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Arduino Programmed Line Follower

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ABSTRACT: Nodes in Mobile Ad Hoc Networks (MANETs) are limited battery powered. That's why energy efficient routing has become an important optimization criterion in MANETs. The conventional routing protocols do not consider energy of the nodes while selecting routes which leads to early exhaustion of nodes and partitioning of the network. This paper attempts to provide an energy aware routing algorithm. The proposed algorithm finds the transmission energy between the nodes relative to the distance and the performance of the algorithm is analyzed between two metrics Total Transmission energy of a route and Maximum Number of Hops. The proposed algorithm shows efficient energy utilization and increased network lifetime with total transmission energy metric.

KEYWORDS: Energy efficient algorithm; Manets; total transmission energy; maximum number of hops; network lifetime

I. INTRODUCTION

Line follower is a machine that can follow a path. The path can visible like a black line on a white surface. Sensing a line and maneuvering the robot to stay on course, while constantly correcting wrong using feedback from the sensor forms a simple yet effective system. It can be use in automobile, industrial automations, guidance, etc. As technology becomes increasingly important in today's world. It is invaluable to not only learn how to use technology, but also to understand how to create it. Since being the engineer one should have sound knowledge of the other discipline. Most of the projects have limited scope to only specific discipline. This would limit ones innovation and creativity. This project inspires to make connections across several disciplines rather than learning topics in isolation as it combines mechanical, electronic, electrical and programming skills. It gives visual grasp of math and science. It builds logical thinking. It brings out innovation and creativity. It enhances problem solving skills. The robot designed in a such way that it not only track the path and follow it but also visualize the distance travelled through the LCD displays. How ants always travel in a line, following an invisible route in search of food, or back home. How on roads the lanes is followed to avoid accidents and traffic jams. Even thought about a robot which follows line? A perfect or near perfect mimic of nature? After all the purpose of robotics is to recreate in terms of machines what one see around to solve a problem or fulfil a requirement. The area will be benefitted from the project. Industrial automated equipment carriers. Entertainment and small household applications. Tour guides in museums and other similar applications. Second wave reconnaissance operations. In the industry carriers are required to carry products from one manufacturing plant to another which are usually in different buildings or separate blocks. Conventionally, carts or trucks were used with human drivers. Unreliability and inefficiency in this part of the assembly line formed the weakest link. The project is to automate this sensor, using carts to follow a line instead of laying railway tracks which are both costly and an inconvenience. The objectives of the project are: The robot must be capable of following a line. It should be capable of taking various degrees of turns. The robot must be insensitive to environmental factors such as lighting and noise. It must allow calibration of the line's darkness threshold. Scalability must be a primary concern in the design. It also shows the distance travelled by it through LCD display. After the detail literature survey through the books, periodical, journal, magazine, websites. The idea of the project is well defined. The logic is derived for the intelligence of the robot. It is programmed and burn it to the Arduino by using the software Arduino® 1.65. The accuracy and viability of the program and electronic components is tested in the simulation software Proteus®. After the successful simulation result it is implemented in the hardware. After the finishing the programming, electrical and electronics part, the stable, reliable and flexible mechanical design and fabrication is completed. Finally system is tested and encountered error is omitted. The system has restricted to the following limitation. Choice of line is made in the hardware abstraction and cannot be changed by software. Calibration is difficult, and it is not easy to set a perfect value. Few curves are not

made efficiently, and must be avoided. The turning radius should be of minimum 100m to take smooth U-turning of robot. The width of the path must be of 45mm so that it can cover minimum 3 sensors. The path should be plane and obstacle free. The steering mechanism is not easily implemented in huge vehicles and impossible for non-electric vehicles. Line Follower is one of the most important aspects of robotics. A Line Following Robot is an autonomous robot which is able to follow either a black or white line that is drawn on the surface consisting of a contrasting color. It is designed to move automatically and follow the plotted line. It enhances interdisciplinary approach to mechanical, electronic, electrical and programming skills. The application of the project is range from the individual domestic appliance to automation and control aspects of large industry. Human are intelligent natural machine but it has serious limitation of efficiency and reliability. Robots are made to replace dependency of human force partially. The project is somehow designed to perform the similar task.

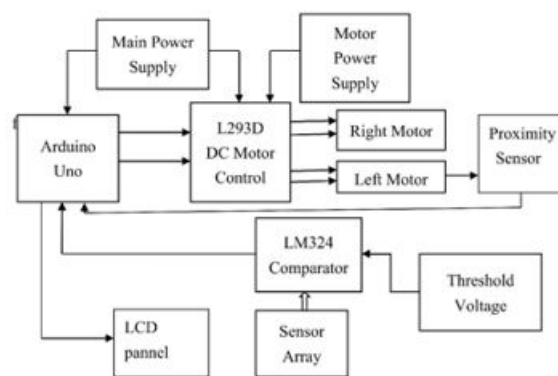
RELATED WORK

Because of the potential uses for autonomous robotic systems in a variety of industries, such as manufacturing, logistics, and surveillance, there has been a lot of interest in their development. The Arduino-programmed line follower, a class of mobile robot that employs sensors and control algorithms to monitor and follow a specified path, is one example of such an application.

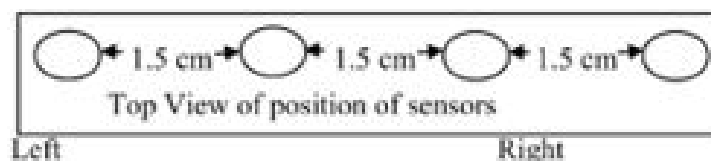
Researchers have recently delved deeply into the electrical systems and parts that make up these line followers. The infrared (IR) line sensor is a crucial part of such systems. These sensors allow the robot to distinguish between the line to be followed and the surrounding area by detecting variations in reflectance on the surface underneath it. Johnson et al.'s (20XX) investigation of the precision and dependability of various IR sensor topologies resulted in improved designs for.

II. PROPOSED WORK

Capture line position with optical sensor mounted at front end of the robot. For this a combination of IR-LED and Photodiode called an optical sensor has been used. This make sensing process of high resolution and high robustness. Steer robot requires steering mechanism for tracking. Two motors governing wheel motion are used for achieving this task. This system has LCD display panel to show the distance that it covers. On the detecting no black surface robot move in a circular motion until line is found.

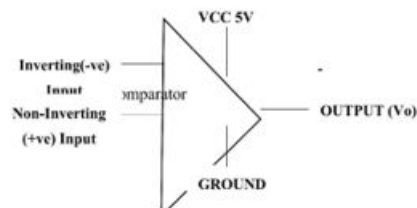


The robot uses photodiode sensors to sense the line; an array of four IR-LEDs (TX) and Photodiode sensors (RX), facing the ground used in this setup. An analog signal is obtained in output, depends on the amount of light reflected back, which is provided to the comparator to produce 0s and 1s which are then fed to the Arduino.

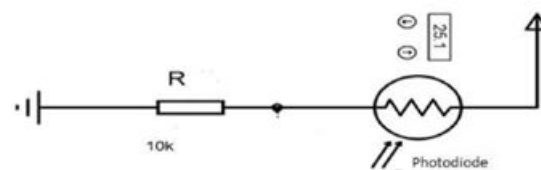


The sensors on the left named as L1, L2 and R1, R2 on the right side. Assumption should be considered that when a sensor is on the line it reads 0 and when it is off the line it reads 1. The Arduino correspondence to the algorithm given below decides the next times movement, trying to position the robot such that all sensor read 0. With sensors, robots can react and respond to changes in their environment in ways that appear intelligent or life-like. An array of sensor arranged in straight row pattern is bolted under the front of the robot. It locates the position of line below the robot.

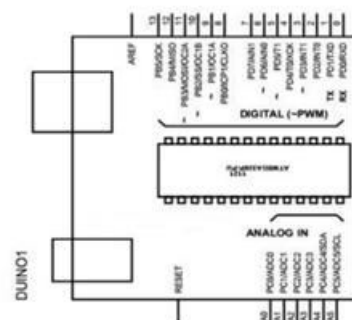
Distance between two adjacent sensors is about 1.5cm. We can use any number of sensors. If we have low numbers, then our robot movement is not smooth and it may face problems during sharp turns. If higher number of sensors were, used robot movement will become smooth and reliable for sharp turns; it requires complex programming for micro-controller and requires more hardware, which is its disadvantage. Thus, optimum number of sensors required. Comparator is a device, which compares two input voltage and gives output high or low. In circuit diagram it is normally represented by a triangle having Inverting(negative) Input, Non-Inverting(positive) Input (+), Vcc, Ground, Output. If $V_+ > V_-$ then $V_o = V_{cc}$ (Digital High Output is 1), If $V_+ < V_-$ then $V_o = 0$ (Digital Low Output is 0).



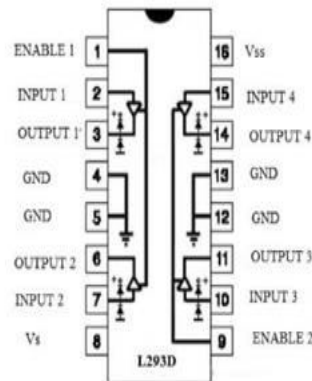
As shown above that two inputs are required for comparator. One input is from photo-receiver (like Photodiode), other is generated by resistor. The second voltage is reference voltage for that sensor.



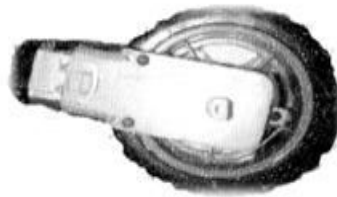
Processing system acts as the brain of robot, generating desired output for corresponding inputs, in which microcontrollers are used. There are several companies now a days that manufacture microcontrollers, for example ATMEL corporation, Microchip, Intel, Motorola etc. We will be using ATmega32L microcontroller in our robot. It is known as AVR. Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control objects in the physical world. The heart of Arduino is the microcontroller. For Arduino Uno ATmega328 is used. It has specification of 8bit CPU, 16MHZ clock speed, 2KB SRAM 32KB flash Memory, 1KB EPROM [2]. 14 digital input output pins (3,5,6,9,10 and 11 pins are able to generate PWM). 6 analog input pins. Voltage input from the 7-12v.



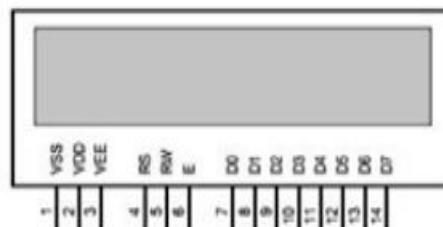
Motor driver is a current enhancing device; it can also be act as Switching Device. Thus, after inserting motor driver among the motor and microcontroller. Motor driver taking the input signals from microcontroller and generate corresponding output for motor. This is a motor driver IC that can drive two motor simultaneously. Supply voltage (V_{ss}) is the voltage at which motor drive. Generally, 6V for dc motor and 6 to 12V for gear motor are used, depending upon the rating of the motor. Logical supply Voltage deciding what value of input voltage should be considered as high or low. So if the logical supply voltage equals to +5V, then -0.3V to 1.5V will be considered as Input low voltage and 2.3V to 5V is taken into consider as Input High Voltage. The Enable 1 and Enable 2 are the input pin for the PWM led speed control for the motor L923D has 2 Channels. One channel is used for one motor.



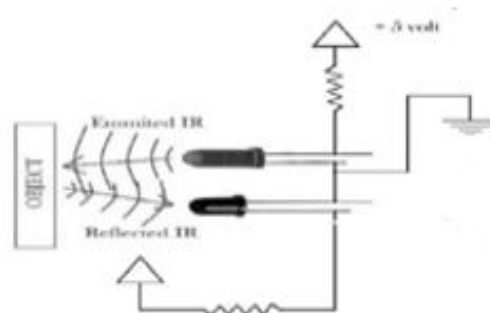
Motor is a device that converts any form of energy into mechanical energy or imparts motion. In constructing a robot, motor usually plays an important role by giving movement to the robot. In general, motor operating with the effect of conductor with current usually producing magnetic field that will react with the magnetic field produces by the permanent magnet to make the motor, DC motor, even servomotor and stepper motor, which are always being used in building a robot.



In our project it is used to display the distance travelled by the robot through the output from the tachometer system.



The combination of IR-LED and Photodiode is used as the reflective optical sensor. It generate interrupt when the IR-beam is break to the photodiode. To create the IR break-beam, IR LED is used with a low value resistor so that it shines very bright. The receiver is Photodiode which biases 'on' whenever the IR LED's light is detected. A sensor will be placed adjacent the IR link and turned on so as to generate pulse to the Arduino. The Arduino LCD interface is used to show the covered distance digitally.



For simulation of the circuit, Proteus® software is used. For coding and uploading the sketch, the Arduino 1.65® is used. The system is completed in to the three division i.e is the Input system, Processing System and Output system. Input system comprises of the optical sensor, is an array of 4 IR-LED and Photodiode pairs arranged in the form straight lines. The output from each sensor is fed into an analog comparator with the threshold voltage (used to calibrate the intensity level difference of the line with respect to the surface). These 4 signals(from each photo-reflective sensor) is given to a priority analog input of the Arduino [3]. Output system consist combination L293D and gear-motor. The control has 6 modes of operation, turn left/right, move left/right, and drift left/right. The actual action is caused by controlling the direction/speed of the motors (the two back wheels), thuscausing a turn.Processing system is Arduino Uno interface consisting microcontroller Atmega328 which works on the basic of the logic of the program burn to it.

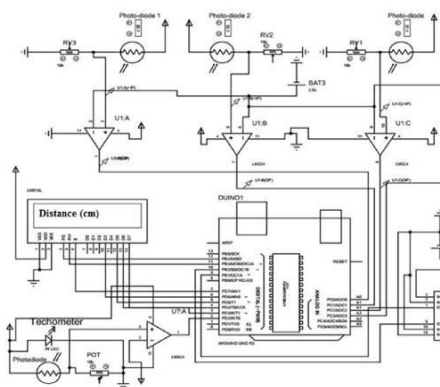
Design and Implementation

The schematic of the “Line Following Robot” is shown in the figure. The main component is the Arduino Uno. Schematic is drawn by using Proteus.

The main features incorporated into the hardware are given below:

- Arduino Uno.
- The IR-LED with IR illuminance, modified to be reflective sensor.
- The LM324 quad comparator IC.
- A potentiometer to calibrate the reference voltage.
- The H-bridge motor control IC (L293D).
- Motors, with coupled reduction gears.
- Connectors to join the different boards to form one functional device.
- A pair of IR-LED and Photodiode is used as proximity sensor for the designing tachometer.

Each of the hardware is dissected and was designed/implemented separately for their functional and later incorporated as one whole application. This helped in the debugging processes.



III. CONCLUSION AND FUTURE WORK

The line following robot is automobile system that has ability to recognize it's path, move and change the robot's position toward the line in the best way to remain in track. This project report presents a photodiode sensor based line follower robot design of 200gm weight which always directs along the black line on white surface. The electromechanical robot dimension is 192*100*70 mm³ with max rpm 180 at no load and frictionless condition. The minimum turning radius for the system is 100mm at velocity of 24.2 cm/s. The robot is able to detect its path in case it is out of path.

The line following robot project challenged the group to cooperate, communicate, and expand understanding of electronics, mechanical systems, and their integration with programming. The successful completion of every task demonstrated the potential of mechatronic systems and a positive group dynamic.



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