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ATOMATED TROLLEY FOR MATERIAL HANDLING

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Abstract

In manufacturing units, material spends more time in a shop moving than being machined, which means that there is more time wasted thereby adding to the cost of the product. Thus, material handling methods used are important in improving the profitability of a manufacturing organization. The major automated material handling systems that are generally used in advanced manufacturing are automated guided Trolley (AGV) or mobile robots, storage and retrieval systems (AS/RS). The primary objective of this project is to design a fully autonomous "line following AGV" capable of following a pre-designed path marked on a surface. The microcontroller receives the input from a series of infrared sensors and from these inputs determines if the AGV should continue forward or the direction of the automated guided Trolley (AGV) should be changed. Accordingly the speed of the motors is controlled and thus the mobile robot is made to follow the predetermined path. In order for the automated guided Trolley (AGV) to turn, one wheel is stopped while the opposite wheel continues to turn A'C' program is developed which could ideally control the path of the AGV. This source code is compiled and the resulting hex file is placed into the microcontroller.

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1. INTRODUCTION

1.1 Productivity and productivity improvement

Material Handling is a vast area of study which uses Automated Guided Vehicles to transport loads between different locations. Automated Guided Vehicles popularly known as AGVs are battery operated driverless vehicles which are guided on a predefined pathway. They are most often used in industrial applications to move materials around a manufacturing factory or a warehouse. The application of the automatic guided vehicle has broadened during the late 20th century. The first AGV was invented by Barrett Electronics of Northbrook, Illinois, in 1953. The subsequent period of 1960 to 1980, however, was marked by the introduction of a large number of AGVs in Europe, which was further accelerated during the following decade because of better (compact and reliable) onboard computers and electronics. Over the years the technology has become more sophisticated and today automated vehicles are mainly Automatic navigated e.g. AGV (Automatic Guided Vehicle). In older days, men carried the material to the preferred locations in a warehouse. Men were replaced by trucks after a few decades. This change in the transportation system reduced the walking distances and loading was more careful. Introduction of AGVs in the industry lead to clear traffic, faster material handling, more space in industry and reduced number of accidents. AGVs improved the work environment.

2. PROBLEM STATEMENT

Firstly we are looking or industry related project. When we visited a medium scale company at BHOSARI MIDC "SANJYOT DIES AND MOULDS" and observed their working environment. We survey at that Industry and we comes at conclusion that we have opportunity to make something different in material handling concept. We have concept in our mind of automatic material handling because currently for material handling 2 workers are required for manual handling. so we discussed our concept with seniors, then they are interested in our idea. So finally they sponsored us to for implementing our project idea.

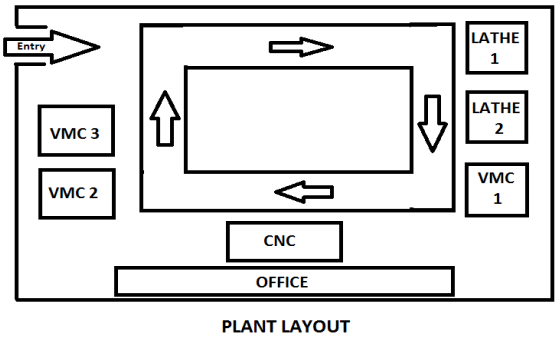


Fig.1 Plant Layout

3. OBJECTIVIES

The material handling is done at a long distance.

- To increase the productivity.
- To handle finished goods without any damage.
- To utilize maximum efficiency of the AGV.
- To avoid Un-wanted transportation of materials.
- To minimize accidents in material handling

4. METHODOLOGY

The Basic Block Diagram of the AGV consists of 3 blocks as showing in the figure, namely,

1. Photo Logic Optical Sensor Module.
2. Microcontroller Module.
3. Motor Control Module.

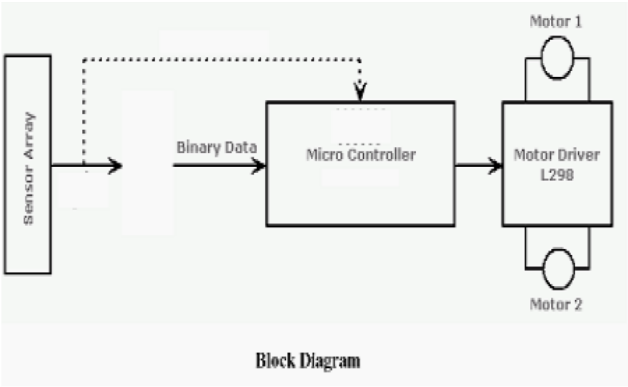


Fig.2: Block diagram

4.1 The line follower robot

Line following robot is generally a wheeled mobile robot. The method of line following varied depending on the number of sensors available and the type of line to be followed. There are four methods identified including edge following, line search, line trap, and cross-over. These four methods are different in number of sensors that used and also the results that will be obtained are different. With only one light sensor, the robot will have to know where the line is, or spends time searching to find it. Whereas with two light sensors, the robot is possible to remember which direction the line went. With more sensors, the result that will be obtained would be more excellent and the robot will be more intelligent. The line following method can be listed in Table No. 1 below.

Table No. 1: Line Following Method

Method	Characteristic
Edge following	Stay on the edge of the line
Line search	Stay on the line
Line trap	Keep the line between sensors
Cross-over	Move back and forth over the line

4.2 Line sensing

The basic principle of the line follower robot actually almost the same as the light follower robot, but instead of tracking the light the LFR sensor is used to track the line. Therefore by differentiating the line colour and its surrounding (black over white or vice versa) any light sensitive sensor could be used to navigate the robot to follow this track.

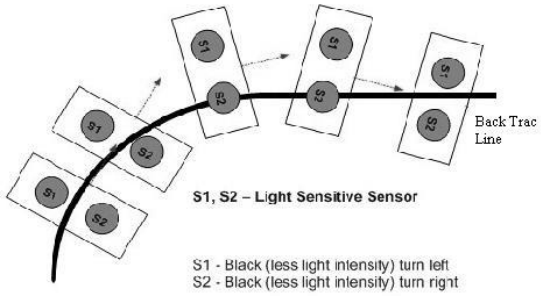


Fig 3: Module of Line Sensing

The line follower robot is a kind of robot that detects and follows a line drawn on the floor. In order to detect the line which is to be followed sensors can be employed. For the line follower robot, when the sensor senses the line the signal is sent to the microcontroller and then the wheels of the robot are controlled and moved through the help of programming. The basic principle of the line follower robot is to capture the line position by making use of IR sensors mounted at the front end of the robot. To accomplish this successfully an opto-coupler which is a combination of Infrared light emitting diodes and phototransistors is used.

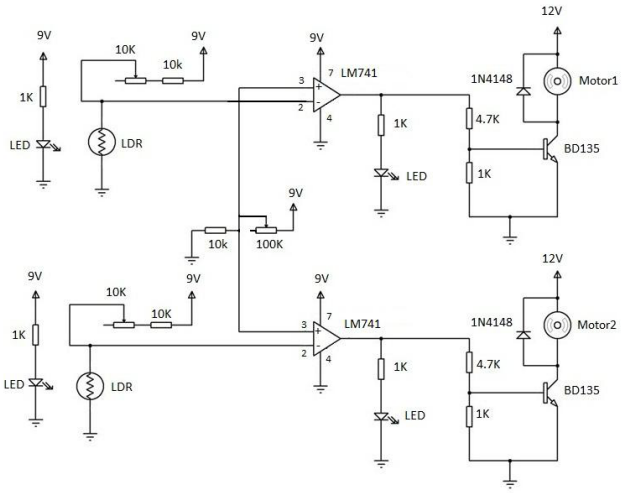


Fig. 4: Circuit Diagram

When the sensor senses the path, analog signal is given to the operational amplifier to produce 0s and 1swhich are then fed to the microcontroller, the microcontroller then decides the next move according to the program. When both the sensors are indicating low (0) the trolley will stop but if the both sensors indicate high (1) then the trolley starts to move along the white path. The microcontroller used is the 8051microcontroller which is a very popular microcontroller on which many derivative microcontrollers are compatible with and are based on. 8051 microcontroller is based on fully static CMOS (89C52) technology controller with 3-level program memory, 32input/output lines, 8 interrupt sources, 3timers/counters, 8K flash memory, and 256 byte on chip RAM.

The photo Logic Optical Sensor Module consists of 3 IR sensors which sense the track using the light reflected from the black /white line on a light background. The sensors then depending on the position of the photo logic Optics send the signals to the next module that is the Micro-Controller Module. The signals from the Photo Logic Optical Sensor Module are given to the Micro-Controller Module where the signals are processed and depending on the signals received the microcontroller gives the corresponding output to the motor control module such that the Trolley (AGV) continues to follow the path. The signals given by the microcontroller as a result of the signals from the Photo Logic Optical Sensors module are then given to the Motor Control Module, where depending on the signal either both the motors work or one of the motor works while the other motor stops working. When one motor works and the other motor stops workings,then this condition causes the AGV to turn in the direction of the motor which has stopped working. When both the motors continue to work then the AGV will move in a straight path. Thus making use of these conditions the AGV is made to follow the pre-defined path. Thus as explained above the signal follows the order, Photo Logic Optical Sensor module to Micro-Controller Module and then to Motor Control Module and in this way continues to follow the pre-defined path which is a black / white line.

5. COMPONENT

In this circuit we are using **L293D IC as a motor diver IC** to control the movements of motors and we are using LDR's as a sensor which will sense the path for the robot to follow. Before understanding the working lets understand the working of individual components.

5.1 LDR

LDR which is working as a sensor here is basically made up of semiconductor material. Semiconductor material has energy band where electrons and holes exist. These are present on valence band and the conduction band. For conduction to take place electrons must exist in conduction band. Bur energy gap prevents the electrons from moving into conduction band. Therefore electrons need energy to reach to conduction band. And this energy is provided in the form of electrical energy by connecting a power supply to the semiconductor material. The number of electrons present in the conduction band and energy gap will give you the resistance of the material. Similar phenomenon happen in LDR when light fall on LDR, Due to light energy electrons move to conduction band causing resistance to decrease.

An LDR (Light dependent resistor), as its name suggests, offers resistance in response to the ambient light. The resistance decreases as the intensity of incident light increases, and vice versa. In the absence of light, LDR exhibits a resistance of the order of mega-ohms which decreases to few hundred ohms in the presence of light. It can act as a sensor, since a varying voltage drop can be obtained in accordance with the varying light. It is made up of cadmium sulphide (CdS).

An LDR has a zigzag cadmium sulphide track. It is a bilateral device, *i.e.*, conducts in both directions in same fashion.

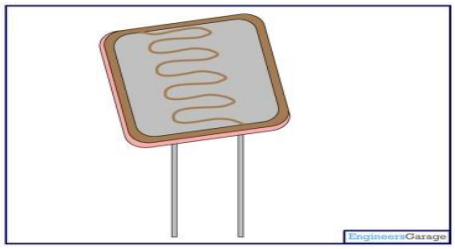


Fig 5:-Pin Diagram LDR

In short LDR can be defining as- LDR is a device whose sensitivity depends upon the intensity of light falling on it. The resistance of LDR decreases when intensity of light falling on it increases and vice versa (resistance increases when intensity of light falling on it decreases). In dark or in absence of light, LDR exhibits a resistance in the range of mega ohms, which decreases to few hundred ohms in presence of bright light.

5.2 L293D

It is a motor river IC which is used to drive the motor on either direction. L293D comes in 16 pin dual inline package. And can drive two sets of DC motor with the help of single IC which can be move independently according to the input provided. It works on the theory of H bridge which permit voltage to flow in either direction in clockwise or anti clockwise direction. Pin diagram of L293D is as follows-

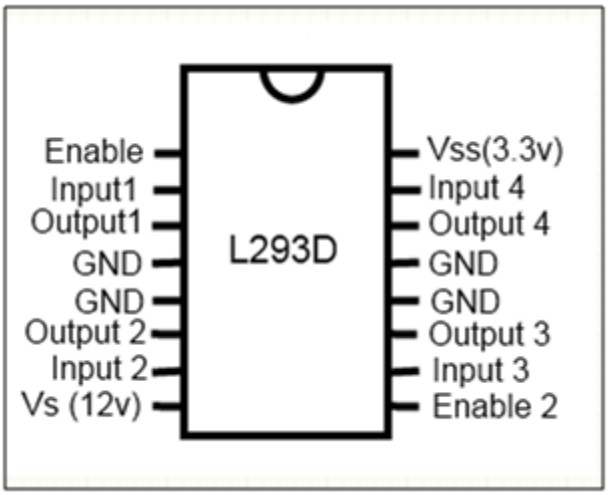


Fig 6:-Pin Diagram L293d

From the pin diagram you can see that it has two enable pin that is pin 1 and pin 9. For rotating the DC motor enable pin should be high. For example if you want to rotate the left motor than enable pin 1 should be high. Similarly for right motor pin 9 should be high. And if any of the pin is lowthan that motor will not work and if both the pins are low robot will stop moving.

L293D contain four input pin 2 pin for controlling each motor. Like pin 2 and pin 7 are on left side and control the rotation of the left motor and pin 15 and pin 10 are on right side and they control the rotation of right motor. And there outputs pin are pin 3 and 6 for left motor and pin 11 and pin 14 for right motor. Following table shown below will help to you know in which direction motor will rotate when logic 0 and logic 1 is provided on the pins.

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.

L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.

5.2.1 Pin description

Table 1.Pin Description

Pin No	Function	Name
1	Enable pin for Motor 1; active high	Enable 1,2
2	Input 1 for Motor 1	Input 1
3	Output 1 for Motor 1	Output 1
4	Ground (0V)	Ground
5	Ground (0V)	Ground
6	Output 2 for Motor 1	Output 2
7	Input 2 for Motor 1	Input 2
8	Supply voltage for Motors; 9-12V (up to 36V)	Vcc_2
9	Enable pin for Motor 2; active high	Enable 3,4

10	Input 1 for Motor 1	Input 3
11	Output 1 for Motor 1	Output 3
12	Ground (0V)	Ground
13	Ground (0V)	Ground
14	Output 2 for Motor 1	Output 4
15	Input2 for Motor 1	Input 4
16	Supply voltage; 5V (up to 36V)	Vcc_1

When both right and left sensors are in path, then receiver sends signal to microcontroller. At this time both sides motors receive signal. And trolley moves straight forward. When left sensor comes out off the path, then right side motor will stop and left side motor continuously runs till both sensors comes on path. And same as for right turn.

Table 2.Binary algorithm

Motor Rotation	Pin 7	Pin 2
Clockwise Direction	Logic 0	Logic 1
Anticlockwise Direction	Logic 1	Logic 0
No rotation	Logic 0	Logic 0
No rotation	Logic 1	Logic 1

5.3 LED

LED stands for light emitting diode. It is made up of semiconductor device which emit different light source as its output. LED is a semiconductor diode that emits narrow-spectrum light when electrically biased in the forward direction of the p-n junction. When LED is switch on in this electronics combines with hole and the device release energy in the form of light.

Light emitting diodes (LEDs) are semiconductor light sources. The light emitted from LEDs varies from visible to infrared and ultraviolet regions. They operate on low voltage and power. LEDs are one of the most common electronic components and are mostly used as indicators in circuits. They are also used for luminance and optoelectronic applications.

Based on semiconductor diode, LEDs emit photons when electrons recombine with holes on forward biasing. The two terminals of LEDs are anode (+) and cathode (-) and can be identified by their size. The longer leg is the positive terminal or anode and shorter one is negative terminal. The forward voltage of LED (1.7V-2.2V) is lower than the voltage supplied (5V) to drive it in a circuit. Using an LED as such would burn it because a high current would destroy its p-n gate. Therefore a current limiting resistor is used in series with LED. Without this resistor, either low input voltage (equal to forward voltage) or PWM (pulse width modulation) is used to drive the LED. Get details about internal structure of a LED.

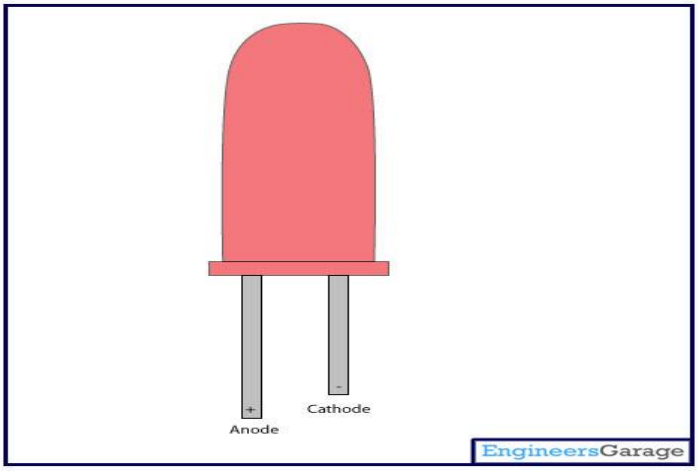


Fig 7: Pin Diagram LED

5.4 Motors

You can use two 2000rpm DC motors and it should be connected with wheel for moving the robot. in place of motor I have used LED. Working of circuit is very simple consider two cases-

Fig 8: Motor

5.4.1 Case 1:

when sensor is placed on black line - As we know in dark LDR has very high resistance in the range of M ohms. Now if we want to calculate the voltage at this point. Suppose resistance of LDR is 1M ohms.

Than voltage at this point is -

= 5*20*1000/((20*1000)+(1*1000000) V

= approx. 0V

5.4.2 Case 2:

When sensor is placed on white line- At this time light fall on LDR and its resistance is very low. Suppose it may be 1 or 2 ohms.

Then voltage at this point is-

= 5*1*1000000/((20*1000)+(1*1000000))

= approx.. 5V

So from the above calculation it is clear that when robot is on black line it will give you logic 0 and when it on white line it will give you logic 1. And from the circuit diagram you can see that this pin is connected to enable pin of L293D IC pin number 1 and 9 and from above it is clear that when this pins are high then only motors will rotate according to the table show below.

While soldering the sensor (LED + LDR) make sure there wire will long enough because they have to look at the line which robot will flow else it will create a problem in following a path. And cover the LDR and LED properly and pair them together -so that light of the room will not affect its working.

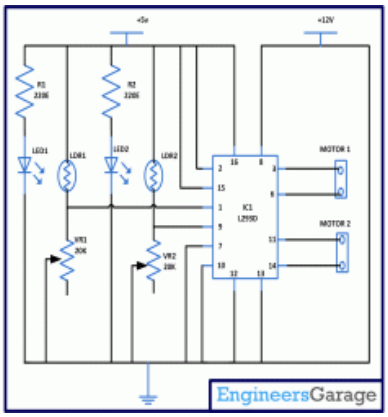


Fig 9: Circuit diagram by using L293d

5.5 Resister

Resistor is a passive component used to control current in a circuit. Its resistance is given by the ratio of voltage applied across its terminals to the current passing through it. Thus a particular value of resistor, for fixed voltage, limits the current through it. They are omnipresent in electronic circuits.

The different value of resistances are used to limit the currents or get the desired voltage drop according to the current-voltage rating of the device to be connected in the circuit. For example, if an LED of rating 2.3V and 6mA is to be connected with a supply of 5V, a voltage drop of 2.7V (5V-2.3V) and limiting current of 6mA is required. This can be achieved by providing a resistor of 450Ω connected in series with the LED.

Resistors can be either fixed or variable. The low power resistors are comparatively smaller in size than high power resistors. The resistance of a resistor can be estimated by their color codes or can be measured by a multi-meter. There are some nonlinear resistors also whose resistance changes with temperature or light. Negative temperature coefficient (NTC), positive temperature coefficient (PTC) and light dependent resistor (LDR) are some such resistors. These special resistors are commonly used as sensors. Read and learn about internal structure and working of a resistor.

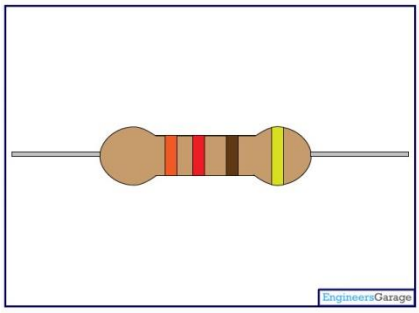


Fig 10:-Pin Diagram Resistor

6. MATERIAL SELECTION

6.1 Mild Steel (Ms)

Why choose mild steel (MS) over stainless steel for flange making ?

6.1.1 Description

Carbon steel is sometimes referred to as 'mild steel' or 'plain carbon steel'. The American Iron and Steel Institute defines a carbon steel as having no more than 2 % carbon and no other appreciable alloying element. Carbon steel makes up the largest part of steel production and is used in a vast range of applications. Welding carbon steels with carbon content greater than 0.3 % requires that special precautions be taken. However, welding carbon steel presents far fewer problems than welding stainless steels in the flange making process.

Stainless steel is defined as a steel alloy with a minimum of 11.5 wt% chromium content. Stainless steel does not stain, corrode or rust as easily as ordinary steel (it "stains less"), but it is not stain-proof. It is also called corrosion resistant steel when the alloy type and grade are not detailed, particularly in the aviation industry. There are different grades and surface finishes of stainless steel to suit the environment to which the material will be subjected in its lifetime.

6.1.2 Costing

Cost is a very important factor that is to be considered in the Manufacturing Industries. Mild steel is a cheap form of iron-carbon alloy, and hence is cheap and suitable to be used in the Manufacturing Industries.

Stainless steel is only more expensive to make , more expensive to machine and when it is welded it moves/changes its shape and needs very skilled and experienced welders. Also, stainless steel contains additional compounds that reduces hydro-corrosion and increases the hardness of the steel. This makes is more expensive, less malleable and is more likely to suffer from stress fatigue and stress fractures, which calls for a lot of fixing, hence increasing the cost factor and making it less suitable to be used for the making of flanges.

Usability:

Mild steel is the most common high volume steel in production. It is often used when large amounts of steel is needed, for example as structural steel .Mild steel is the most common form of steel as its price is relatively low while it provides material properties that are acceptable for many applications especially in the flange making industries.

On the other hand Stainless Steel is a hard, beautiful metal which is ideal for furniture and art decor but finds lesser applications in Manufacturing Industries and especially that of flanges due to the cost factor, brittleness, non – malleability etc.

Malleability:

Mild steel is any day more malleable than stainless steel, hence paving its way in to the manufacturing industries and its excessive use in flange making. It is subject to corrosion but is malleable and does not suffer from the brittleness issues of stainless steel thereby making stainless steel less effective to be used in flange making.

Corrosive properties:

When it comes to resistance to corrosion, mild steel is a lot more vulnerable when compared to steel. Basically, steel contains a sufficient amount of chromium that helps it form a kind of passive film made out of chromium oxide that helps prevent further corrosion. Do keep in mind that there are modern treatments that can be applied to mild steel which can help delay or completely prevent corrosion in it as well.

Hardness and Strength:

Mild steel is less harder than that of stainless steel as stainless steel reduces hydro-corrosion and increases the hardness of the steel. But this makes it less ductile. Mild steel has a reasonable strength and hardness it is easier to weld than stainless, and it is cheaper. Even though mild steel has a relatively lower tensile strength, it is malleable and ductile, highly suitable for the manufacturing of flanges. However mild steel can be hardened by increasing the carbon content and surface hardness can be increased through carburizing.

Weight:

Mild steel weighs less than that of stainless steel. Stainless steel weighs more due to its hardening properties and has a lesser occupancy to be used for flange making as it makes it difficult to be handled during the manufacturing process.

Chemical composition (Ideal analysis to meet the majority of grades listed above)	
Carbon	0.16-0.18%
Silicon	0.40% max
Manganese	0.70-0.90%
Sulphur	0.040% Max
Phosphorus	0.040% Max

7. LOAD CALCULATION

Load Assumed to be handled =25kg

Therefore, Torque = Force*Distance(Radius of wheel)

1.Force= mass*Acceleration

Mass=25kg

Accleration= (v-u) / t

v=$\frac{\pi dn}{60000}$ (As wheel diameter consider 100 mm)

v=$\frac{\pi*100*60}{60000}$

v=0.314159 m/sec

Therefore ,

a=(v-u)/t

a=(0.3141-0)/1

a=0.3141 m/sec^2

so

force =m*a

=25*0.314159

F=7.85 N

Frictional force is given by

FR= μf_R

=0.3*7.85..(μ=0.3 for concrete)

FR=2.355 N

Total force=7.85+2.355

=10.18 N

Torque= force*Radius

=10.18*0.05

T=0.509 Nm……(For 2 motors)

Torque shared by each motors=(0.509/2)

=0.2545 Nm

We refer catlog of DC motor For T=0.2545 Nm and we select the motor of RPM=7095(No load conditions)

WE have calculate the NO of revolution to travelled 100m

Therefore,

Number of revolution*circumference=Distance Travelled

Number of revolution*π*100*10^{-3}=100

Number of revolution=318.309

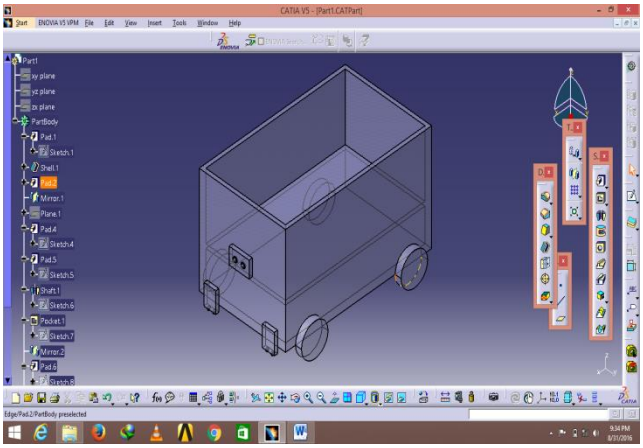
Therefore,

The total time required to cover distance 100 m = ((318.309)/60)

=5.30min

If 10 jobs are produce during 1 cycle in 1 hour so for 8 hour ship approximately 40 min trolleys in working conditions.

8. BASIC MODEL OF AUTOMATED TROLLEY



9. FUTURE SCOPE

- Obstacles can be detected in path which AGV moves by using extra sensors (IR) AGV can be turned to another direction
- By using ccd camera along with AGV we can use AGV for monitoring purposes in a manufacturing unit
- The AGV, which can be operated with the mobile phone, has a micro controller with user defined layout. It has pre-programmed points in which the AGV is expected to move. It is connected to a GSM modem with a SIM card. (Using the advanced Short Massaging System embedded technologies)
- To move the vehicle to a particular point or through a defined circuit, one has to just send an Short Messaging Service (SMS) across the GSM modem placed in the vehicle. "The unmanned A.G.V could be used to perform various operations in resorts, industries, shipyards etc. It can even identify objects coming in its way and give voice warning.
- Satellite enabled GPS system can be employed toexactly know the location of the vehicle.

10. CONCLUSION

All existing models of the line follower robot have had the limitation of speed in detecting their path and executing tasks due to their design. In this Report, the problem of the speed with which the line follower robot detects its path has been addressed with the introduction of sophisticated color sensors which enable the line follower robot detect its path in the shortest possible time after the order of nanoseconds so this will help in quick movement of trolley.

REFERENCE

1.K. Kishore Kumar, Asst.Professor, Dept of mechanical Engineering, KLUniversity,,Volume 3, Issue 1, January- April (2012), pp. 24-32

2.Imran Sarwar Bajwa1, Natasha Nigar2 and M. J. Arshad31School of Computer Science, University of Birmingham, UK2,3Faculty of Electrical Engineering, University of Engineering and Technology, Lahore, Volume 1, Issue 1, November 2011.

3.Ebiesuwa O. O 1, Adekunle Y. A 2, Akinyemi L. A 3, Oyerinde O. D 4*1, 2, 4 Computer Science Department, Babcock University Ilishan-Remo, Ogun, Nigeria 3Lagos StateUniversity, Ojo, Lagos, Nigeria*,Vol. 2 Issue 7, July – 2013

4.M. S. Islam & M. A. RahmanDepartment of Electrical and Electronic Engineering, Rajshahi University of Engineering andTechnology, Rajshahi-6204, BANGLADESH, Asian Journal of Applied Science and Engineering, Volume 2, No 2 (2013)

5.Zuria Zaidura Hassan Bachelor Degree of Electrical Engineering (Electronics) Faculty of Electrical & Electronics Engineering KolejUniversitiKejuruteraan&Teknologi Malaysia APRIL, 2006

6. G. Bekey, R. Ambrose, V. Kumar, A. Sanderson, B. Wilcox, and Y.Zheng, "International Assessment of Research and Development inRobotics," World Technology Evaluation Center, Jan. 2006.

7. Rajeev K Piyare, *Member, IAENG*, and RavineshSingh ,International multi conference of engg.&computer scientist 2011 vol-II IMECS,march 16-18,2011,HongKong

8. Lothar Schulze, Sebastian Behling, and Stefan BuhrsProceedings of the International MultiConference of Engineers and Computer Scientists 2008 Vol II IMECS 2008, 19-21 March, 2008, Hong Kong

9.Amit Kumar1 *ISSN 2278 – 0149 www.ijmerr.comVol. 3, No. 1, January 2014© 2014 IJMERR. All Rights Reserved*

10.S.Achille Department Name : MECHANICAL Name of organization – ACET R. Sathish Kumar Department Name: MECHANICAL,Automated Guided Vehicle