

LECTURE-10

Black Line Following Vehicle

Introduction:-

One of the most fundamental functions that any automated vehicle or Robot must perform is to move along a fixed path without manual control. The path may be defined in terms of a marking on ground, color of side-walls, obstructions in field, or towards a sound or heat source.

A Line following vehicle is designed such that it traces the path of any curve which is marked in black color against a white background.

The curve is about 2-3 cm thick and is generally zigzag with sharp turns.

Differential turning:-

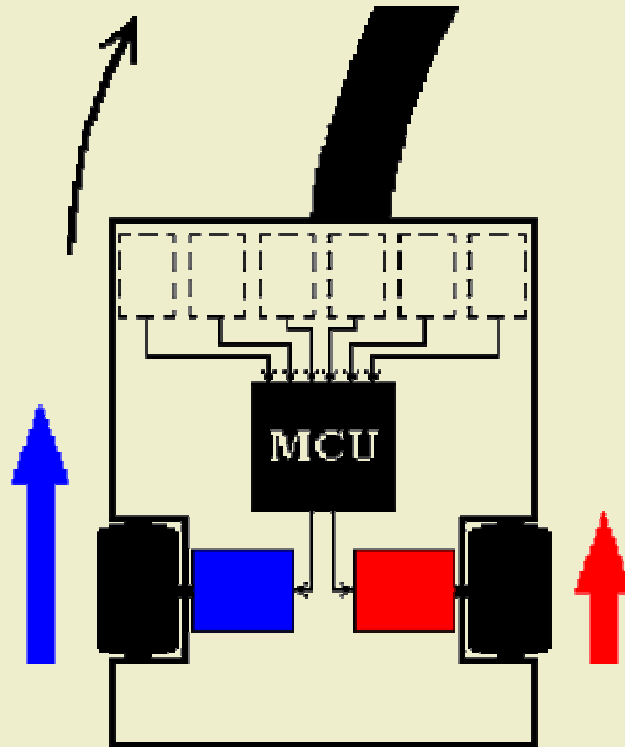
DT is the simplest and hence the most commonly used mechanism for directing a vehicle. Consider the case when we want our vehicle to take a right-turn. Our vehicle must rotate about the point of contact of the right wheel and the ground. This can be achieved by stopping the right motor and hence allowing the vehicle to rotate about the point of contact with the left motor.

Thus, the vehicle would take a right-turn. Just remember that the motor in the direction in which we want our vehicle to turn must be switched off while the opposite motor remains on.

Implementation:-

DT can be implemented using a very simple logic. Assume that initially the black line is exactly below the centre of the vehicle. As soon as the black line curves towards right, our right motor must be switched off, i.e. as soon as the right wheel is close to black line right motor must be switched off.

We place a sensor sufficiently close to each wheel and a transmitter equidistant from both sensors.

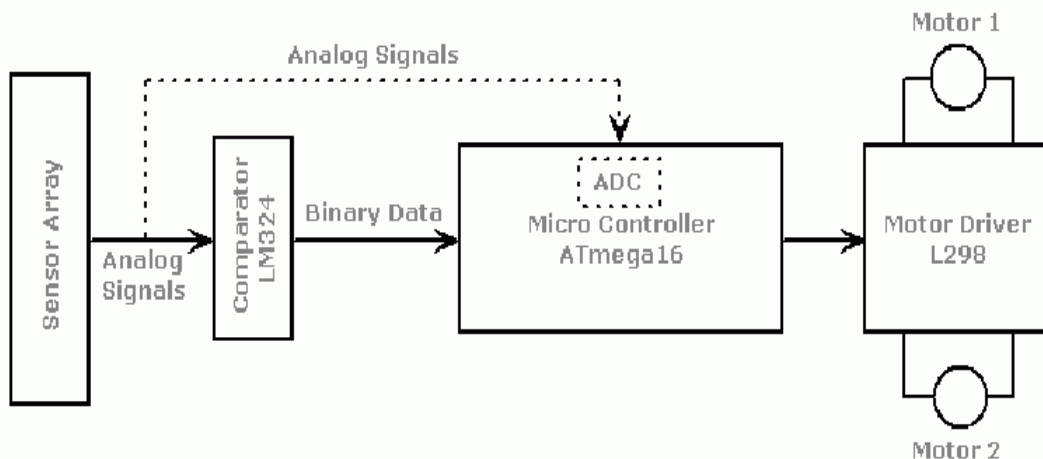


The transmitter emits Infra-Red radiations which are incident directly on the surface below. We assume that the black part completely absorbs the IR radiation while the white part completely reflects it. The sensor on each side will detect the the type of surface (black or white) exactly below it depending upon whether IR radiation is incident on it or not.

When the sensor sees black below, it will send a signal to switch the motor on its side off. If it sees white below it sends a signal to keep the motor running. Thus, the vehicle will trace out the path formed by the black line.

How to go about?

While designing the electronics part here is a step-by-step procedure.



- Check the motor specs - Max. Voltage, Max. Current, Speed and Torque
- Finalize the Power Supply method. Check the number of components requiring power supply and their respective voltages. Hence design an appropriate potential divider.
- Check LED specs. - Max Current, use suitable current limiting resistor.
- Check TSOP specs. - Input voltage etc.
- Modify the circuit as per available components
- Use appropriate power transistor- Check saturation base current, max collector current etc.
- Design Physical Layout of the circuit - for example IR LEDs, TSOPs should be on the underside while the power transistor must be well exposed.
- Test each component separately and then mount on the circuit.

Notes:-

1. In differential turning, the vehicle is pivoted about the stopped wheel. This makes it necessary that the wheel must stop instantly when its power supply is cut off, i.e. the motor must not roll after switching off. Thus, choice of motor becomes important. DC motors make a good choice.

2. The TSOP sensor will be placed near each wheel. When the vehicle is turning about a wheel, the Sensors will also rotate and eventually the surface below them will also change.
3. The sensors must be placed such that they are sufficiently away from each other and sufficiently in front-of the wheels.
4. The sensors must not be too high above the surface.
5. The sensors must be capped by a black paper on the side of the IR LED. This is to be done because the TSOP must respond *only* to the reflected radiation and not that coming directly from the source.
6. Just imagine what happens when the vehicle turns. The entire vehicle is rotated about by a single motor and thus must produce high torque. In case of a four-wheeled vehicle the rear-wheels and the rear body require a lot of torque to rotate about the front wheel. This will make the vehicle insipid. Moreover the rear wheels roll over might change the direction of the the vehicle and make it lose the white line.
7. A two wheeler is a safer choice because of its low torque requirements and low weight. The design needs to be precise, however.