LIBRARY ASSISTANCE ROBOT

A Interim Project Report

Submitted by

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to

APJ Abdul Kalam Technological University

in partial fulfillment of the requirements for the award of the Degree of

Bachelor of Technology (B.Tech)

in

MECHATRONICS ENGINEERING

Under the guidance of

FR AJEESH BABU PERINCHERY

CREATING TECHNOLOGY
LEADERS OF TOMORROW
ESTD 2002

DEPARTMENT OF MECHATRONICS ENGINEERING

Jyothi Engineering College

NAAC Accredited College with NBA Accredited Programmes*

Approved by AICTE & affiliated to APJ Abdul Kalam Technological University

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February 2023

DECLARATION

We the undersigned hereby declare that the project report "LIBRARY ASSISTANCE ROBOT", submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by us under supervision of Fr Ajeesh Babu Perinchery. This submission represents our ideas in our own words and where ideas or words of others have been included, we have adequately and accurately cited and referenced the original sources. We also declare that we have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in this submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously used by anybody as a basis for the award of any degree, diploma or similar title of any other University.

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LEADERS OF TOMORROW
ESTD 2002

CERTIFICATE

This is to certify that the report entitled " **LIBRARY ASSISTANCE ROBOT** " submitted by AKSHAY P G(JEC19MC003), DENNY ROBANS(JEC19MC016), DIVIN U VARGHESE(JEC19MC019), S REGHURAJ(JEC19MC042) to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree in Bachelor of Technology in **Mechatronics Engineering** is a bonafide record of the project work carried out by them under my/our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

Fr Ajeesh Babu Perinchery
Assistant Professor
Internal Supervisor

Dr Anoopa Jose Chittilappilly
HOD
Head of the Department

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VISION OF THE INSTITUTE

Creating eminent and ethical leaders through quality professional education with emphasis on holistic excellence.

MISSION OF THE INSTITUTE

- To emerge as an institution par excellence of global standards by imparting quality Engineering and other professional programmes with state-of-the-art facilities.
- To equip the students with appropriate skills for a meaningful career in the global scenario.
- To inculcate ethical values among students and ignite their passion for holistic excellence through social initiatives.
- To participate in the development of society through technology incubation, entrepreneurship and industry interaction.

VISION OF THE DEPARTMENT

Create eminent and ethical leaders committed to profession and society in the field of Mechatronics through quality professional education to excel in industrial automation and innovation.

MISSION OF THE DEPARTMENT

To impart orientation to meet the challenges of the modern industry and provide motivation for research. To provide quality education to create graduates with professional and social commitment.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1: Graduates shall possess fundamental and advanced knowledge in electronics, electrical and mechanical along with fundamental knowledge in mathematics, basic sciences and computer programming to analyze and solve the challenges related to automation.

PEO 2: Graduates shall have ability to design and create novel solutions with modern tool usage which lead to a lifelong learning or higher qualification, making them experts in their profession.

PEO 3: Graduates shall have the ability to work in a multidisciplinary environment with good professional and ethical commitment.

PROGRAMME SPECIFIC OUTCOMES

Graduate possess -

PSO 1: Associate the concepts related to electrical, electronics, Mechanical, Robotics, Control and Instrumentation to solve the challenges of modern industries.

PSO 2: Analyze and design systems with modern tools for the benefit of the society.

PROGRAMME OUTCOMES

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

COURSE OUTCOMES

COs	Description
CO1	Model and solve real world problems by applying knowledge across domains(Cognitive knowledge level: Apply).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: Apply).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: Apply).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: Apply)
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: Analyze).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: Apply).

CO MAPPING TO POs

	POs											
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	2	2	1	1	1	1	2
CO2	2	2	2		1	3	3	1	1		1	1
CO3									3	2	2	1
CO4					2			3	2	2	3	2
CO5	2	3	3	1	2							1
CO6					2			2	2	3	1	1

ABSTRACT

Modern industries are highly automated for various applications. In industrial as well as domestic applications, there is a continuous rise in the use of robots. These are products of mechatronics engineering and are able to implement different tasks in specialized physical environments automatically. The frequent applications of robots in diverse areas make essential understanding of the fundamentals of robots for embedded system design engineers. The embedded system involves a microcontroller, software, hardware, control theory, interfacing knowledge, and the use of sensors. The knowledge of software algorithms and hardware circuits is equally important for a vital embedded system design. The embedded system design skills are needed to fabricate a low-cost cost wheeled line follower robot [1-3]. The primary tasks of line follower robot are- (i) Precise speed control as per predefined line is required. Further, the maximum value of speed is constrained because of friction between the surface and the tires.

CONTENTS

LIST OF FIGURES

LIST OF ABBREVATIONS

JECC	Jyothi Engineering College, Cheruthuruthy
EEE	Electrical & Electronics Engineering
ECE	Electronics & Communication Engineering
CSE	Computer Science & Engineering
ME	Mechanical Engineering
CE	Civil Engineering
MC	Mechatronics Engineering

CHAPTER 1

INTRODUCTION

In this 21st Century, where the world is moving forward in the field of robotics and automation, Industry 4.0, digitization of things, etc but we are lagging when it comes to the library. Despite the increasing availability of digital platforms like Kindle, eBooks etc, people still favour reading physical books. In large libraries, people need to invest a lot of time in searching for a book, get it issued or return while standing in a long queue. This is because people nowadays are not interested in going to the library to search for the book, wait for issuing and returning the books in the queue. In the last 50 – 60 decades the evolution of libraries are achieving great heights in terms of quantity and quality of different books. The number of books is increasing day by day. As the new technologies and researches are evaluating that changes the whole process dramatically . Now the libraries are equipped with different sensors and modules for library management to manage a large number of books with their different editions are much easier . A line following robot is designed to keep track of the line direction defined for library bookshelf arrangements using sensor-driven motors . Line follower robot is a mobile robot capable of detecting and following the line drawn at the ground. The route is usually predefined and can either be visible on a white surface with a high contrasting colour like a black line, or it can be invisible as a magnetic field. This type of robot will certainly feel the line with its IR sensors mounted under the device .

After that, particular transfer buses transmit the data to the processor. The processor will then decide on the proper commands and then send them to the driver, and the robot will obey the path . Nowadays, libraries are getting digitalize to seek the location of the books, users authentication, getting details of the books (edition, number of copies present, place where they were kept) easily but for issuing and returning the book the process is still manual and time-consuming for both readers and librarian staffs. Another problem is that if we have tracked the location of the book through database and send it to the robot though ZigBee transceiver or wi-Fi, the movement of the robot in the library to find that tracked location is very difficult.

CHAPTER 2

LITERATURE SURVEY

2.1 A Line Follower Robot from design to Implementation.Mehran pakdaman, M. Mehdi Sanaatiyan, Mahdi Rezaei Ghahroudi.

The Line follower robot is a mobile machine that can detect and follow the line drawn on the floor. Generally, the path is predefined and can be either visible like a black line on a white surface with a high contrasted color or it can beinvisible like a magnetic field. Therefore, this kind of Robot should sense the line with its Infrared Ray (IR) sensors that installed under the robot. Afterthat, the data is transmitted to the processor by specific transition buses. Hence, the processor is going to decide the proper commands and then it sends them to the driver and thus the path will be followed by the line follower robot.

2.2 Design and Development of IOT Based Smart Library using Line FollowerRobot. Tushit Gupta, Rohit Tripathi, Manoj K. Shukla and Shailendra Mishra.

The main objective of this paper is to automate the existing system in the library whichincludes the operations like search, detect, pick and place the book from shelves, which will help the readers in seeking the book in less time and quite efficiently. The paper emphasis on how a robot can issue and return a book in the library. The robotic system includes a robot that uses a LAN network with static IP for accessing the robot from anywhere in the campus. The robot is capable of picking the book and placing it with the help of a Robotic arm to the library counter. This robot introduces the MultipleSource Multiple Destination Robot, which is capable of detecting the target line through several color lines via a color sensor for its movement in the library which solves the problem in tracking the path to the shelves. Each line is colored differently, as its identity.

2.3 Line Follower Robot: Design and Hardware Application.Satyam Tayal,Harsh Pallav Govind Rao,Suryansh Bhardwaj,Harsh Aggarwal.

Robots are specially designed machines used to accomplish dedicated and repetitive actions with high speed, precision and endurance. These actions are mainly controlled by using advance programming, manipulators and sensors etc. The sensor based black line follower robots are one of the most basic robots used to follow black line on white background or vice versa. These robots may be used to in various industrial and domestic applications such as to carry goods, floor cleaning, delivery services and transportation. In this paper, a simple

and cost effective circuit design of black line follower robot and its practical implementation has been presented.

2.4 Enhancing the Academic Library Experience with Chatbots: An Exploration of Research and Implications for Practice Indra Ayu Susan Mckie Bhuva Narayan

This paper explores the potential of using chatbots to improve the academic research experience for university students with a literature-based discussion reflecting on a prototype being developed at the University of Technology Sydney (UTS). The paper proposes that information professionals need to adapt emerging technologies such as chatbots to innovate, improve and support library services. Designing a positive experience for the user is essential to ensure that such technological solutions are sustainable. In this exploratory paper, we argue that it is important that librarians engage with the conversational design of the library chatbot in collaboration with the technology developers in order to make it useful, friendly, trustworthy, and customisable for uni- versity students.

CHAPTER 3

METHODOLOGY

The library consists of all the records of the books, and user information in the database handled by librarians. A user has to log in to the online database platform using the credentials and after getting the successful login, the user can access the platform for searching the availability of a particular book or article in the library. A robot will detect the line and follow the particular line. Arduino will give commands to the robot and instruct the robot to control the processes. Esp8266 is used for creating a web interface for a database andconnected to Arduino. This database will guide the reader about the information of the book if it's available in the library or not. If the book or article is present in thelibrary then the reader can issue it otherwise it will pop up with the message like the book or the article is not available.

3.1 Block Diagram

The line follower robot system used sensors such as phototransistors, photodiode and light dependent resistance (LDR). The follower utilizes infrared sensors for line sensing . The infrared sensors are placed on the front right and front left sides of the robot. There is a directly inverse relation between resistance of IR sensors and the amount of light with this. Thus on white surface the amount of refracted light on IR sensor is very high and its resistance increase when line follower robot is on the black line. Thus the direction of line follower robot may be control by means of IR sensors. The sensor data is utilized by the microcontroller and signals are transmitted to driver system. The black line follower robots may be used in various industries and domestic applications such as automated equipment carrier, floor cleaning, hotels for transfer of material and military purposes.

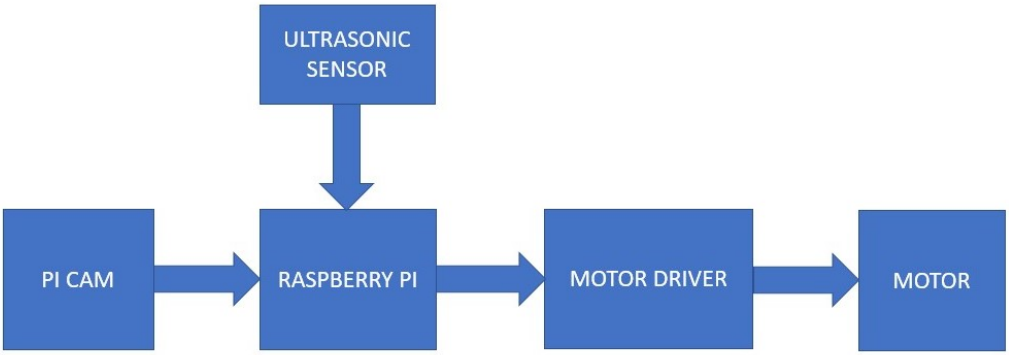

Figure 3.1: Block Diagram

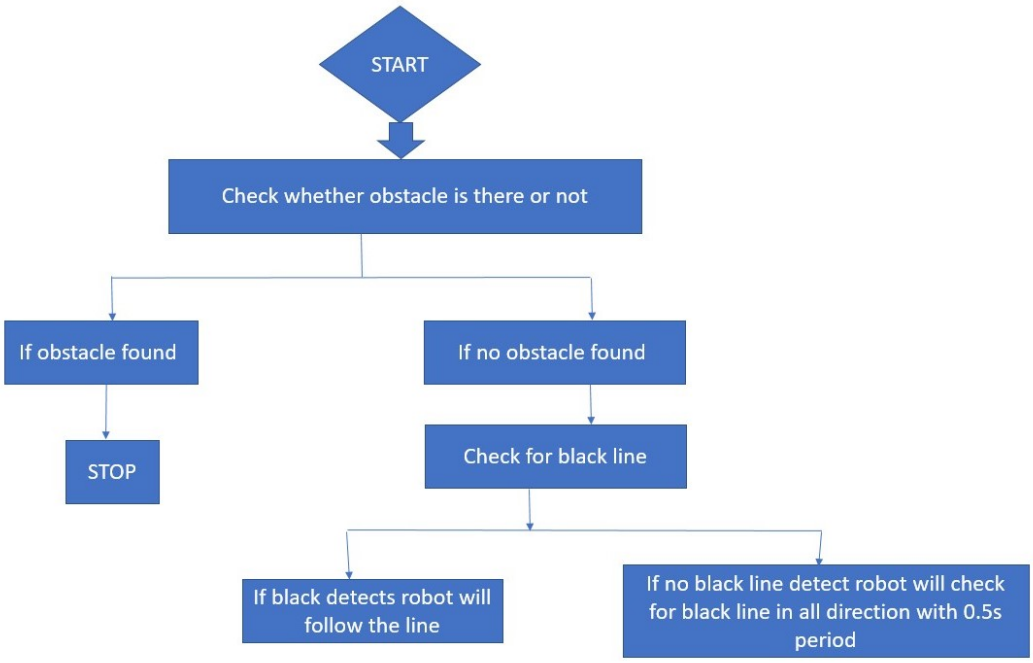

Figure 3.2: Flow Chart

3.2 Flow Chart

The flow chart explains how the line follower works. Initially the line follower checks for obstacles and if the obstacle is present then the motor stops, and if the obstacle is not found then it detects for the black line drawn on the floor. The black line is drawn with a width of 5inches.

If the black line is detected then the robot will follow the path, else it checks for the black line in all directions with a speed of 0.5 sec. The IR sensors detects the line, it can detect the variation for white surface and black strip, in corners the line follower turns in the specified speed towards the required side. as one side IR sensor detects black strips. If its a curved path then constant variation in direction happens till it turns to the specified direction. If obstacle is detected the line follower stops and seeks manual assistance. The admin is prompted a message that there is an intervention in the path.

3.3 Components

1.Raspberry pi 3 model B
2.Pi cam
3.DC Motor (100 rpm)
4.L293D motor driver
5.3 inch wheels

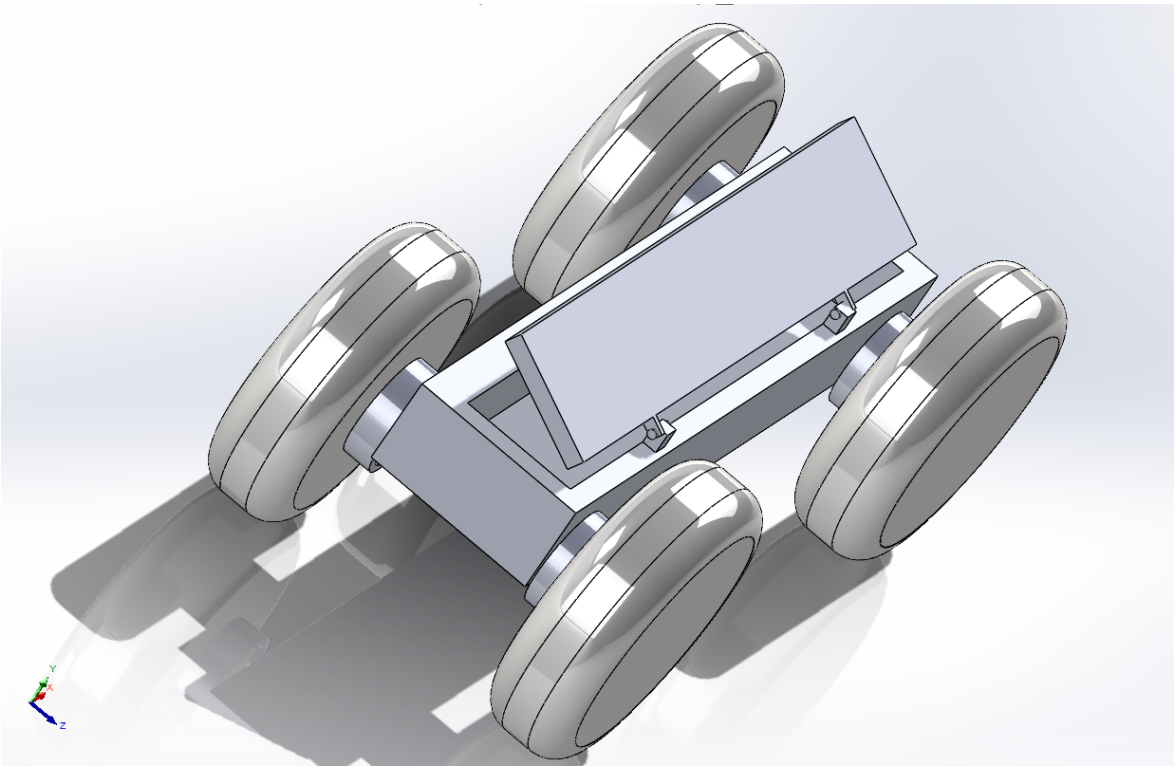

Figure 3.3: Solidworks Design

6.3s Lipo battery pack
7.2s Li ion battery for rs pi
8.Electromagnet
9.Micro servo Motor
10.FM jumpers
11.MM jumpers
12.Pi encloser
13.Cooling fan
14.Bar Code Scanner
15.Voice recoginition module
16.Tcs3200 colour sensor.

3.4 Design

The proposed design has four wheels, where two rear wheels are driven using motors(100 rpm), front two wheels can be powered if the total weight increases above 5kg. The design consists of a body which has a hollow space where all the components can be placed. The hollow space has a flap to cover the top surface. The flap is fixed to the body via screws. The space for the body can be made half if robotic arm is being fixed on the top for pick and place.

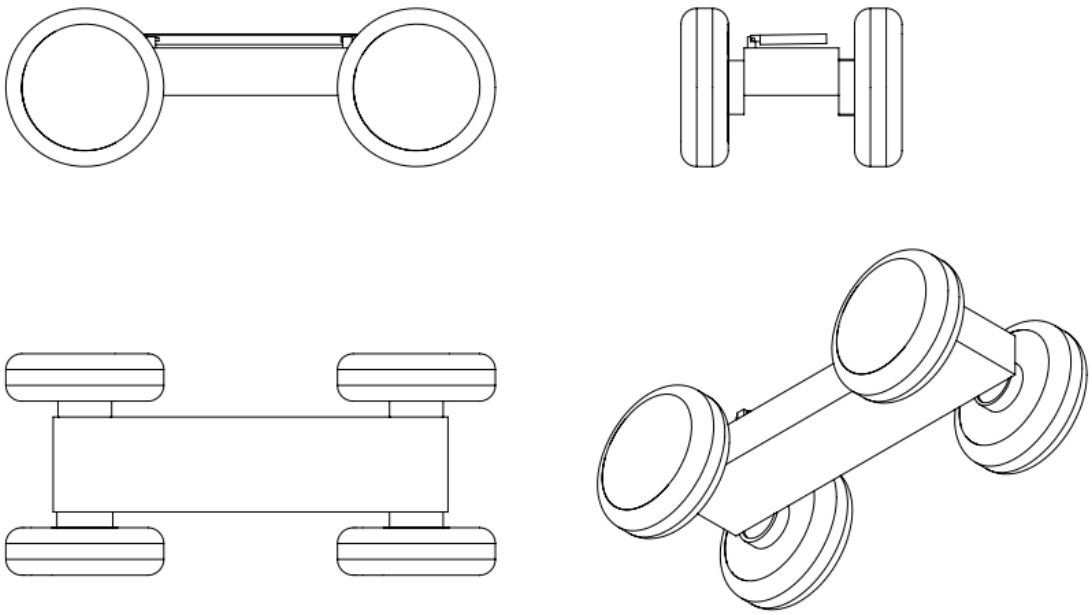

Figure 3.4: Proposed Design

The bar code reader can be placed above the flap. If the robotic arm length exceeds 1m then four wheel drive shall be employed.

3.5 Circuit Diagram

The circuit involves two IR sensors and a pair of motors connected to the Raspberry pi. The complete circuit is powered by a Mobile Power bank (represented by an AAA battery in the circuit above.

Since the pin details are not mentioned on the Raspberry Pi, we need to verify the pins using the below picture. As shown in the picture the top left corner pin of the PI is the +5V pin, we use this +5V pin to power the IR sensors as shown in the circuit diagram (red wired). Then we connect the ground pins to the ground of the IR sensor and Motor Driver module using black wire. The yellow wire is used to connect the output pin of sensor 1 and 2 to the GPIO pins and 3 respectively.To drive the Motors, we need four pins (A,B,A,B). This four pins are connected from GPIO14,4,17 and 18 respectively. The orange and white wire together forms the connection for one motor. So we have two such pairs for two motors.The motors are connected to the L293D Motor Driver module as shown in the picture and the driver module is powered by lithium ion battery pack.

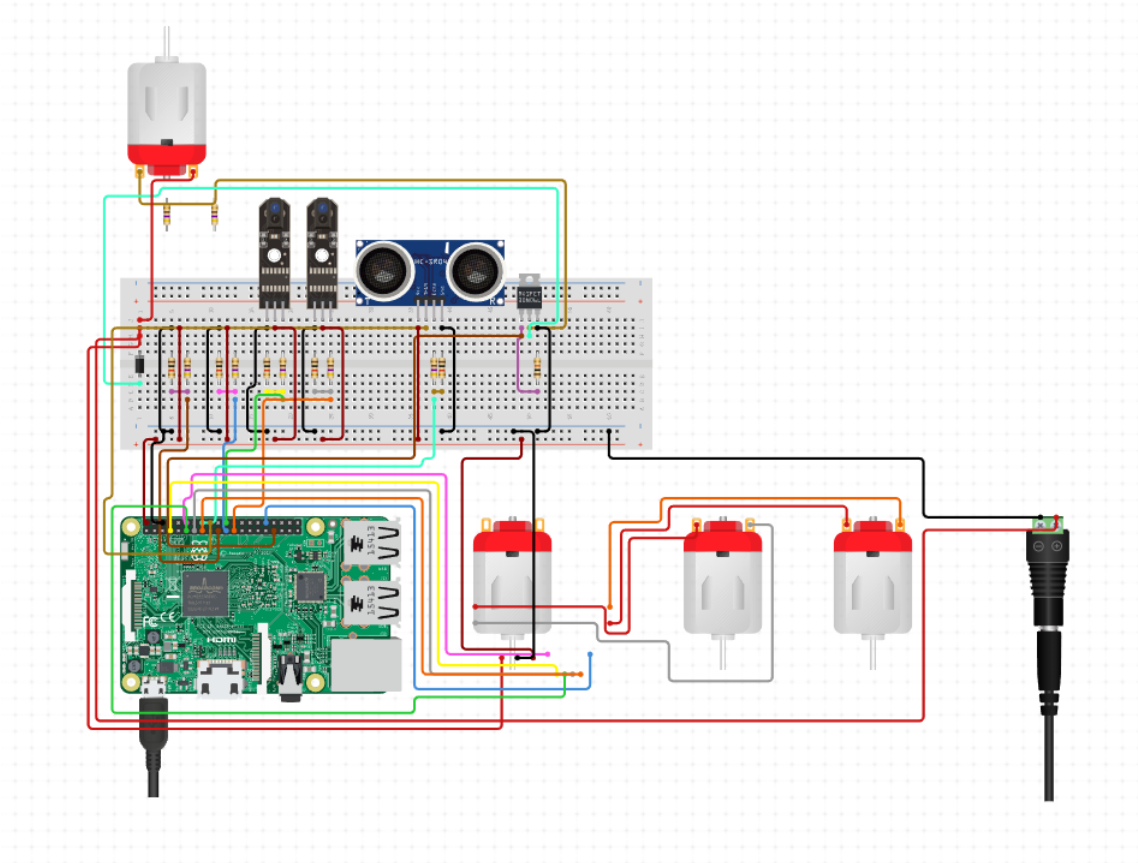

Figure 3.5: Circuit Diagram

CHAPTER 4

RESULTS & DISCUSSION

The bot will reduce the time required for a task like searching a book as it reduces the human interception and uses electronic and mechanical automation in place of that. This smart and intelligent bot has more benefits because it doesn't consume much power. This bot can provide an alternative to the existing system by replacingskilled labor, which in turn can perform better tasks with accuracy and lower per capita cost. Executing this bot in central libraries will help many readers. Fastest, easiest, most efficient way to track, locate manage library materials. Unique code is assigned to every book so that it prevents counterfeiting.

4.1 Result

When the left motor stops and the right motor is rotating in clockwise direction the robot will turn left. One pin of the left motor should be HIGH and all the other pins should be LOW. When both the sensors are on white surface then the robot moves forward and when both the sensors are on black surface then the robot stops. In this case both the sensors will detect the black line but the position where the sensors are located decides whether the robot will stop or will move forward. Flow Chart of working of the robot One pin on either side of the motor will be HIGH and the other two pins will be LOW. This makes the left and right motor to rotate in clockwise direction and hence the robot moves forward. When only left IR sensor detects black line then the robot has to turn left, for that only right motor has to work. When the left motor stops and the right motor is rotating in clockwise direction the robot will turn left. One pin of the right motor should be HIGH and all the other pins should be LOW. When only right IR sensor detects the black line then the robot has to turn right, for that only left motor has to work.

Left Motor	Right Motor	Robot Movement
Straight	Straight	Straight
Stop	Straight	Left
Straight	Stop	Right
Stop	Stop	Stop

Figure 4.1: Result Table

CHAPTER 5

CONCLUSION & FUTURE SCOPE

5.1 Conclusion

The proposed line follower robot comprises of a costeffective and easy to implement circuit. The dynamically controlled line follower does not deviate from the predefined line, walks smoothly on the track and takes short time to complete the given circuit. These robots may be utilized in large number of industrial/ domestic applications involving repetitive tasks such as hotels, floor cleaning, transportation, automation and military defence purposes. The robot follows the black line precisely and is unaffected by external disturbances such as variations in light intensity and dust etc. The purpose of the Smart Library system is to provide the details of a large number of books, magazines, journals, thesis and allow the administrator/Librarian, staff or students to search, borrow and return facilities. This system will reduce the time required for a task like issuing and returning the book as it reduces the human interception and uses electronic and mechanical automation in place of that. Executing this system in central libraries will help many readers.

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