

# Line Following Trolley

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- Abstract :** Line follower trolley with a simple concept with simple circuitry. Basically, there are two types of line follower trolleys: one is black line follower which follows black line and second is white line follower which follows white line. Here we have designed the first one. Line follower actually senses the line and run over it. The trolley uses arrays of optical sensors to identify the line, thus assisting the trolley to stay on the track. The array of four sensor makes its movement precise and flexible. The trolley is driven by DC gear motors to control the movement of the wheels. The Arduino Uno interface is used to perform and implement algorithms to control the speed of the motors, steering the trolley to travel along the line smoothly. This project aims to implement the algorithm and control the movement of the trolley by proper tuning of the control parameters and thus achieve better performance. In addition, the LCD interface is added in order to display the distance travelled by the trolley. It can be used industrial automated equipment carriers, small household applications, tour guides in museums and other similar applications, etc. The Following Trolley Carrier is a small, wheeled trolley and ALT, which will follow the user, and will have a surface on which to conveniently place heavy objects. A working, full--scale version of the product was expected to be constructed for the purposes of this project, but budget and time constraints led to a small prototype being made instead. This will be used to demonstrate the functions of the proposed product, the feasibility of the project and to gain insight into its technical aspects. This device is an automatic hand wash dispenser which dispenses a specific amount of handwashing liquid on to your hands when placed under a distance measuring sensor(ultrasonic sensor).

**IndexTerms – Line Following Trolley Using IR Sensor, Automatic Hand Santizer**

## 1. INTRODUCTION

Line follower is a machine that can follow a path. The path can be visible like a black line on a white surface. Sensing a line and manoeuvring the trolley to stay on course, while constantly correcting wrong moves using feedback from the sensor forms a simple yet effective system. It can be used in automobile, industrial automations, guidance. There is currently no aide on the market that helps to carry objects for those who need it. The closest competitor would be the Starship25 trolley, which is designed to make package deliveries. ALT is a rapidly expanding part of the worldwide market for trolley systems in 2014 was estimated to be around \$32billion<sup>8</sup>, with government subsidies being planned for such products<sup>9</sup>. Thus the Following Trolley Carrier could make a name for itself as a staple piece of technology for this large proportion of the population. However, this product must be designed with extra criteria in mind, as although there is a trend of the elderly becoming more technology savvy, the large majority are still finding it difficult to understand technology<sup>10</sup>. To cater towards this, the trolley must be made to be very simple to operate. Furthermore, the trolley should be easy to set up for use to make it accessible for those with physical impairments.

A line following trolley is a mobile machine employed to sense and follow the black lines that are drawn on the white surface. As this trolley is developed using a breadboard, it will be very simple to construct. This technique can be incorporated into the Automated Guided Vehicles (AGV) for providing the easy way of operation.

Unlike room-exploration trolleys that often get stuck against chairs and carpet edges, you don't have to chase after a well-designed line-following trolley. Most line-following trolleys have two motors, two front sensors, and a basic electronic circuit for autonomous control. But, a great thing about this type of trolley is that it easy to make small changes for added complexity. Simple improvement is to install the trolley in a decorative container, along with colourful LEDs. More advanced designs add various sensors and a programmable microcontroller for faster speed, smoother turning, or maze-solving.

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## 2. LI TERATURE SURVEY

The line follower is a self-operating trolley that detects and follows a line that is drawn on the floor. The line follower trolley using Arduino is a self-operating system that detects and follows track drawn on the floor. The track consists of a black path drawn on white surface.

### i. Basic Operation

- Capture line position with optical sensors mounted at front end of the trolley. For this a combination of IR-LED and Photodiode called an optical sensor has been used. This makes sensing process of high resolution and high robustness.
- Steer trolley 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 trolley move in a circular motion until line is found

### ii. Optical Sensors

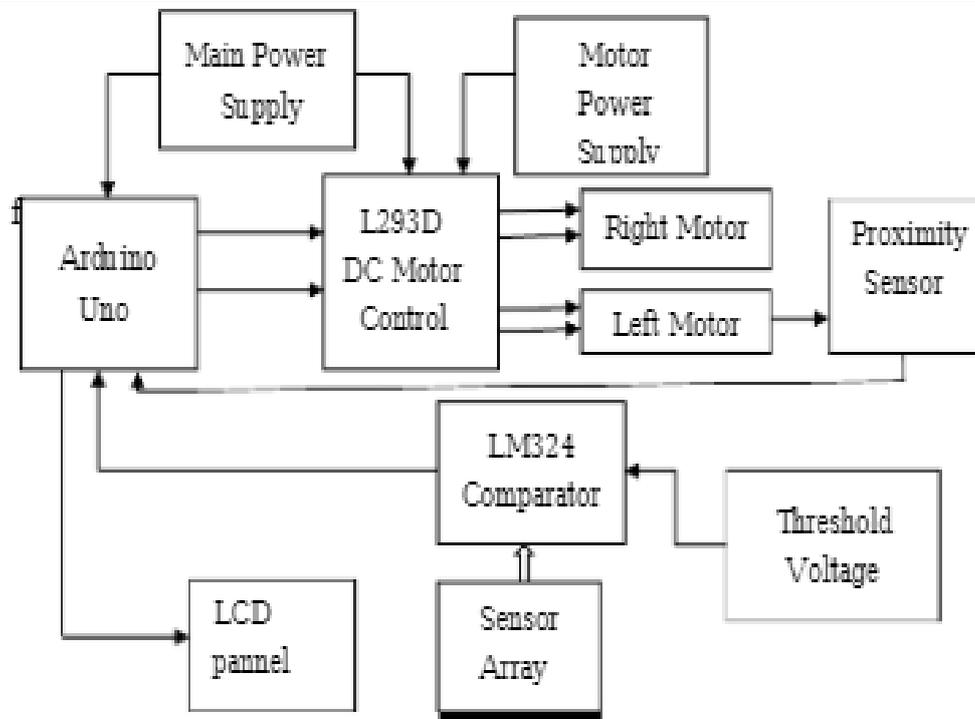
- The trolley uses photodiode sensors to sense the line; an array of four IR- LEDs (TX) and Photodiode sensors (Rx), facing the ground used in this setup. An analogy signal is obtained in output, depends on the amount of light reflected back, which is provided to the comparator to produce 0s and 1s which 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 movement, trying to position the trolley such that all sensors read 0. With sensors, trolleys can react and respond to changes in their environment in ways that appear intelligent or life-like.
- There have been plenty of applications of mobile trolleys for transporting materials. Some of the projects have already been commercialized. Companies like Caddy Trek and Stewart Golf sell following golf bags, which free up golfers to concentrate on the game DonkiBot, an auto following trolley trolley invented by Omotrolley Inc., are raising fund on kickstarter. These products are mainly targeting high-end users. Taking Stewart Golf as an example, its trolleys are sold at £1,499, which is around HKD16,000. These automated trolleys have always been luxury products and price is yet to be brought down to affordable level for normal people. Some of the academic research applies mobile trolley to shopping trolley in supermarkets. Most of the designs are based on the idea of human following trolley, which the trolley can follow human with luggage loaded. Here are some common components used for automated following trolley.
- This device is an automatic hand wash dispenser which dispenses a specific amount of handwashing liquid on to your hands when placed under a distance measuring sensor(ultrasonic sensor).

## 3. PROBLEM STATEMENT

- The algorithm of the same is very simple. There is one US sensor and two IR sensors. I want the trolley to run along the black track such that if any obstacle is detected by US sensor, then it will stop and reverse the direction by turning into 180 degrees on the black track.
- Design and fabricate an LINE FOLLOWING TROLLEY capable of navigating efficiently through guided white lines on a Black floor.. The vehicle must be able to effectively follow the guiding path. The racers will be tested on speed and accuracy of path following.
- 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, cars 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 sector, using carts to follow a line instead of laying railway tracks which are both costly and an inconvenience.

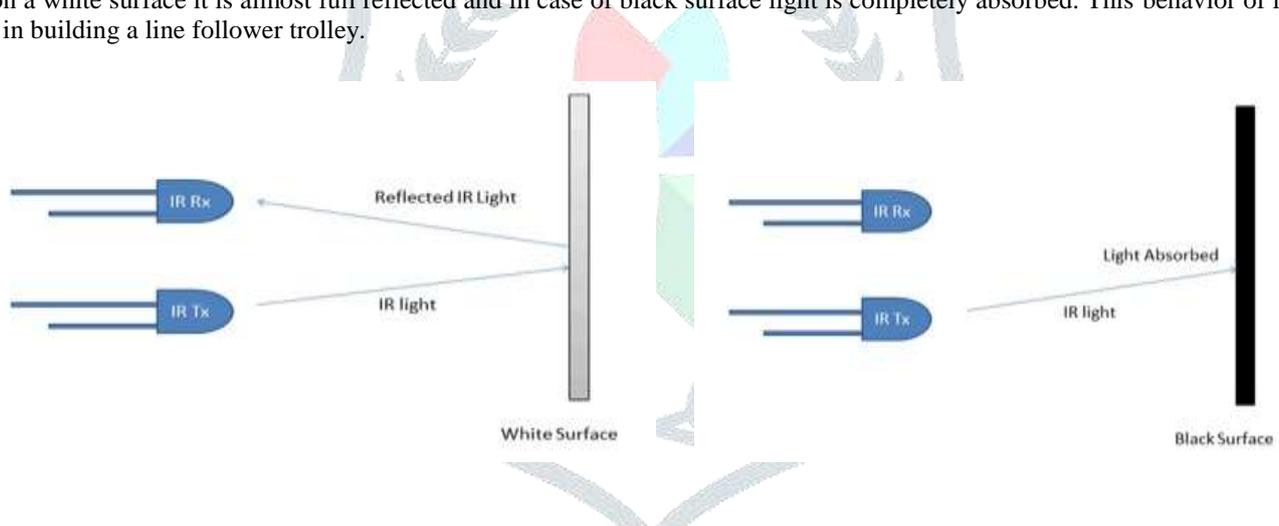
## 4. METHODOLOGY

- 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.



## 5. Working

Concept of working of line follower is related to light. We use here the behavior of light at black and white surface. When light fall on a white surface it is almost full reflected and in case of black surface light is completely absorbed. This behavior of light is used in building a line follower trolley.



In this line follower trolley, we have used IR Transmitters and IR receivers also called photo diodes. They are used for sending and receiving light. IR transmits infrared lights. When infrared rays fall on white surface, it's reflected back and catch by photodiodes which generates some voltage changes. When IR light falls on a black surface, light is absorb by the black surface and no rays are reflected back, thus photo diode does not receive any light or rays. Here in this line follower trolley when sensor senses white surface then IC gets 1 as input and when senses black line IC gets 0 as input.

- **Circuit Explanation:**

The whole line follower trolley can be divided into 3 sections: sensor section, control section and driver section.

- **Sensor section:**

This section contains 2Array IR Sensors which includes IR diodes, potentiometer, Comparator (Op-Amp) and LED's. Potentiometer is used for setting reference voltage at comparator's one terminal and IR sensors are used to sense the line and provide a change in voltage at comparator's second terminal. Then comparator compares both voltages and generates a digital signal at output. Here in this **line follower circuit** we have used two comparator for two sensors. LM 358 is used as comparator. LM358 has inbuilt two low noise Op-amps.

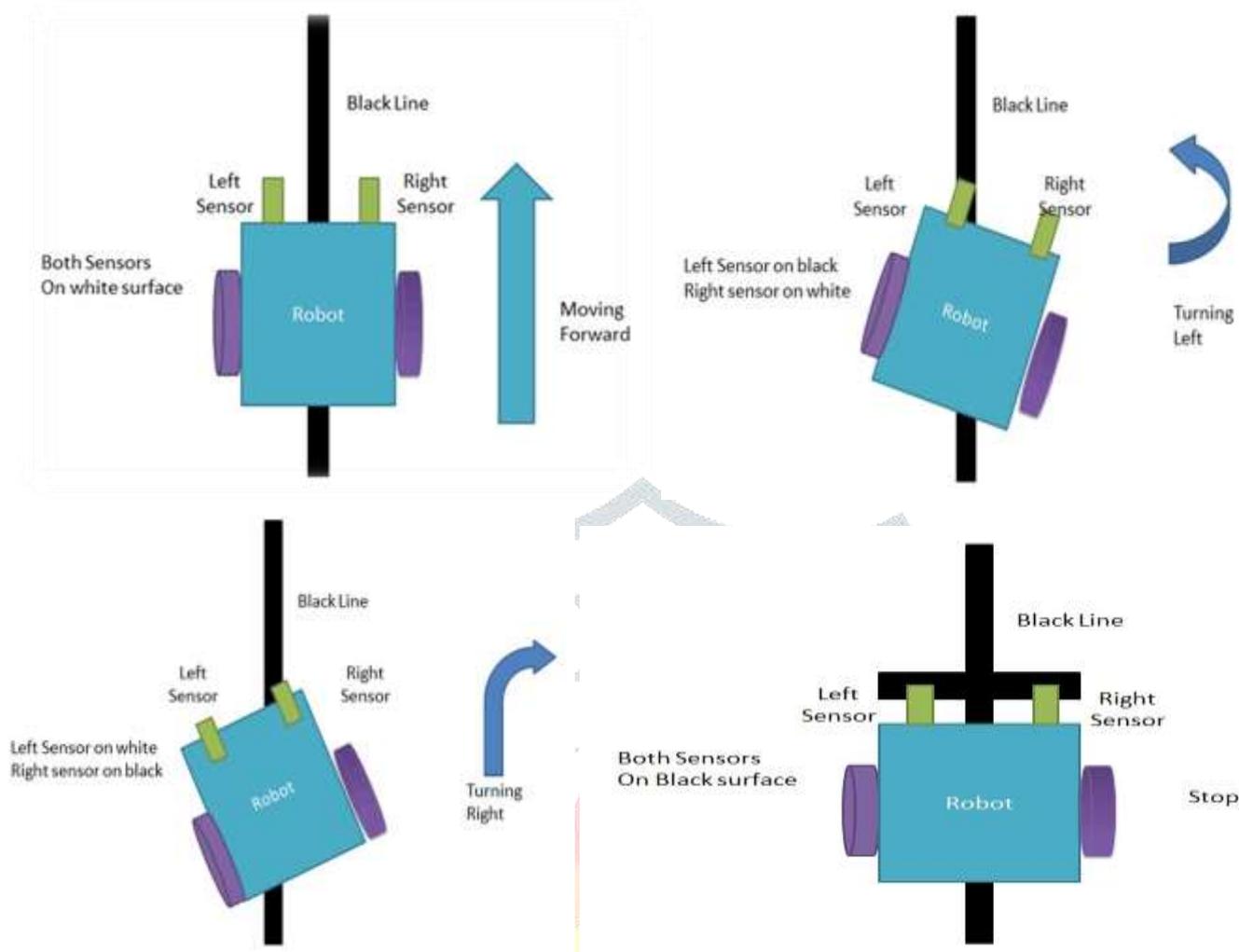
- **Control Section:**

IC ULN2003 is used for controlling whole the process of line follower trolley. This IC reads these signals and send commands to driver circuit to drive line follower.

- **Driver section:**

Driver section consists motor driver and two DC motors. Motor driver is used for driving motors. So, we add a motor driver circuit to get enough voltage and current for motor. IC ULN 2003 sends commands to this motor driver and then it drive motors.

Here in this project we are using two IR sensor modules namely left sensor and right sensor. When both left and right sensor senses white then trolley move forward.



Both sensor are on white surface, both motors will move forward

Left motor will stop as left sensor is on black line, right motor will move forward ( this will make left turn).

Right motor will stop as right sensor is on black line, left motor will move forward ( this will make right turn).



• **Hand Sanitizer:**

This device is an automatic hand wash dispenser which dispenses a specific amount of handwashing liquid on to your hands when placed under a distance measuring sensor(ultrasonic sensor).

Here the ultrasonic sensor is used to detect the presence of hand placed under the device ( 20 cm from the sensor).

A 12 V Peristaltic pump is employed to eject the right amount of liquid at the right time. i.e. when the hands are placed in the 20 cm range.

The Arduino UNO board controls the pump based on the distance obtained from the ultrasonic sensor. The peristaltic pump is controlled via NPN Transistor (BC 547), a flyback diode (IN4007) is connected in parallel with the motor. The diode protects the Arduino from the back emf produced by the pump.

An adapter (12 V 1 A DC Output) is used to power the Arduino, which in turn controls the 12 V Pump.

Make sure the U. S. sensor is placed just above the outlet of the peristaltic pump so that it can detect the hands kept under the outlet.

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Input		Output				Movement Of Trolley
Left Sensor	Right Sensor	Left Motor		Right Motor		
LS	RS	LM1	LM2	RM1	RM2	
0	0	0	0	0	0	Stop
0	1	1	0	0	0	Turn Right
1	0	0	0	1	0	Turn Left
1	1	1	0	1	0	Forward

## 6. FUTURE SCOPE

The line follower trolley is made by op-amps and transistors, where the motor is directly on or off using the signal of the comparator. Now the techniques can be replaced by

PWM using more sensor, microcontroller and H-Bridge motor controller IC i.e. L293D. I want to try it earlier but failure in some cases. I have compiled some programs of microcontroller. Also instead of LDR it can be used phototransistor whose response is much better than LDR. There are 2 line sensors used here so the fluctuation of line is a fact. Using more than 2 sensor likely 5 sensor array may be used to detect the black line quickly. Also using microcontroller it can draw the reverse direction as well as obstacle avoiding turning the motor 180°. The block diagram may be represented as follows. Also using color sensors the trolley can sense different colors. It can be used in the trolley game competition and other fields. So the development features in brief:

- Applying PWM technique
- Use of Microcontroller
- Use of color sensor
- Obstacle avoiding

## 7. CONCLUSION

In this project, we have designed a line following trolley. This trolley does not need any remote controller or any controller like Bluetooth, Wi-Fi, GSM, driver etc, it will run automatically with following a line. We have not used any microcontroller. This trolley is very low cost but very effective for various purposes. Our project can be used in various sectors like in medicine delivering in hospitals, delivering products in any places, spying, and surveillance and so on. In future we can add several sensors, cameras etc to get more features.

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