus over a LAN network with a static IP address is part of the robotic system. With the aid of a robotic arm, the robot can pick up the book and place it on the library counter. The many Source Multiple Destination Robot, which this robot introduces, addresses the challenge of following the journey to the shelves by using a color sensor to detect the target line through many color lines. Each line has a unique hue that corresponds to its identification. The robot will select the intended location by differentiating between the colors red, blue, and green. Using vocal commands that are recognized, library staff members can interact with the robot. Unlike any other particular line follower robot, this one may be referred to as a fully autonomous line follower robot that can be trained to follow voice directions through a simple process. Via the use of a color sensor, the robot detects a line and uses a straightforward feedback mechanism to correct its mistakes in order to move closer to the intended objective. This is a very effective closed-loop system. Additionally, a camera mounted on the robot records and monitors every activity. A camera and bar code scanner are used to identify a specific book on various shelves. It will use a robotic arm to grab the book after it has detected it and return to the counter. Through the library database, users may also verify whether a specific book is available as well as how many copies are currently on hand.

Keyword : Robots, Library Management Systems ,IOT Bluetooth Module,Line follower

I. INTRODUCTION

The 21st century is seeing rapid advancements in fields such as robotics and automation, Industry 4.0, digitization of goods, etc., yet libraries are still trailing behind. Even with the growing accessibility of digital platforms such as eBooks and Kindles, individuals continue to prefer reading physical books. People have to spend a lot of time in lengthy lines to find books at enormous libraries, have them issued, and then return them. This is a result of people's disinterest in visiting libraries these days to look for books, wait in line to check them out, and then return them. The amount and caliber of books that libraries have acquired during the past fifty to sixty years have reached unprecedented heights. Books are becoming more and more plentiful every day. In the past, maintaining and managing the books through a manual administration procedure required a large personnel and labor force. The entire process is drastically altered by the new technology and studies being evaluated .

These days, libraries are outfitted with various sensors and library management modules to make it much simpler to keep track of a big number of books in various editions . Using sensor-driven motors, a line following robot is made to follow the line direction specified for library bookcase configurations . A mobile robot that can recognize and follow a line drawn at the ground is called a line follower robot. The path is often predetermined and can be invisible in the form of a magnetic field or visible on a white surface with a highly contrasting color, such as a black line. With its infrared sensors positioned beneath the apparatus, this kind of robot will undoubtedly sense the line . Following that, certain transfer buses send the data to the CPU. The robot will follow the path after the processor determines the appropriate orders and sends them to the driver .

In order to identify the various rows and columns in the library and save time when searching for books, RFID tags and bar code scanners are employed . The location of books, user authentication, and book details (edition, number of copies, location of storage) can all be easily found in libraries these days thanks to digitization. However, the process of issuing and returning books is still manual and takes time for both readers and librarian staff. Another issue is that it is very difficult for the robot to go around the library and locate the monitored location of a book if the location has been tracked using a database and sent to the robot via WiFi or a ZigBee transceiver . Since the robot cannot proceed along a guided path to solve this issue, a method that uses a straightforward algorithm to solve it automatically has been devised. One multidirectional line follower robot makes up this system. Here, the robot will follow the Red, Blue, and Green color lines that have been established and developed for its travel within the library. In addition, the robot has a barcode scanner, WiFi camera, and an internet-accessible robotic arm. A bar code scanner and a camera are used to identify books, and they are used to direct a robot to select a book from a specific



shelf and set it on the library counter. In a similar vein, returning the book involves the opposite procedure. Only when the librarian staff issues voice commands to the robot will the robot be able to properly manage and maintain the books. We have also worked on the robot's effectiveness and the amount of time it takes it to finish tasks.

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II. LITERATURE SURVEY

[1] "Smart Lighting System for Library Using IoT Technology" by Chitra Batumalai, Xin Rou Kong, and Malathy Batumalay was published in the INTI JOURNAL in June 2019.

This essay discusses an automated and intelligent lighting control system that uses Internet of Things (IoT) to govern lighting in specific library spaces. This approach aids businesses in improving energy efficiency and comprehending library illumination more effectively. By taking this technique, the organization becomes more eco-friendly and convenient.

[2] N. Gayathri Anurag Yadav "IoT with Motion Sensor Application for Smart Learning Environment" (May the year 2020) This study revealed that motion-sensor equipped intelligent classrooms are a noteworthy development that will probably play a big role in the future. The finest project for reducing excess and needless energy use is this one. IOT is quite demanding in the modern world. IOT is enabling smarter objects, such as smart cities and smart homes. Electrical energy is thus wasted during the undesired time. To address this automatically, PIR sensors and LDR are utilized. PIR detects human presence within the classroom and only activates to conserve electricity when a person is there.

[3] Erwin L. Enriquez and Francis Jesmar P. Montalbo, "An IoT Smart Lighting System for University Classrooms" 2020 IEEE In this essay, we've examined how the need for IoT is growing in today's world and how online engagement is becoming more prevalent. Using gadgets for daily tasks, such as wireless sensors, laptop computers, and cell phones, can save time and effort. An Internet of Things (IoT) system connects wireless devices and permits data interchange over large networks.

III. PROPOSED WORK A.

Block Diagram

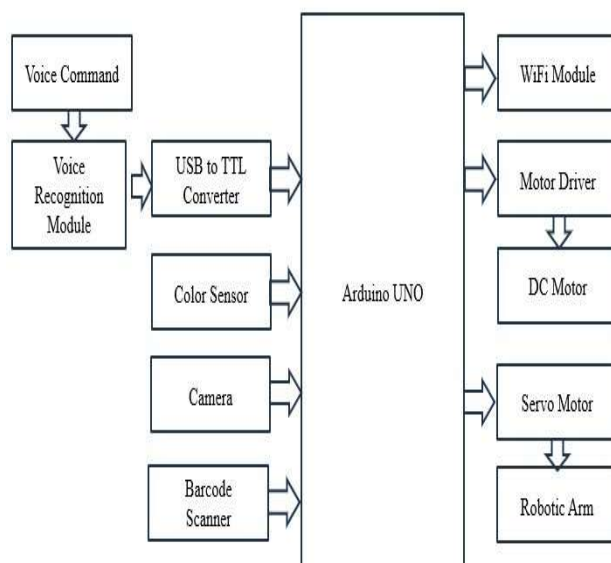


Fig 1 Block Diagram

IV. METHODOLOGY

Every library is made up of all the book records and user data stored in the database that librarians manage. In order to use the online database platform and search for a certain book or article that is available in the library, a reader must first successfully log in with their credentials. Once the reader has obtained the information from the online database, they can proceed with the following actions: retrieving the book or article from the library, lending it out, and returning it. A robot will recognize the line and proceed along it. Additionally, it can be accessed by the registered voice commands of the library staff for a variety of tasks including organizing the books in a specific order or returning them to their proper locations. The proposed system's block diagram is displayed in Fig. 1.

The user can quickly train and predefine speech commands in the voice recognition module. Up to 80 voice commands—a maximum of 7 at once—can be supported, with each voice command lasting 1500 ms (one or two sentences said). Staff librarians' voice command data is kept in the speech recognition module and is only available to them when they need to manage and maintain the library appropriately. An Arduino microcontroller is coupled to a voice recognition module. The robot will receive commands from Arduino and be instructed to control the procedures. Esp8266 is linked to Arduino and used to create database web interfaces.

If the book is available in the library or not, this database will direct the reader to the relevant information about it. The reader can check if the book or article is available at the library; if not, an error notice stating that the book or item is unavailable will appear. The robot will choose whether to issue or return a book based on the reader's inputs via the database and online interface. Currently, a robot equipped with a color sensor (TCS3200 color sensor) can detect three different lines: red, blue, and green. This sensor is used to determine the robot's path or line of sight. The motor driver L298N will be instructed to follow a certain line among the three distinct colors by the color sensor. Along with a bar code scanner, a robot has a WiFi camera installed to guide its course, monitor its movements, and help with book searches. The robot will use its two-degree-of-freedom robotic arm to select the specific book once it has determined the book's location using a database, bar code scanning, and a camera. A gripper-equipped robotic arm will pick up the book, hold it, and move it to the appropriate location.

V. FLOW CHART

To help the robot distinguish between the many columns in the library, we assigned distinct colors to each column. Let's look at three columns. For the time being, we are using the colors Red, Blue, and Green to indicate the columns based on technology, friction, and the Encyclopedia, respectively. The librarian enters all of the book details into the database. Similar to this approach, logging into the database and entering the student's information is the initial step towards authentication. The reader can search the book once they are in the system. All relevant information about the book (ISBN, edition, Author, Publication) will be provided to the reader.

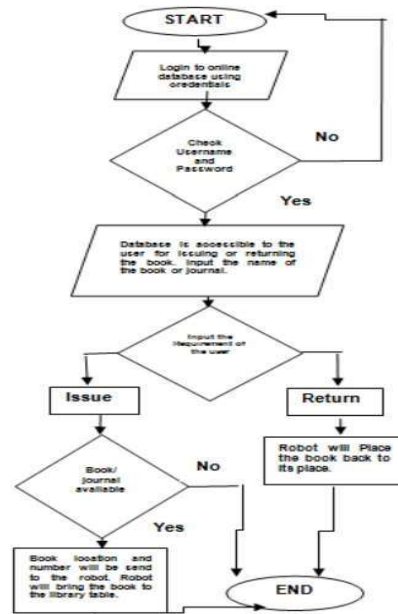


Fig 2 Flow Chart

VI. COMPONENT SPECIFICATIONS

1) Arduino UNO

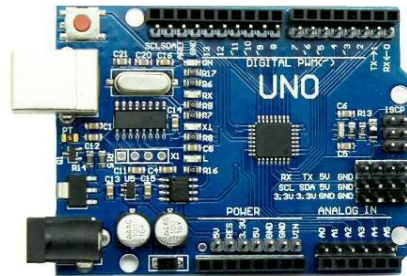


Fig 3 Arduino UNO

The less expensive variant of the well-known Uno R3 Arduino is the Uno R3 CH340G ATmega328p Development Board. Rather than utilizing an Atmega16U2 processor, the CH340 USB to Serial converter chip is used in its assembly. Many of these inexpensive Arduino boards with CH340 chips have been utilized by us, and we have found them to function flawlessly. The CH340 chip is only utilized when programming or utilizing the USB port's serial output. This board functions exactly the same as the more costly model without the CH340 chip under typical circumstances.

Features:

1. ATmega328 (SMD) microcontroller with CH340G interface
2. The 5V operating voltage
3. Recommended input voltage range: 7–12V
4. Input Voltage (5–20V) Limits

5. There are 14 digital I/O pins, 6 of which give PWM output. 2)ESP 8266

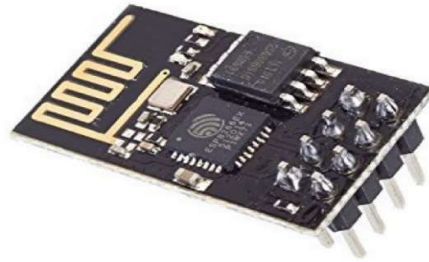


Fig 4 ESP 8266 Wi-Fi Module

Any microcontroller can access a WiFi network with the help of the ESP-01 ESP8266 Serial WIFI Wireless Transceiver Module, a self-contained SOC with an integrated TCP/IP protocol stack. Either an application can be hosted on the ESP8266, or it can delegate all Wi-Fi networking tasks to another application processor. Every ESP8266 module is pre-configured with an AT command set firmware, so all you have to do is connect it to your Arduino device to obtain almost the same amount of WiFi functionality as a WiFi shield—and that's right out of the box! The ESP8266 module is a very affordable board with a sizable and continuously expanding community. Through its GPIOs, this module may be integrated with sensors and other application-specific devices with minimal work required up front and minimal loading during runtime thanks to its robust onboard processing and storage capabilities.

Features:

1. b/g/n Standards (802.11)
2. Soft-AP and WiFi Direct (P2P)
3. Flash Memory of 1 MB
4. An application processor could be derived from an integrated low-power 32-bit CPU.
5. Aggregation of A-MPDU and A-MSDU and 0.4 ms guard interval
6. Take a few moments to wake up and send packets.
7. Less than 1.0 mW of standby power usage (DTIM3)

3)Color Sensor



Fig 5 Color Sensor

With the help of a top-notch light sensor and a mix of Red, Green, and Blue, the TCS3200 Color Recognition Sensor Module for MCU Arduino can detect any color. All of the TCS3200 pins are conveniently provided by the module on 0.1" headers, making it perfect for use with PCBs, breadboards, or stripboards.

Features:

1. 3V–5V operating voltage
2. Conversion of light intensity to frequency with high resolution.
3. Every chip pin has been drawn for the usual 100.
4. Insert the 2.54 mm needle.
5. Very practical for a bitmap board.
6. Programmable color and output frequency on full scale.
7. Have direct communication with a microcontroller.
8. Surface mount package with a low profile.

4)L298N motor driver



FIG 6 L298N MOTOR DRIVER

A high power motor driver ideal for DC motors and stepper motors is the L298N 2A Based Motor Driver. It contains an onboard 5V regulator that it may feed to an external circuit, and it makes use of the well-known L298 motor driver IC. Up to four DC motors can be driven by it, or two DC motors with speed and direction control.

Features:

1. The motor's current sense.
2. Heat sink for enhanced efficiency.
3. An LED power-on indication.
4. L298N is the Double H bridge Drive Chip.
5. VDC (operational voltage): 5 to 35
6. Maximum Current (A): Two 7. Constant Current (A): 0.03–0.66 mA
8. There are two channels.
9. Protection Against Over-Currenting: Yes
10. Thermal Protection: Yes

5)Voice recognition module



Fig 7 Voice Recognition Module

Compact and simple to use, the Speak (Voice) Recognition Module V3 is an Arduino-compatible speaking recognition board. A speaker-dependent voice recognition module is the Speak (Voice) Recognition Module V3. In total, it can handle up to 80 voice instructions. Up to seven voice commands can be used simultaneously. You might train any sound to be the command. Before allowing the module to recognize any voice commands, users must first train it. There are two ways to control this board: General Input Pins (half of a function), and Serial Port (full function). The board's general output pins might produce a variety of waves in response to recognized voice commands.

Features:

1. 4.5–5.5 V for supply voltage;
2. <40 mA for current.
3. Digital Interface: GPIO and UART interface operate at 5V TTL level.
4. Support up to 80 voice commands, with a 1500 ms speech time (one or two syllables).
5. Up to seven voice commands can be used simultaneously.
6. A library for Arduino is provided.
7. General Pin Output under user control.

6)DC Motor



Fig 8 DC Motor

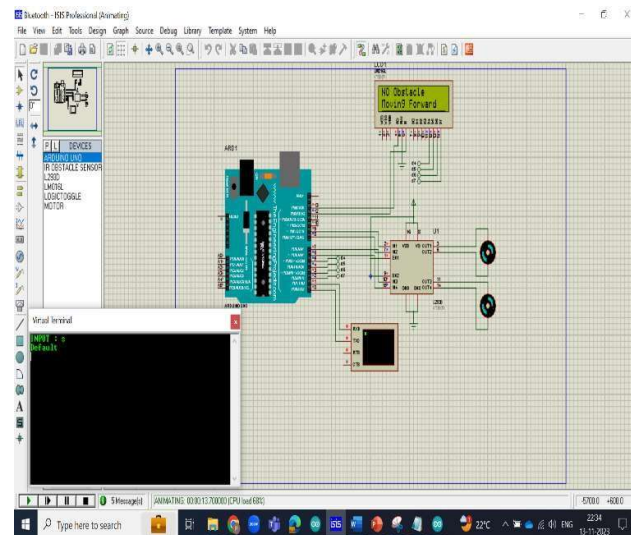
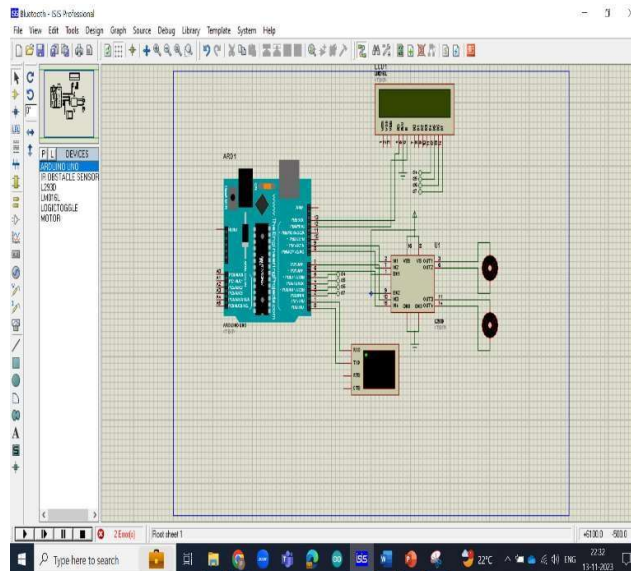
These motors are straightforward DC motors with shaft gears to get the best possible performance characteristics. Because the shaft of its gearbox assembly passes through its center, they are referred to as center shaft DC geared motors. Utilizing these DC motors in standard size is quite simple. Additionally, using an Arduino or other comparable board to control motors doesn't have to cost a lot of money. This motor, which has a voltage of between 5 and 35V DC, can be utilized with the L298N H-bridge module with an integrated voltage regulator motor driver.

Features:

1. 12V is the operating voltage.
2. RPM (rated speed): 500
3. Rated Torque: 0.7 kg/cm
4. Stationary Torque (kg/cm): 3
5. Inactive Load Current (A): 0.06
6. 0.3 load current (A)

VII. RESULT DISCUSSION

Proteus Simulation Results:



VIII. CONCLUSION

The Smart Library system's objectives are to give information about a vast array of books, periodicals, journals, theses, and other materials and to enable staff, students, and administrators to search, borrow, and return materials. Because this method combines mechanical and electrical automation in place of human intervention, it will take less time to complete tasks like lending and returning books. Many readers will benefit if this approach is implemented in central libraries. Different user types are granted different privileges. The robot may also be controlled by voice commands, which allows librarian staff to use it to assist in effectively administering and maintaining the library. While readers can choose to issue or return books through it without having to go anywhere by accessing it through the web database to receive the specifics of their account.

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