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Automated Library Robot

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Abstract: The managing and arranging of books in a library manually is a difficult task. In this paper the application of Robots in Library Management System is presented and technique for implementing the same is proposed. In this method, a robot will be designed that will work on path orientation strategy. The rack number will be given as input to the robot, this input will be searched and matched to the code. If the match is found, then the robot will move towards the corresponding rack. The sole purpose of the robot is to make transfer of the books from one location to another. The proposed technique is applied to the college library.
Keywords: Robot, Rack Number, Automation, Path Orientation, Library Management, Microcontroller

I. INTRODUCTION

Rapid advances in software programming techniques combined with new vision and motion technologies are rapidly expanding the scope of robot applications. Robots have now taken the steps in the field of home automation, hospitals, and many space-works. This has significant implications for how work, and organisations, will be structured in the future **Error! Reference source not found.**. In this paper the wheel rotation and IR sensing technology is used and is primarily concerned with rack detection and reducing labour work. Library book management turns into tedious work. Library staffs have to ensure that the books are been kept into the respective racks after taken back from the users[1].

Isaac Asimov created the three laws of robotics, which he used in his own works of fiction. These rules were then accepted by other writers who used them in their science fiction pieces as well. The three rules dictate the ways a robot must act with regard to humans:

One: A robot may not injure a human being or, through inaction, allow a human being to come to harm.

Two: A robot must obey orders given it by human beings except where such orders would conflict with the First Law.

Three: A robot must protect its own existence as long as such protection does not conflict with the First or Second Law[4].

The paper is organized as follows: Section II describes the literature survey. Section III describes the history of automation and robots. The proposed system design is described in section IV. Section V gives methodology; section VI gives the simulation results and section VII gives conclusion.

II. LITERATURE SURVEY

This paper provides a simple introduction to the Robotics as well as IoT, its application and potential benefits to the society. Robotics has received much attention from industries, scientists and government all over the World for its potential in making the modern day living easy.

Robotics deals with the design, construction, operation, and use of robots, as well as computer systems for their control, sensory feedback, and information processing. In aspect, a library contains hundreds of thousands of books that are frequently borrowed and returned back to the racks. To facilitate users to easily locate a particular book, books are placed in dedicated areas and sorted using their specific barcode.

Library staffs have to ensure that the books are placed in order, a laborious and time-consuming process. Library staffs first need to perform rack reading, i.e., manually search for books that are misplaced in the wrong book sequence, then pick up the book and place it in the correct rack[1].

Typically, they have to pick the books and hand it over 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 takes a lot of time as many a times the books gets overlooked by the human eye.

To automate the process of book arrangement we suggest a robot which will be able to follow the path to the respective book rack using the required code and reach the rack, i.e., what we are working towards here, is an autonomous robot that will help the library staff to arrange up the books to the respective racks after the users return to the library.

III.HISTORY OF AUTOMATION AND ROBOTS

Early on, the concept and development of robots, automation and AI went unrecognized by most of the world. Still, people of many different backgrounds, cultures and professions studied the obscure interest. In the early 1900s, the term robot was coined by Karel Capek, a Czech writer, in his 1920 play Rossum's Universal Robots. Having coined the term, Capek's play also presented the first instance of robots taking over the world. (The science fiction trope started alongside the creation of robots themselves.)

The most rapid advances in automation are driven by software programming techniques that enable applications to analyse, find patterns in and make predictions from vast quantities of data. These broad techniques are being applied in almost every industry to improve the accuracy, quality and speed of specific processes.

In robotics, these software developments are combined with improvements in hardware such as grippers and sensors to expand the scope of robot applications, most notably in enabling robots to work alongside humans rather than separately in cages **Error! Reference source not found.**.

Business process automation or BPA (recently becoming known as robotic process automation or RPA) is becoming more and more refined and efficient. In the present day, automation software has become a necessity rather than a luxury. Its widespread use is optimizing employee time and work, and leading to enormous resource savings [5].

IV.SYSTEM DESIGN

1) *Arduino Mega 2560*: The Arduino MEGA 2560 is designed for projects that require more I/O lines, more sketch memory and more RAM. The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. The Arduino Mega 2560 is programmed using the Arduino Software (IDE), our Integrated Development Environment common to all our boards and running both online and offline.

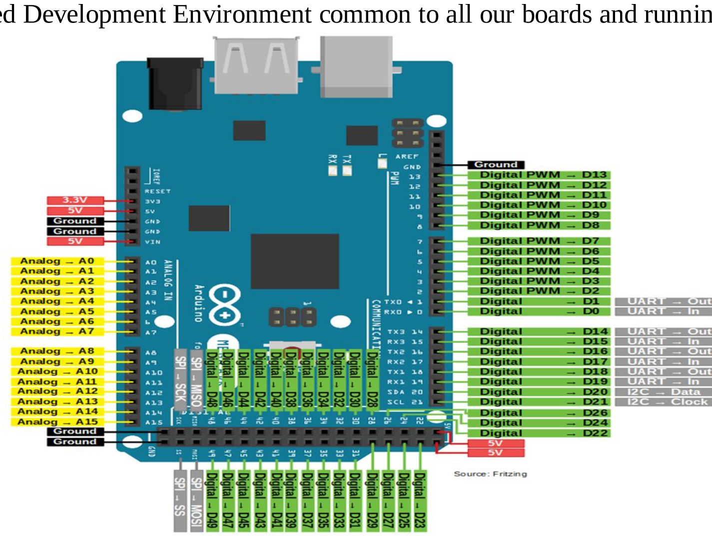

Fig. 1. Pinout Diagram of Arduino Mega 2560

2) *L298N Motor Driver*: This L298N Motor Driver Module is a high power motor driver module for driving DC and Stepper Motors. The L298N Motor Driver module consists of an L298 Motor Driver IC, 78M05 Voltage Regulator, resistors, capacitor, Power LED, 5V jumper in an integrated circuit. L298N Module can control up to 4 DC motors, or 2 DC motors with directional and speed control. ENA & ENB pins are speed control pins for Motor A and Motor B while IN1& IN2 and IN3 & IN4 are direction control pins for Motor A and Motor B.

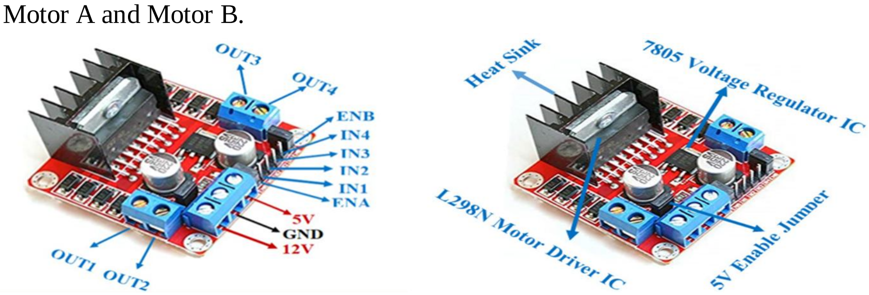

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Fig. 2. Pinout Diagram of L298N Motor Driver Fig. 3. Module Diagram of L298N Motor Driver

3) *IR Sensor:* Infrared Obstacle Avoidance IR Sensor Module has a pair of infrared transmitting and receiving tubes. When the transmitted light waves are reflected back, the reflected IR waves will be received by the receiver tube. The onboard comparator circuitry does the processing and the green indicator LED comes to life. The module features a 3 wire interface with Vcc, GND and an OUTPUT pin on its tail. It works fine with 3.3 to 5V levels. Upon hindrance/reflectance, the output pin gives out a digital signal (a low-level signal). The on-board preset helps to fine-tune the range of operation; effective distance range is 2cm to 80cm.

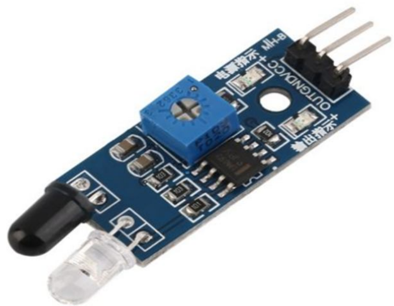

Fig 4. Diagram of IR Sensor

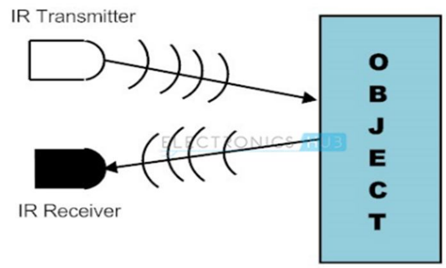

Fig 5. Working of IR Sensor Diagram

4) *LCD I2C*: The I2C 16x2 Arduino LCD Screen is using an I2C communication interface. It means it only needs 4 pins for the LCD display: VCC, GND, SDA, SCL. It will save at least 4 digital / analog pins on Arduino. All connector is standard XH2.54 (Breadboard type). You can connect with jumper wire directly. To avoid the confliction of I2C address with other I2C devices, such ultrasonic sensor, IMU, accelerometers and gyroscope, the I2C address of the module is configurable from 0x20-0x27. And its contrast can be adjusted manually.

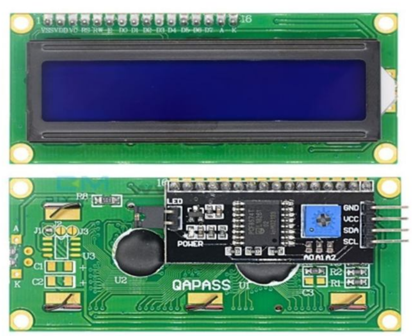

Fig 6. Diagram of I2C and LCD with I2C

5) *Keypad(3x4):* The keypad is a set of buttons arranged in rows and columns (called matrix). Each button is called key. Beneath each key is a membrane switch. Each switch in a row is connected to the other switches in the row by a conductive trace underneath the pad. Each switch in a column is connected the same way – one side of the switch is connected to all of the other switches in that column by a conductive trace.

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Fig7. Pin Diagram of Keypad(3x4)

V. PROPOSED METHODOLOGY

The hardware is implemented as a robot unit. Firstly, enter the rack number of the book which is need to be placed using keypad. The entered rack number is then matched with the predefined path number, if both the rack number and path number get synchronized the robot will follow the defined path.

The robot end consists of a robot which works with Atmega2560 microcontroller. The input is given using a matrix keypad. The firm name and rack number is displayed in LCD. The robot end consists of 2 DC motors driven using L298N motor driver which is used to move the robot from initial location to racks, all control is done my Atmega2560 microcontroller which inter links all other components. The IR sensor is used to calculate the number of rotations made by the attached wheels. The predefined path is developed by calculating number of rotations to each rack using the IR sensors. The IR sensor counts one rotation on every detection of white colour. The robot can perform movement functions- left, right, forward, backward as per the need of the traced path. The predefined paths are loaded to the microcontroller along with movement function.

The below is the circuit diagram of the proposed methodology.

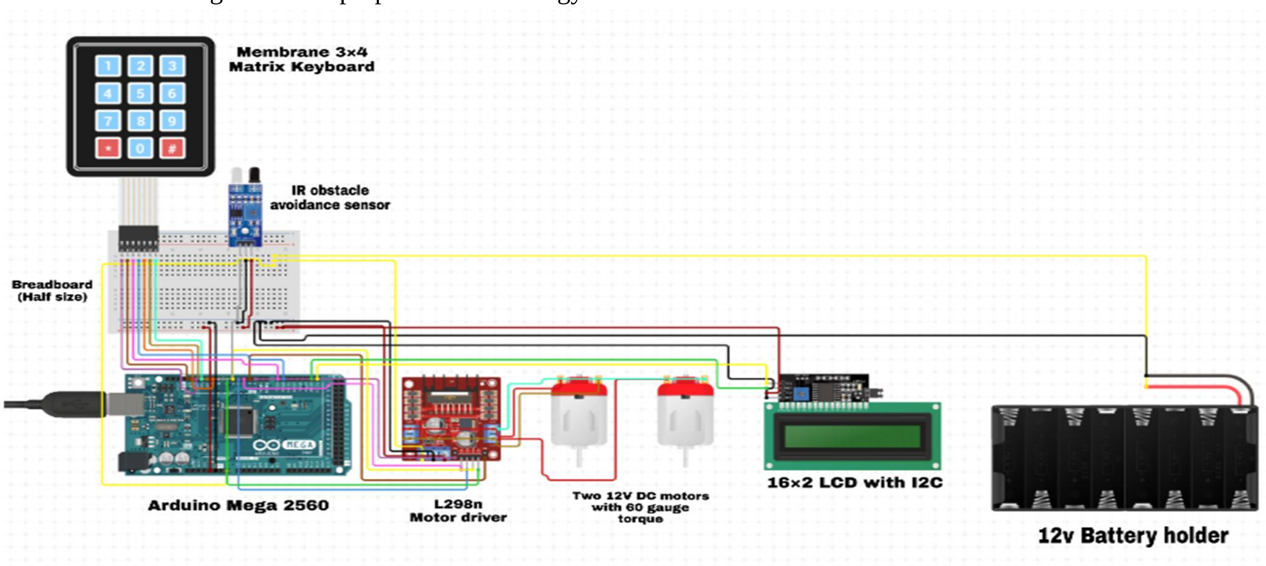

Fig 8. Circuit Diagram of Proposed Methodology for Robot

VI. SIMULATION RESULTS

The proposed technique was implemented on the University Library for 10 racks. Initially the robot is at the home position (0,0). The IR is set onto the white, as soon as the input rack number is received, the robot unit moves to the target location by tracing the predefined path. The robot will wait at the rack for specified delay till the book is been taken. The robot will station at the home position till the next cycle begins. The robot is ready for the next task from the user.

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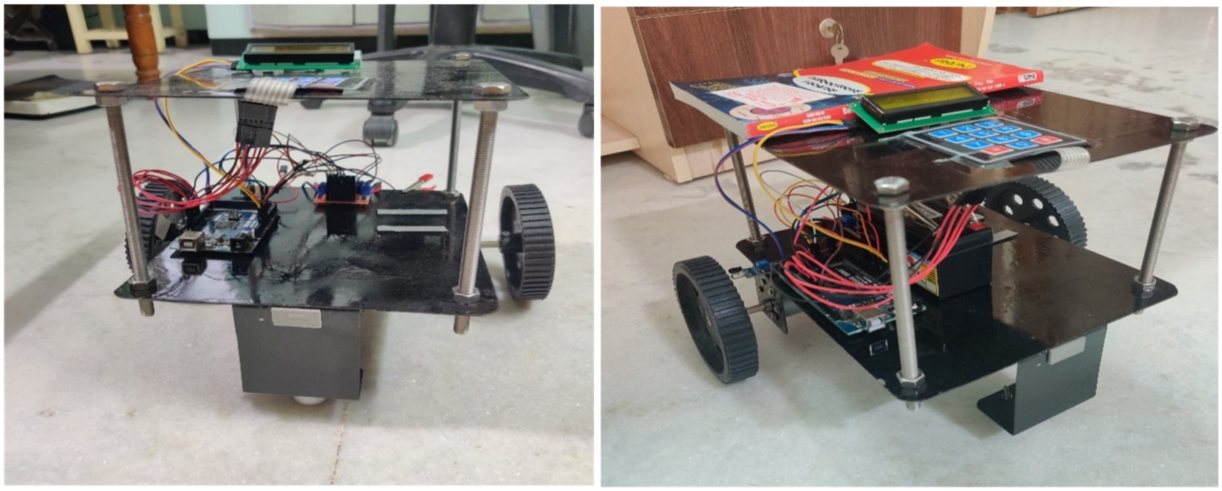

Fig 9. Front Look of Robot

VII. CONCLUSIONS

In this paper, we have proposed a technique for managing the books in library with help of robot. From the experimental results, managing books gets easier using minimal manual work. The proposed method does not involve any path constraints and is simple as compared to other techniques of path tracing. It gives the advantage of being platform independency. This robot unit is flexible and can be applied to any library. This can be employed as an initial process of automating all manual work at library.

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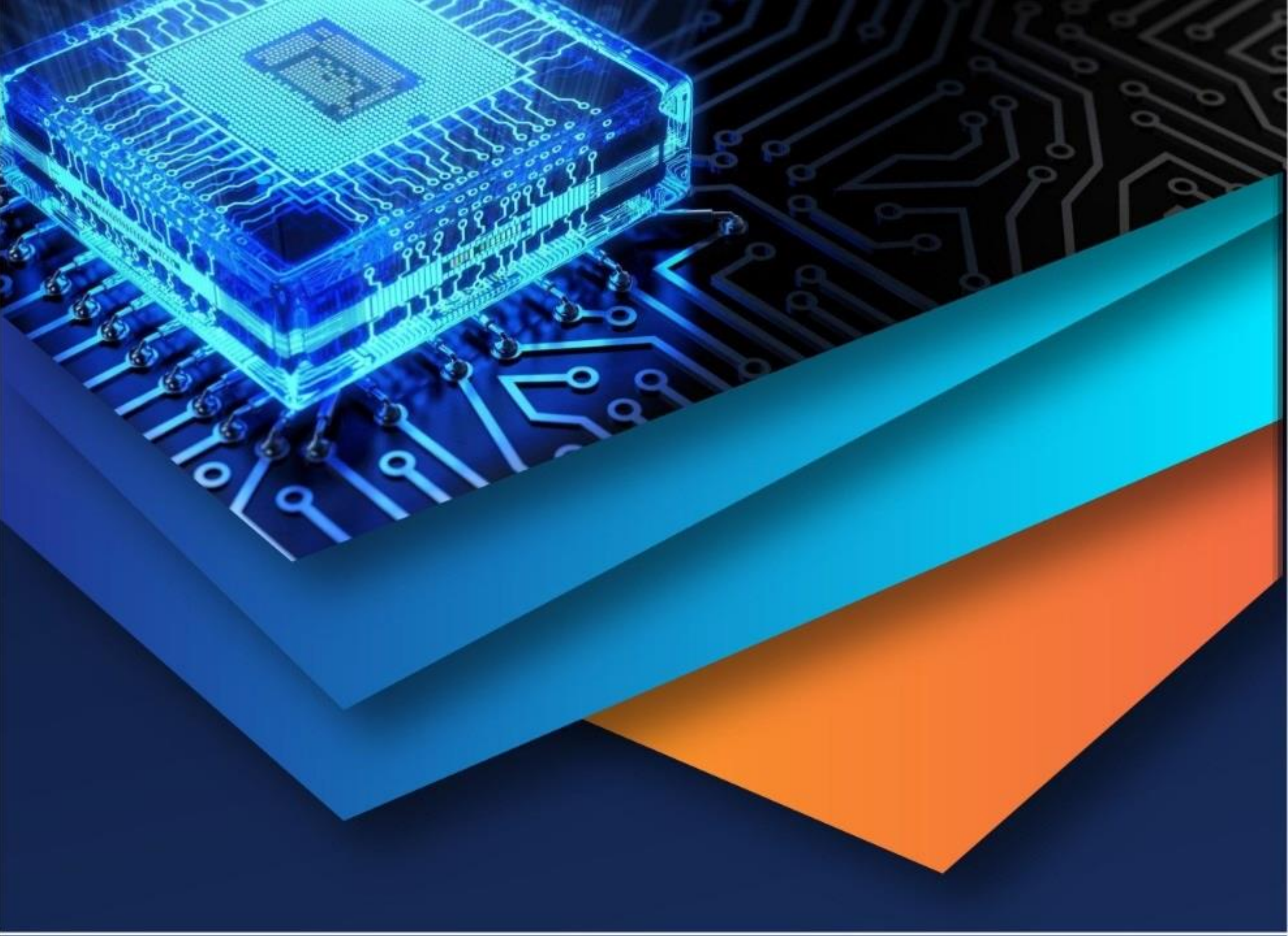

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