Ant Path Following Robot

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This paper introduces the Ant Path Following System in its entirety. It is continuously in need of a machine or software that can stand on its own and fulfill its duties in our everyday lives. Long-distance driving makes us fatigued, and wish our legs were a bit more relaxed instead of constantly pressing the pedal and our hands rested instead of continuing to manage the steering wheel. It is not necessary to push the trolley to a factory, supermarket, or infant vehicle. Based on the image processing concept, the line tracker can address all of these and many more difficulties. In this study, it attempted to build an active line follower robot that employs the line tracking concept. It differs from standard line followers in that it employs photodiode sensors, allowing it to predict the future. (e.g., the upcoming line pattern), and is ready to direct that pattern. The robot can also follow any color line that contrasts with the surface.

Keywords: Arduino, ICL293D, Infrared LED, DCMotor and Proximity Sensor,Q-learning.

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1 Introduction

A one-way machine is an ant route that follows a system. The route can be viewed as a black or white line in either the white or black region. The ant that follows the system is a traceable robot of its own. It is programmed to move and track itself. An LED is used to signify the presence of a robot. DC gear Motors are used to regulate the robot's wheel speed. The wide extent of the challenge of finding a means entails concerns about efficiency and safety.

An algorithm is commonly used by Arduino displays to regulate the speed of the motors, causing the robot to move smoothly down the line. There is also an LCD interface that displays the robot's movement. It has the potential to be extremely beneficial in the automated administration of industrial equipment, small in-house applications, and other similar applications. Babies are frequently transported via an ant-trailing strategy to shopping malls, residences, hospitals, and industries.

Basic knowledge of the IR or UV sensors, microprocessor, and motor is essential to comprehend the general operation of the robot. The infrared sensor detects the incidence and reflection of light. In the case of a white surface, the light is totally reflected, while in the case of a colored surface, it is partially reflected. Because black absorbs light, the surface is entirely pulled up when it is black. As a result, these ideas are applied in path detection. Arduino or any other microcontroller, such as the Raspberry Pi or PIC, can be utilized.

Following an Autonomous Line Image processing and neural networks can be used to create a robot. Another way to regulate a line follower approach is with a proportional controller. Recently, reinforcement learning has been employed in applications like as robotic arms and gaming. In reinforcement learning, an agent makes a decision that can be rewarded or punished. It uses trial and error to arrive at a solution. The objective is to maximize the prizes. Q-learning is a way of controlling the robot that is based on Reinforcement Learning. When designing a robot, there are two major components: recognizing lines and operating the motor. PWM (Pulse Width Modulation) is a simple method for controlling motors [1]. Autonomous robots can also be used to identify obstacles and carry loads in transportation and hence, there are many requirements for such robots now days.

2 Building Components

i. Arduino (Microcontroller)

Arduino is a free and simple hardware and software platform. This platform may be utilized to carry out the project. Each board has the same component: a colored microcontroller. A microcontroller is a compact system. The ATmega328 is used in Arduino. It has an 8-bitCPU, a 16-MHz clock speed, 2KBSRAM, and 32KBFlash Memory. Other features include:

- 14output-inputpinsand11input-outputPWM.
- 6inputpins
- Voltageinputfrom7-12V

ii. ICL293D(Motor Driver)

This is the motor driver IC used in this project, and it is capable of driving two motors at the same time. The supply voltage is the motor drive's operational voltage. The DC V motor was powered by 6V, while the 12V was powered by 6V. The gear motor utilized is determined by the system's size. Voltage that is reasonable determines whether the input power should be regarded high or low based on the kind of value. As a result, a conventional power supply is rated at+ 5V,which is thus viewed as-0.3V to 1.5V

input, but 2.3V to 5Vinput is deemed high voltage in this system. The Enable 1 and Enable 2 are PWM-powered high-speed inputs and two microcontrollers used in the project, one of which is high quality and the other poor quality, so it can say that two identical circuits are utilized, but the performance of both is comparable. Figure shows the 16 pin configuration of IC L293D.

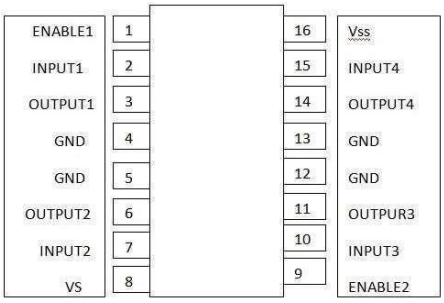

Fig. 1. Pin Configuration ICL 293 D

iii. Infrared LED

Line sensor for LEDs (3LEDs) when the robot hears a straight line, the center LED turns off, and the two other LEDs, which represent left and right, light up. When the robot hears/shuts left, the left LED turns off, and the other two LEDs; center and right, light up. The robot then hears/turns right, and the right LED is switched off, while the other two LEDs representing left and one are a light up. Ultra sonic sensors can also be used to identify obstacles. As per the difference in table, IR sensors can be used in large range applications. Both sensors can be used according to the requirement.

Table 1. Comparison of the sensors

Parameters	**IR Sensor**	**Ultrasonic Sensor**
Range	10cm-80cm	2cm-10m
Beam-width	75deg	30deg
Frequency	353THz	40KHz
BeamPattern	Narrow(line)	Conical

iv. DC Motor

A vehicle is a mechanical device that transforms any energy force and conveys movement. The auto mobile is frequently used in the fabrication of robots to provide system mobility. In this system, an automobile is often driven by a conductor with a magnetic current and current. To make the automobile spin, the current driver normally generates a magnetic field in conjunction with a permanent magnetic field. In most cases, three fundamental types of motors are employed in the system: a DC motor, a servo motor, and a stepper motor, which are the most typically used in the creation of an ant traffic light. DC engines are quite simple to operate. There is a single DC vehicle with two performance indicators. Resetting the power supply to it may modify the needed direction, and the speed may vary depending on the vehicle's electrical power.

v. Proximity Sensor

A proximity sensor is useful for providing contact less obstacle detection, and its fast reaction rate improves the robot's overall efficiency. As a visual viewing sensor, an IR-LED and Photodiode

combination is employed. When the IR beam enters the photodiode, it creates disruption. The IRLED is used with a low-value resistor to shine brightly to create the IR break-beam. When an IRLED light is available, the receiver is a Photodiode that chooses' switch on. The IR link is connected to it and rotated to generate a pulse in Arduino. The LCD interface on the Arduino is used to display the integrated range in numerical form.

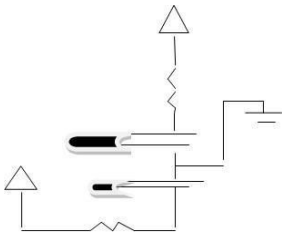

Fig. 2. Circuit Diagram of Proximity sensor

vi. RFID

RFID is a technology that stores or encodes digital data in radio-frequency identification, RFID tag, or smart label. These RFIDs are displayed on radio waves by an RFID reader. RFID is similar to barcode but has many advantages over barcode technology. The most important advantage is that the RFID tag can read data without focus. Therefore, RFID technology can be used to identify barriers. An RFID program consists of three components: an RFID tag, an RFID reader, and an antenna. The antenna transmits the data to the RFID reader. The reader converts radio waves into data-based channels [8]. The information collected in the tag is transmitted via a visual link found in the capturesystem.

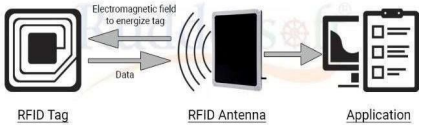

Fig 3. RFID

vii. Comparator

The voltages between the inverting and non-inverting terminals are compared using a comparator. It is a gadget that generates a digital signal by comparing two voltages or currents [8] and reporting which is greater as an output. When anything comes between the transmitter and the receiver, an infrared signal is generated. The comparator then transmits the desired signals to the controller, which makes the choice depending on the input signal.

viii. Interaction of System Component

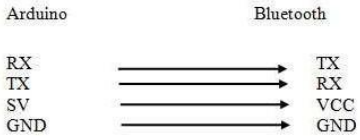

Fig. 4. Arduino to Bluetooth connectivity

Connect the LED refuse to the Arduino microcontroller's GND and the positive to pin 13 with a resistance value ranging from 220ohms to 1kohms. In this case, the Android app is intended to transmit serial data to the Bluetooth module when a certain but to n is pressed. The other end receives Bluetooth module data and transfers it to the Arduino through the TX pin of the Bluetooth module and the RX pin of the Arduino). If the Arduino code1 is 1 received data, it will examine and compare the received data. If the received data is 0(in our instance 3) the LED lights on, indicating connection; otherwise (in our case 4) the LED shuts off, indicating Bluetooth connectivity is disconnected.

- Open the application
- Scan for the available device
- Pair the device with a Bluetooth module
- After connecting, use the app to issue the instruction to start the robot.

3 Working and Algorithm

The robot follows a white line drawn along the path using an IR sensor. One line follower includes an infrared light sensor and an infrared LED. It works by illuminating the surface with infrared light; the sensor then selects the reflected infrared radiation and, based on its intensity, determines the reflection of the surface in question. This signal is sent to a DC motor operating at a certain speed. This communication is controlled by our microcontroller. There is also a proximity sensor to prevent it from touching the surroundings. This can bedoneusing electromagnetic or electromagnetic radiation beams, in which the field or return signal where the object exists in the surroundings is altered.

Algorithm: After reviewing and comparing the algorithms, the Q-learning algorithm [20] is an algorithm that can be used when accuracy is important. The algorithm is based on reinforcement practice. There are two main types of reinforced learning - Model Based and Model Free, the algorithm mentioned here is Model-Free Learning Algorithm.

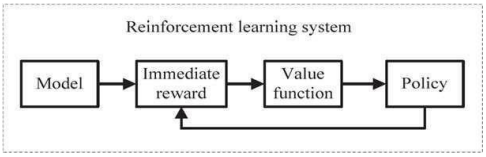

Fig. 5. Reinforcement learning block diagram

Q*(s,a) is the expected value (cumulative discount reward) by doing a in the state and then following the correct procedure.

Q-Learning uses the temporal variance (TD) to estimate the value of Q*(s,a). The temporal difference is the agent who learns from the environment through episodes without prior knowledge of the environment.

- Agent maintains a table of Q[S,A] where S is the set of states and A is the set of actions.
- Q[s,a] represents your current estimate Q*(s,a)

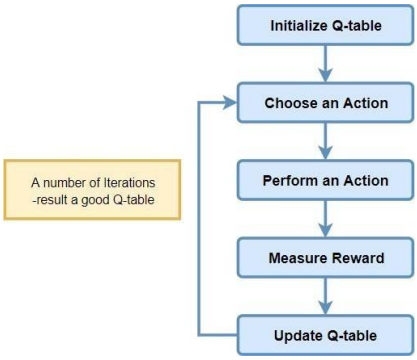

Fig. 6. Q-Learning algorithm block diagram

Steps in the algorithm:

- Step 1: Initialize the table: The table is a grid of environments depicted in an* n value depicting the environment present around them.
- Step 2: Design actions and enumerate them. For example, for our robot, the actions could be movement's right, left, front, etc.
- Step 3: Based on the environment and the movement is rewarded based on our intuition. For example, since our robot is designed to move in a straight line, the maximum reward is given on forward action.
- Step4: Update the environment matrix based on the rewards gained.

The rewards, in technical terms, are called weights and the environment matrix is called a Q-Table. These values may be estimated using MATLAB simulation to generate a minimum Q-Table and update values in real-time.

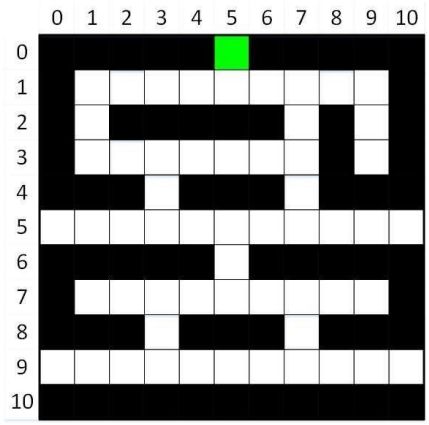

Fig. 7. Robot path matrix

The path for the robot to move and divided into a matrix as shown in figure. Once the data are stored in the microcontroller, the robot uses a greedy technique to locate the path with the most weight.

4 Conclusion

According to the analysis, numerous components were employed depending on the demand. In most applications, an IR sensor is employed to identify obstacles. The microcontroller is a crucial component whose selection is dependent on the application and requirements such as code size, programming skills, and on-chip component requirements. If someone wants a robot that works well but is a chip, PIC is a good alternative, although Arduino provides a better interface to programming and does not have a high learning curve. Line follower robots are most typically equipped with LDR and IR sensors.

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