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Fabrication of Automated Guided Vehical

Authors

Mr.Vishal S.Ingle[1], Mr.Vishal S. Badase[2], Mr.Kunal S. Bhorkar[3], Mr.Shrikant I.Dudhalkar[4], Mr.Indrapal K.Gaidhane[5], Mr.Shivaji R. Bhagat[5], Kishor H. Watane[6], Prof. Prof.K. W. Watane[7], Prof. V.R.Khawale[8], Prof. Dr. P. V.Ingole[9]

[1,2,3,4,5,6]Department of Mechanical Engineering, G. H. Raisoni College of Engineering & Management Anjangaon Bari Road, Amravati – 444701 (M.S)

[7]External Examiner Guide, Dept. of Mechanical Engineering

[8]Head, Department of Mechanical Engineering

[9]Principal, GHRCEM, Amravati

ABSTRACT

Automated guided vehicle are battery powered, automatically steered vehicles that follow defined pathways in the floor. The pathways are unobtrusive. AGV's are used to move unit loads between load and unload stations in the facility. Routing variations are possible, meaning that different loads move between different stations. They are usually interfaced with other system to achieve the full benefits of integrated automation. Paint strips are used to define the vehicle path ways, the vehicle possesses IR sensor system that is capable of tracking the paint. The strips can be taped, sprayed, or painted on the floor.

An onboard sensor detect the reflected light in the strip and controls the steering mechanism to follow it. The paint guidance system is useful in environments, where electrical noise would render the guide wire system unreliable or when the installation of guide wires in the floor surface would not be appropriate. One problem with the paint strip guidance method is that the paint strip must be maintained.

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 vehicles (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 AGV should be changed. Accordingly the speed of the motors is controlled and thus the mobile robot is made to follow the predetermined path.

CHAPTER I

INTRODUCTION

1.1 Automated Guided vehicle

An automated guided vehicle or automatic guided vehicle (AGV) is a mobile robot that follows markers or wires in the floor, or uses vision or lasers. They are most often used in industrial applications to move materials around a manufacturing facility or a warehouse.

Automated guided vehicles increase efficiency and reduce costs by helping to automate a manufacturing facility or warehouse. The AGV can tow objects behind them in trailers to which they can autonomously attach. The trailers can be used to move raw materials or finished product. The AGV can also store objects on a bed. The objects can be placed on a set of conveyor and then pushed off by reversing them. Some AGVs use forklifts to lift objects for storage. AGVs are employed in nearly every industry, including, pulp, paper, metals, newspaper, and general manufacturing. Transporting materials such as food, linen or medicine in hospitals is also done.

An AGV can also be called a laser guided vehicle (LGV) or self-guided vehicle (SGV). Lower cost versions of AGVs are often called Automated Guided Carts (AGCs) and are usually guided by specific lines magnetic tape. AGCs are available in a variety of models and can be used to move products on an assembly line, transport goods throughout a plant or warehouse and deliver loads to and from stretch wrappers and roller conveyors.AGV applications are seemingly endless as capacities can range from just a few kgs to hundreds of tons. The Aim of the project is to design and fabricate such a AGV.

There are many definitions of AGVs, different according to points of view.

Wikipedia, the free encyclopedia, defines AGVs as:

"A robot that been used highly in industrial applications to move materials from point to point"

The American Society of Safety Engineers (ASSE) defined AGVs as:

a. Machines without drivers that can move along pre-programmed routes, or use sensory and navigation devices to find their own way around.

b. Vehicles that are equipped with automatic guidance systems and are capable of following prescribed paths Or Driverless vehicles that are programmed to follow guide path.

1.2 BACKGROUND

The creations of Automated Guided Vehicle (AGV) have been around since the 1950's and the technology was first developed by Barret Electronics from Grand Rapids, Michigan. It was then developed by the Europeans in the 1970's and nowadays AGVs can be found in any countries. One of the first AGVs was a towing vehicle that pulled a series of trailers between two points and today's there are many task given to AGVs and they also have their own name and potentials.

Considering the full potentials and advantages of the Automated Guided Vehicle (AGV) in our livings, it is valuable to do this project, as it also will be the first step towards the creation of more intelligent technology or system. The simplest AGV model may use just a sensor to provide its navigation and can be the complex one with more sensors and advance systems to do the task. They can work or do the task everywhere needed but the safety for the AGV as well as the people and environment surround it must be provided.

The AGVs is just the same as mobile robot, which can moves from one place to another to do their task, but mostly the mobile robot is used for difficult task with dangerous environment such as bomb defusing. Furthermore, the mobile robot can be categorized into wheeled, tracked, or legged robot. Although the AGVs may not be glamorous of robots but their work which usually menial are often be essential to the smooth running of factories, offices, hospitals, and even houses. They can work without any complaint around many workplaces all over the world.

1.3 PROBLEM STATEMENT

There are many reasons which yield to the creation of Automated Guided Vehicle (AGV) around the world. Mostly the reason is to overcome the logistic problems that often occurred in the workplaces and to make improvement to the facilities provided in the workplaces. Usually the AGVs are implemented in factories, hospitals, offices, houses, and even can be found anywhere outdoors without the people surround realized it.

In the industries or factories, the AGVs can ease the physical strain on human workers by performing tiring tasks, such as lifting and carrying heavy materials, more efficiently with no signs of fatigue creeping in. They can carry far more than human workers, and their movements can be tracked electronically at all times. Their movements can be timed to feed or collect products or materials from the work cells in the factories.

Besides that, in the hospitals thousands of staff spends a portion of their day moving medical supplies, bedding, medicines and other equipment around large hospitals. By using the AGVs, the strain on the workers can be ease as well as the hospital's system would be more smart and systematic without any bad complaint from the patients and people. AGVs also capable of both cutting cost and releasing more staff hours to tend and care for patients.

Therefore it is very significant that the valuable knowledge on AGV construction is studied and be further implemented from the result of this project. It is due to its advantages to our own living and technology.

We have pleasure in introducing our project AGV, which is equipped by microcontroller, motor driving mechanism, and battery. The power stored in the battery is used to drive the DC motor that causes the movement to AGV. Battery assembled on the AGV is easily replaceable and detachable, used for recharging the battery, while the AGV is under roof.

1.4MARKET SURVEY

A market survey is an important requirement for initiating any successful business. The objective ofa market survey is to collect information on various aspects of the business. This survey is a toolthrough which we can minimize risk. After the market survey, the results must be analyzed in orderto finalize a business plan.

We are implementing automatic guided vehicle which replaces the normal transporting methods. So that we wants to consider all the sections related to this works such as problems arising while installing. So we conducted a market survey by personnel interview techniques was used with the measure emphasis on personal interview method. Interviews were conducted through the structure questionnaire, Also we go through people who work in large industries such as production plant, supply station etc.

The following questions are mainly taken for questionnaire:

Area of applications? i.e. inside/outside/both

Types surface of flooring?

Weights of loads max?

Distance to transportation?

From the data which we got from the market survey, we are well know about the things what the market needed and what modifications should be taken to the system. After having their market survey we came to know that the need of market and what modification should be taken to the system. And we analyse the data.

CHAPTER II
LITERATURE REVIEW

Maxwell and Muckstadt et al [1] addressed that, designing an automatic guided vehicle system is a complex task. Beside hardware consideration, the design engineer should assess the impact on facilities layout, material procurement policy and production policy.

Bozer and Srinivasan et al [2] addressed that, initiate the concept of tandem configuration as a set of no overlapping, bidirectional loops, each with a single vehicle. Another problem in steering issues is to schedule several AGVs in a non-conflicting manner which is a complicated real-time problem, especially when the AGV system is bi-directional. In fact, many conflicting situations may arise such as head-on and catching-up conflicts when the AGVs or the guide-paths are bidirectional and if no efficient control policy is used to prevent them. Several conflict-free routing strategies have been proposed and can be classified into two categories:

- Predictive methods: Aim to find an optimal path for AGVs. The conflicts are predicted off-line, and an AGV's route is planned to avoid collisions and deadlocks.
- Reactive methods: the AGVs are not planned and the decisions are taken in a real-time manner according to the system state.

Rizauddin Ramli, Jaber Abu Qudeiri, and Hidehiko Yamamoto et al [3] addressed that, Nowadays the market for industrial companies is becoming more and more globalized and highly competitive, forcing them to shorten the duration of the manufacturing system.

development time in order to reduce the time to market. In order to achieve this target, the hierarchical systems used in previous manufacturing systems are not enough because they cannot deal effectively with unexpected situations. To achieve flexibility in manufacturing systems, the concept of an Autonomous Decentralized Flexible Manufacturing System (AD-FMS) is useful. In this paper, we introduce a hypothetical reasoning based algorithm called the Algorithm for Future Anticipative Reasoning (AFAR) which is able to decide on a conceivable next action of an Automated Guided Vehicle (AGV) that works autonomously in the AD-FMS.

K. Kishore Kumar et al [4] addressed that, 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 vehicles (AGV) or mobile robots, storage and retrieval systems (AS/RS). The primary objective is to design a fully autonomous "line following AGV" capable of following a pre-designed path marked on a surface. The microcontroller EM78P156ELP 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 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 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.

Sajjad Yaghoubi et al [5] addressed that, the design and development of the AGVs, a low-cost, modular, and flexible AGV system. Low cost was achieved by using simple, off-the shelf components and by avoiding large software and hardware development costs. The vehicle navigation system is very flexible in that it is capable of either line-following or free navigation. In addition, the guide path in the line-following mode is a simple reflective tape that can be installed, removed, and changed easily. The potential of robot technology to increase the intelligence and adaptability of AGVs is largely unexploited in contemporary commercially-available vehicles. AGVs are increasingly becoming the popular mode of container transport and factories. These unmanned vehicles are used to transfer containers between two or more destination. The efficiency of a container terminal is directly related to the amount of the time each vessel spends in the port.

2.1 AUTOMATED GUIDED VEHICLE BUILT WORLDWIDE

Some of the Automated Guided Vehicles (AGVs) that are well known are discussed in brief.

2.2 MOBILE POST DISTRIBUTION SYSTEM (MOPS)

MOPS or Mobile Post Distribution System (Tschichold, Vestli, Schweitzer, 1999) is a research AGV developed at the Institute of Robotics in Zurich, Switzerland. It is used to transport mail around the Swiss Federal Institute of Technology in Zurich. MOPS is powered up by rechargeable batteries which give it a 4-hour active life, weighs around 90kg and can carry up to 50 kg of postal payload. It is also capable of hot-swapping its own batteries pack, thus ensuring 24h availability.

The MOPS provide services of picking up boxes with incoming mail at the ground floor of the five floor building, which is sorted by human first, delivering them to the secretary offices subsequently bringing back the outgoing mail to the ground floor station. It is also capable of switching floors by sending an infrared signal to the building's lifts. As the building is open to the public, protection against theft of the mail is provided by motorized blinds over the pigeon-hole mail points, which can be opened by the robot and by authorized staff.

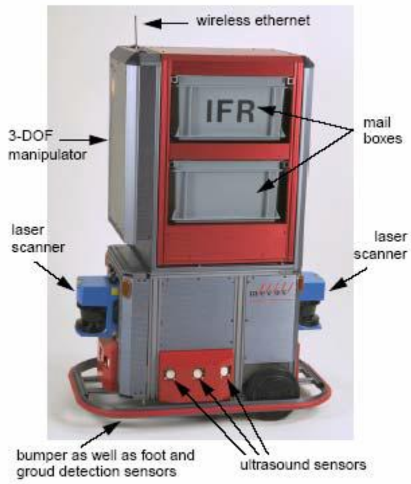

Figure 2.1 the Mobile Post System MOPS

2.3 PARKSHUTTLE AGVS OF AMSTERDAM'S SCHIPHOL AIRPORT

Figure2.2 The Park Shuttle AGVs of Amsterdam's Schiphol Airport.

The Park shuttle (FROG Navigation Systems) is an automatic navigating vehicle which provides transportation for passengers. It is a people mover system. There is no driver on board, instead a computer and an electronic navigation system do the driving. This Park Shuttle has a safety system of sensitive and intelligent sensors. The sensors scan the area in front of the vehicle and will decelerate or stop the vehicle when an unknown obstacle is detected.

An additional safety feature is provided by the bumper system that brings the vehicle to an immediate halt when it is impressed. In addition, the vehicle has emergency stop buttons (both inside and outside) that can be operated by the passengers. The speed is limited to 40 km/h obtain a good ride quality. The Park Shuttle vehicle runs on four rubber tires. Traction is provided by an electric motor powered by a rechargeable battery. Up to 100 km can be covered on one battery-load. It has a capacity of 10 passengers, 6 seated and 4 standees. It is easy to get into and out of the vehicle (wheelchair accessible) and provides good all-round visibility. Inside the vehicle is a console on which the passengers can indicate their destination.

Each vehicle is also fitted with an information display that announces the stop at which the vehicle has arrived. The maximum load is 800 kg. The maximum vehicle weight is monitored by means of weight sensor.

2.4 LINE FOLLOWING 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.

Table 2.1 Line Following Method

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

2.5 KERWIN'S LINE FOLLOWING ROBOT

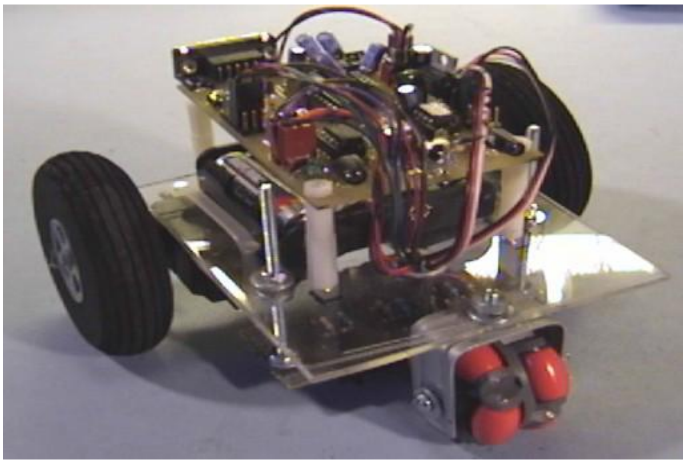

Figure 2.3 The Kerwin's line following robot using three matched IR transmit/receive pairs

The Kerwin's line following robot (ranchbots) is a design with Futaba S-148 servo motors mounted to the bottom of the Plexiglas. It has three wheels with the front wheel is the Omni-directional wheel. The sensor system consists of an array of three matched IR transmit/receive pairs mounted on a circuit board that can be raised or lowered to fine tune the sensitivity.

CHAPTER III
COMPONENTS SELECTION & DESCRIPTIO

3.1 DESIGN OBJECTIVES

In nowadays AGV has a greater influence in the production field. Why we prefer this system is mainly because of its accuracy to transport goods, avoiding accidents at industrial zone and decreasing production overall cost etc.

In our project the important factor is that, we have given an importance to the fact that cost reduction is an important factor while making an AGV, Also we provide a sensor which detects the objects in the paths to avoid collision with those objects, by stopping the vehicle and moves after the when object leaves the path.

3.2 DESIGN CONSIDERATIONS

The impact of decisions on mutual interactions and performance might be difficult to predict. It might be hard to decide on one thing without considering other decision variables. At least the following tactical and operational issues have to address in designing an AGV system.

- Flow path layout
- Traffic management: prediction and avoidance of collisions and deadlocks
- Number and location of pick-up and delivery points
- Vehicle requirements
- Vehicle routing
- Vehicle scheduling
- Battery management

A flow path layout compromises the fixed guided paths on which vehicles can travel to the various pick-up and delivery points of loads. Traffic management is required to avoid collisions and deadlock situations in which two or more vehicles are blocked completely. To ensure that loads are transported in time, sufficient vehicles should be available and the right vehicle should be dispatched to the right load.

This layout is usually represented by a directed network in which aisles intersections and pickup and delivery locations can be considered as nodes. The arcs represent the guide path the AGV scan travel on. Directed arcs indicate the direction of travel of vehicles in the system. The layout of this flow path directly influences the performance of the system. In our project we have made path loop. So that vehicle will follow path in continuous loop.

In controlling and designing AGV systems the problem of prevention of AGV collisions and deadlocks should be addressed. By attaching sensors on AGVs, physical collisions can be avoided. An AGV should have the ability to avoid obstacles and the ability to return to its original path without any collisions. We had fabricated only one AGV. So the traffic management has only less important in our case. But while using more than one carrier we should take care about them.

To determine an optimal AGV's system, capable of meeting all requirements, many factors have to be taken into account. Several of these factors are:

• Number of units to be transported
• Points in time at which units can be or need to be transported
• Capacity of the vehicle
• Speed of the vehicle
• Costs of the system
• Layout of the system and guide path
• Traffic congestion
• Vehicle dispatching strategies
• Number and location of pick-up and delivery points

If AGVs use batteries, frequent battery changing might be required. McHaney (1995) presents an overview of AGV battery technology. The time required for replacing or charging batteries can impact the number of vehicles required. Simulation results from McHaney (1995) Indicatea significant increase in the number of AGVs required while incorporating battery management issues in the simulation study compared to neglecting these issues in the studies. Furthermore, the time required for charging batteries impacts throughput, congestion andcosts.

3.3 COMPONENTS OF AGV

1. MECHANICAL PARTS

The Mechanical components includes,

1. Chassis
2. Steering system

Chassis

- Act as a frame for attaching other components
- Carry the load of other components and the payload.
- Act as sacrificial component to prevent damage of expensive payload in case of accidents

Steering System

Steering system is for steering the AGV. The two individual motors are directly attached with the wheel for steering

2. ELECTRICAL COMPONENTS

Electrical components include the motor and the power supply unit for the motor, sensoring unit

3. ELECTRONIC COMPONENTS

Electronic components provide sensing, logical decision and control of the vehicle. It includes microcontroller, which is the brain of the vehicle for the decision logic, the motor driver as both sensing and control of motor, regulator ICs, sensors for sensing the path, detect object in the path etc.

4. SOFTWARE COMPONENTS

Computer is used for making and implementing program for the microcontroller, using embedded computer programming language. For this project we use Arduino Uno microcontroller board based on the ATmega328 .The Arduino Uno can be programmed with the Arduino software.

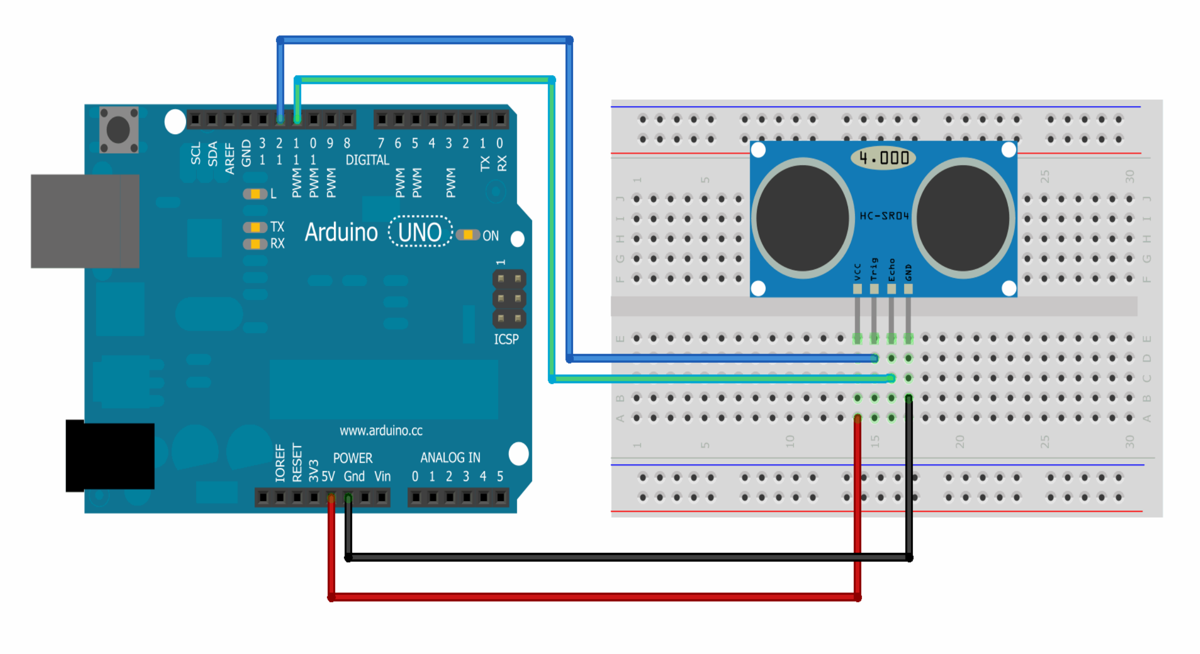

Figure 3.1 Arduino UI

3.4 MECHANICAL PART

3.4.1 CHASSIS

The chassis is fabricated from Acrylic sheet. This is done for ease of fabrication and to reduce the overall weight. It was designed in ProE; part of fabrication was outsourced due to unavailability of precision cutting tools. The chassis was designed to take a static load of 30kg.

The Top part of chassis has lots of drilled holes which serves as holes for bolting other parts and reduce the weight of the chassis. The Holes are arranged in a zigzag linear arrangement so that the decrease in strength of chassis is not considerable.

The coupling which holds the motor was designed using Aluminium and is bolted to the chassis. So that the driving motors can easily accommodate above the chassis. The chassis incorporates hole for attaching rear wheel.

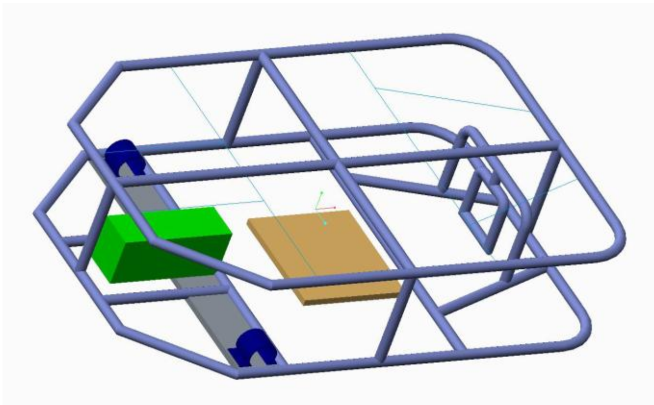

Figure 3.2 Chassis of AGV

Table 3.1 Technical Data of Chassis

Features	Data
Length	533.4mm
Breadth	381mm
Height	127mm
Material	Stainless steel
Maximum load	1.8kg
Mounting Holes	5×3mm ø Holes for general mounts 2×8mm ø Holes for motor 1×5mm ø Hole for switch

3.4.2 Steering system

The steering system used in the model is of differential type. A differential wheeled vehicle is a vehicle whose movement is based on two separately driven wheels placed on either side of the body. It can thus change its direction by varying the relative rate of rotation of its wheels and hence does not require an additional steering motion. It allows the turning centre to be on the vehicle body thus the ability to rotate on the point

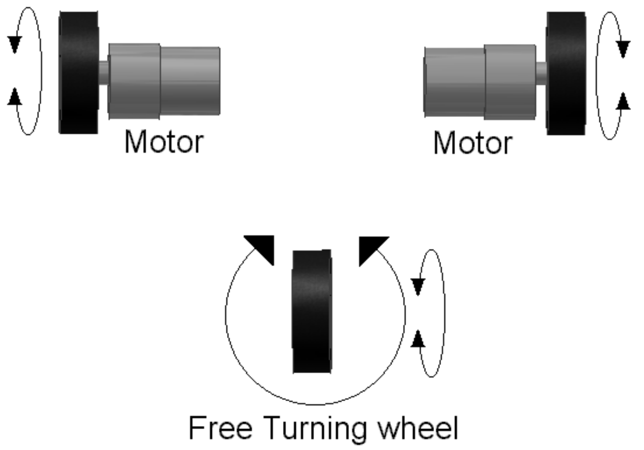

Figure3.3 Differential Steering

If both wheels rotate at the same speed and in the same direction, the robot will move in a straight line.

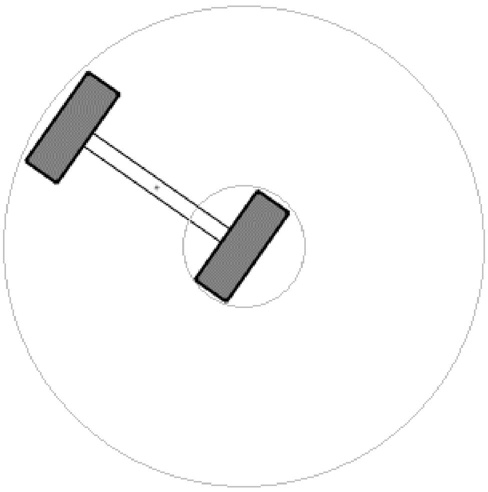

Figure 3.4Small radius turning

If one of the wheels is stopped, while the other continues to rotate, the robot will pivot around a point centred approximately at the mid-point of the stopped wheel.

Table 3.2 Steering Specifications

Feature	Data
Wheel Base	390mm
Wheel Diameter	100mm
Track Distance	260mm
Material	Rubber and plastic
Turning radius	260mm

3.5 ELECTRICAL COMPONENTS

3.5.1 DC MOTOR

60 RPM DC Motor with Gearbox generally used for robotic application are used for the driving mechanism, steering mechanism. We can adjust it to desired RPM using gear box. Very easy to use. It is excellent for line tracking robotic application.

Figure 3.5 DC Motor with Gear box

Table 3.3 Motor Specifications

Feature	Data
Supply voltage	12V DC
Speed	60 RPM with gear box
Shaft Diameter	6mm
Weight	300gm
Torque	20Kgcm
No-load current	2.5A(Max)
Load current	9.5A(Max)

3.5.2 BATTERY

The power required for the entire working process is given by a Rechargeable valve regulated Lead-Acid battery. The power from the battery is split it into two part, one is given to microcontroller and second to driving unit.

Figure 3.6 Battery

Table 3.4 Battery Specification

Features	Data
Made	SF Sonic
Voltage	12V DC
Current	2.5Amp
Type	Dry

3.6 ELECTRONICS COMPONENTS

3.6.1 MICROCONTROLLER

A microcontroller (µC, uC or MCU) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications.

We use ATmega 328 in our AGV. The Atmel®AVR® ATmega 328 is a low-power CMOS 8-bit microcontroller based on the AVR RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega8 achieves throughputs approaching 1MIPS per MHz, allowing the system designed to optimize power consumption versus processing speed.

The reasons for using ATmega 328 are:

- Low cost
- Easy to program
- High-performance, Low-power
- Fully Static Operation
- High Endurance Non-volatile Memory segments
- Power-on Reset and Programmable Brown-out Detection
- Internal Calibrated RC Oscillator
- External and Internal Interrupt Sources
- High stress value
- Five Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, and Standby
- I/O and Packages
- 23 Programmable I/O Lines
- 28-lead PDIP, 32-lead TQFP, and 32-pad QFN/MLF
- Operating Voltages
  2.7V - 5.5V to 4.5V - 5.5V

The Microcontroller is programmed with the required program to accept the data from the sensing unit, interpret it and give responses to the driving and lifting mechanism in very small time interval.

Table 3.5 Specification of ATmega 328

Type:	28Pin DIP Package
Flash	32K Bytes
I/O pins	23 Pins
Minimum/Maximum Voltage:	1.8/5.5V
Maximum current:	20mA
Number of PORTS	4
No of channels	6
Bus width	10Bit
Oscillation Speed	20Mhz
PWM	6

Table 3.6 Important Connections

PIN Name	Pin No
Vcc	7
GND	8,22
XTAL1	9
XTAL2	10

RXD/PD0	2
PB4	16
PB5	19
PB6	9
PB7	10
Reset	1
Rxd	2
Txd	3
AVCC	20
AREF	21

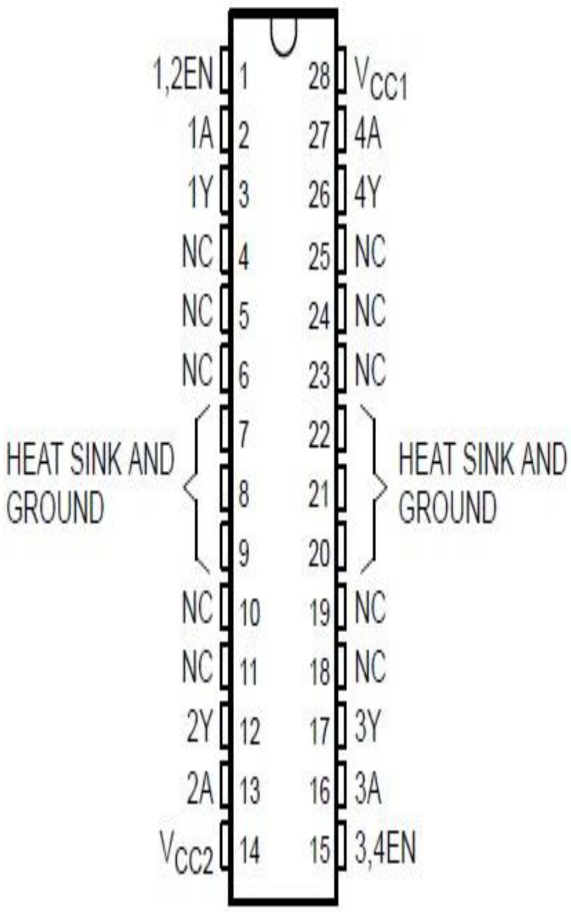

Figure 3.7 ATmega 328 microcontroller

3.6.2 Motor driver

It is an electronic circuit which enables a voltage to be applied across a load in either direction. It allows a circuit full control over a standard electric DC motor. That is with an H-bridge, a microcontroller, logic chip, or remote control can electronically command the motor to go forward, reverse, brake and coast.

A "double pole double throw" relay can generally achieve the same electrical functionality as an H-bridge, but an H-bridge would be preferable where a smaller physical size is needed, high speed switching, low driving voltage, or where the wearing out of mechanical parts is undesirable. The term "H-bridge" is derived from the typical graphical representation of such a circuit, which is built with four switches, either solid-state (e.g., L293/ L298) or mechanical (e.g., relays).

In our AGV we use the driver IC L297N. There are two driver ICs are provided in the design, because three motor are in the AGV. One driver circuit is connected to the two motors of driving mechanism. And second one is used for the motor which is incorporated with the lift.

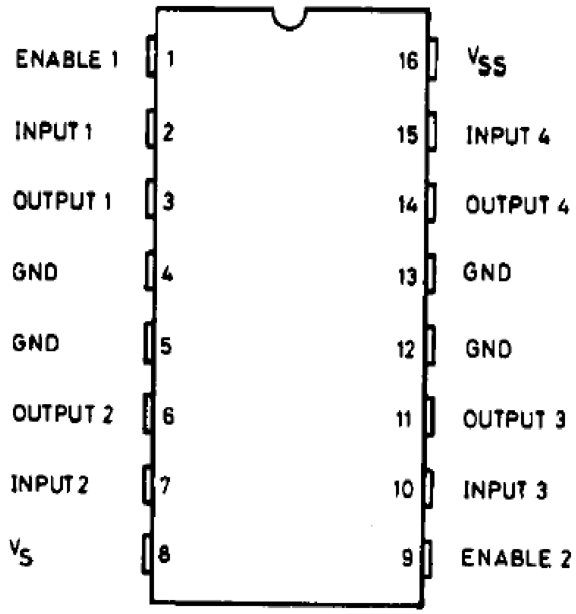

Figure 3.8Motor Driver (L298N)

The following figure shows the connection of the driving mechanism.

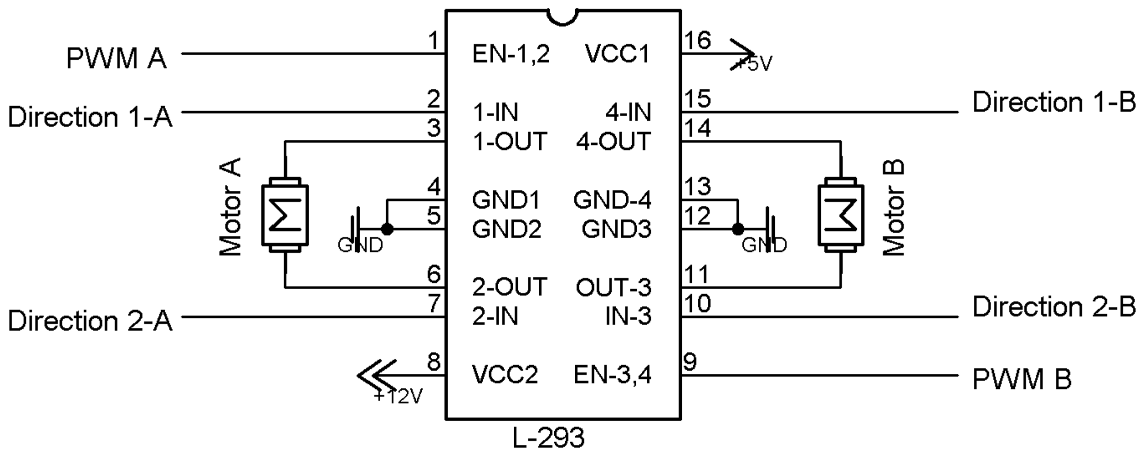

Figure 3.9L298N connected with two motors

To simplify use as two bridges each pair of channelsis equipped with an enable input. A separatesupply input is provided for the logic, allowing operation at a lower voltage.

This device is suitable for use in switching applicationsat frequencies up to 5 kHz.

In the both end of a motor voltage is always 5v. So there no potential difference between the two terminals of the motor. Therefore there is no current flow between terminals, and motor will not work. During the operation at one terminal the voltage becomes zero volts. And thus the current flows through the motor and it works. We can rotate the motor in two directions.

In the driving mechanism, in our design one direction of rotation of motor is needed. Because the AGV doesn’t wants to moves in reverse. But the connection is made in such a way that both two motors rotate in opposite direction. i.e., the motor which rotates the right wheel in clockwise direction and that of left wheel rotates in counter clockwise direction.

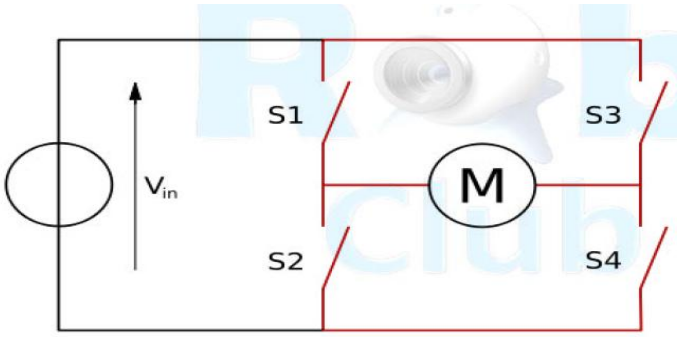

Figure 3.10 Circuit connection of driving motor

3.6.3 REGULATORS

Mainly two types of voltage regulators are used in the design. One is variable and the next is not. The non variable belongs to 78 series. And variable is LM series. The main supply is 12V. But we need only 5V. It is made possible using these regulators

3.6.3.1 7805 Regulator

It is the one of the important electronic part. The motor, driving IC, microcontroller etc need only 5V for their operations. Before the supply is given to these circuits it is given to the 7805 voltage regulator. It reduces the voltage from 12V to 5V.

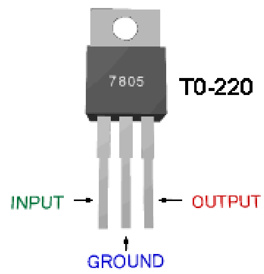

Figure 3.11 7805 REGULATOR

The main features of these regulators are:

- Internal Thermal Overload Protection.
- Internal Short Circuit Current Limiting.
- Output Current up to 1.5A.
- Satisfies IEC-65 Specification.

Table 3.7 Maximum Ratings of 7805

Characteristic	Symbol	Rating
Input Voltage	Vin	35V
Operating Junction Temperature	Tj	-40 to 150 °c
Storage Temperature	Tstg	-55 to 150 °c
Max. junction Temperature	Tj(max)	150 °c

Table 3.8 Technical Specifications of 7805
ELECTRICAL CHARACTERISTICS (VIN=10V, IOUT =500mA, 0°c≤ Tj≤ 125°c)

Characteristic	Data
Output Voltage	4.8 to 5.2 V
Input Regulation	100 mV
Output Noise Voltage	50 microVrms
Ripple Rejection Ratio	78dB
Drop Out Voltage	2.0V

3.6.4 INFRARED SENSORS

IR Sensor is one of the important parts. Path detection and obstructer detection is done with the help of IR Sensors. There are five IR Sensors are in our AGV. Out of them four are used for the path detection and rest of one is used for obstructer detection. IR sensor have a transmitter and a receiver port.

The strength of signal reached at the receiver port after the reflection of light is used to detect the path. Path is marked in the black background by white lines. Sensor detect the white line by the strength of IR wave. The reflected wave from white line has high strength than that of from black. TSOP1730 are used in the design.

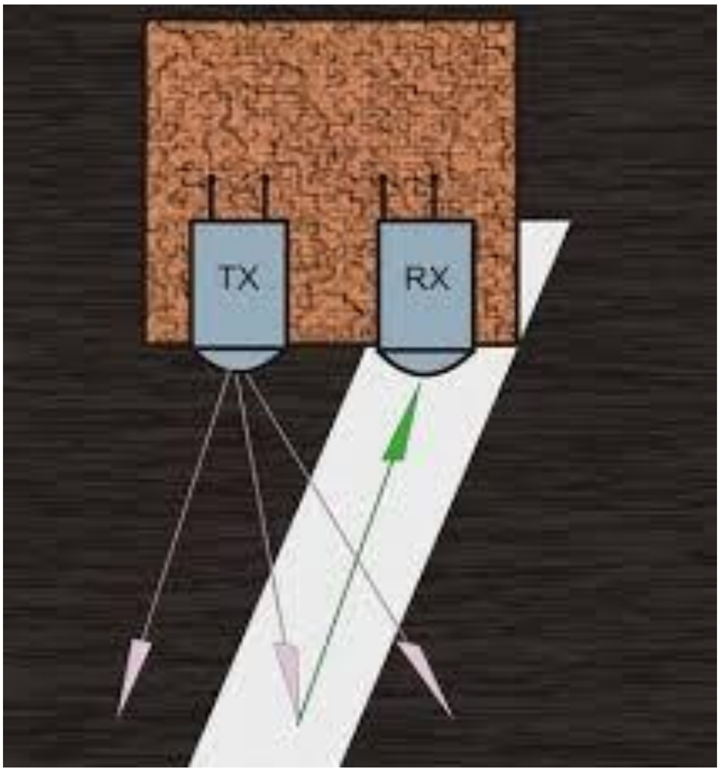

Figure 3.12 IR for Path Detection

The IR pair circuits are shown in the figure give below:

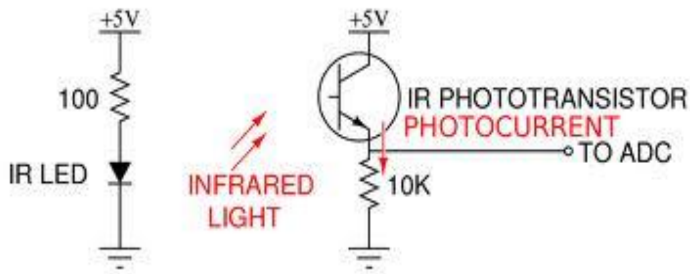

Figure 3.13 IR pair Circuit

The main features of this IR pair are:

- Photo detector and preamplifier in one package
- Internal filter for PCM frequency
- Improved shielding against electrical fielddisturbance
- TTL and CMOS compatibility
- Output active low
- Low power consumption
- High immunity against ambient light
- Continuous data transmission possible(up to 2400 bps)
- Suitable burst length 10 cycles/burst

Table 3.9 Technical Specifications of IR pair

Characteristics	Data
Supply Voltage	-0.3 to 6.0V
Output Voltage	-0.3 to 6.0V
Junction Temperature	100 °c
Operating Temperature	-2.5 to 85°c
Power Consumption	50mW
Irradiance	$30W/m^2$
Directivity	±45°

Figure 3.14 IR circuit

3.7 SOFTWARE COMPONENTS

We used ATmega328 microcontroller in this AGV. The microcontroller is the brain of the vehicle. So the programming of the microcontroller has great importance in the working.

Arduino software is used to program the microcontroller. Program is burned using special microcontroller board. For this ATmega328 microcontroller Arduino Uno board is used.

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments.

The program is written in the Arduino software using special commands. The main feature of this software is that we can run the program before burning in to the microcontroller. And we can check the function. It will helps to make changes in the program, in easy way.

The program is written in such a way that when the vehicle is in on condition, the four line detecting sensors works and detect the line. If the middle sensors close, the two driving motor rotates. If left sensors close right motor works, if right sensors close left motor works. If the object detector sensor closes, all the two motors stops whatever may be the line detecting conditions.

CHAPTER IV
DEVELOPED PROTOTYPE

4.1 STRUCTURE

The vehicle is designed in such a way that, have stability during loading and working. The lifting parts are provided in the front position. It comes above the front globe tyre. The electronic and electrical parts are situated the rest of surface. Motor for driving are provided in the rear region. Hence during dynamic loading the vehicle will be stable.

The structure of the vehicle is shown in the figure.

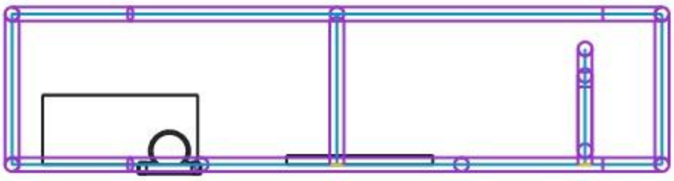

Figure 4.1 side view of AGV

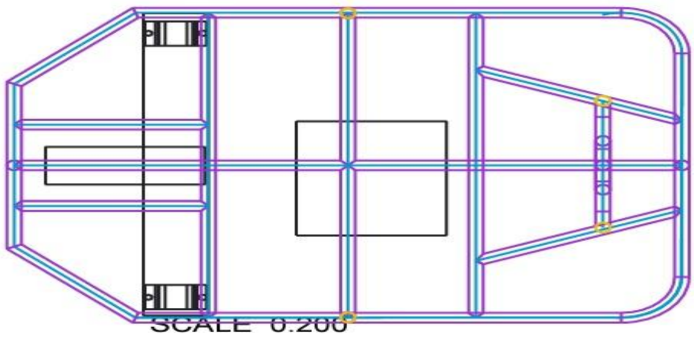

Figure 4.2 Top view of AGV

4.2 SENSORS POSITIONS

The positions of sensors are important factor to detect the position. The sensors for detecting the path are situated after the front wheel. But the obstruction detection sensor is placed above the chassis, and in front of the front tyre. There are four IR sensors used to detect the path. They are along a line parallel to the breadth. And side sensors are placed at an equal distances from middle sensors.

The width of the black line is little more than the distance between two sensors. All the four sensors were give different movements during different combination. The combination means closing of IR sensors. According to it the working of the driving motors change. Initially the AGV is placed above the line, in such a way that the two middle sensor comes above the white line.

During the straight path the middle sensors close, the two motors run in forward direction with equal speed. Thus the vehicle moves in the straight line. When two of the left side close left motor stops and right works. Then the AGV takes a left turn depending upon the curvature. And when two right side sensors close right side motor stops and the left works. Thus the AGV takes a right turn.

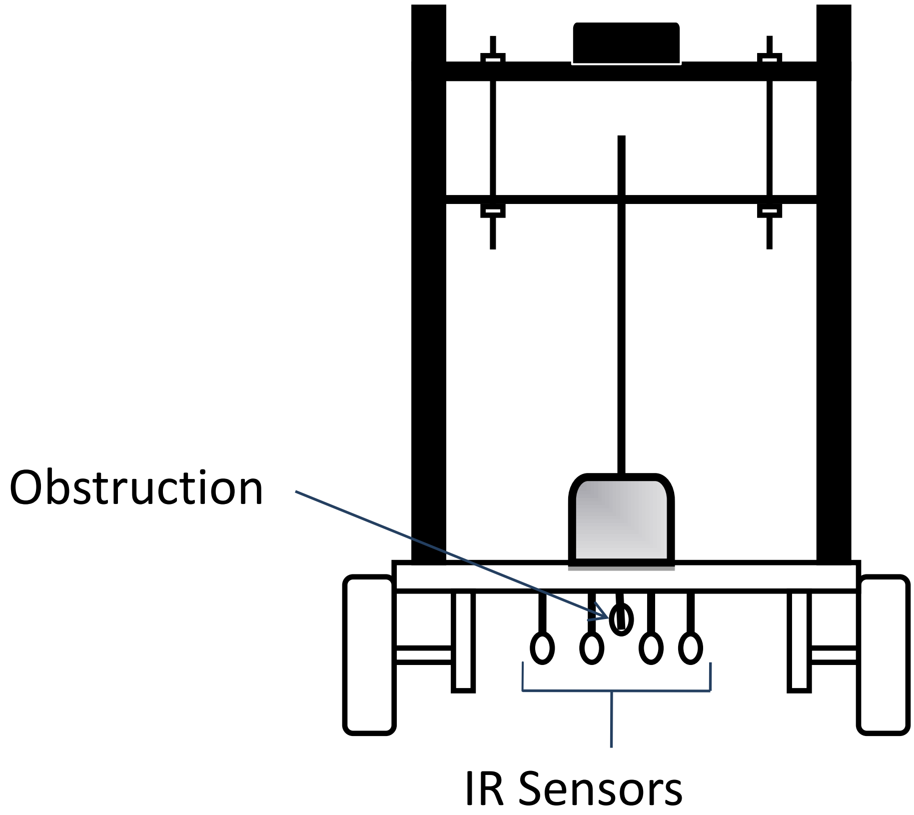

Figure 4.3 IR Sensors positions of AGV

4.3 FLOW CHART

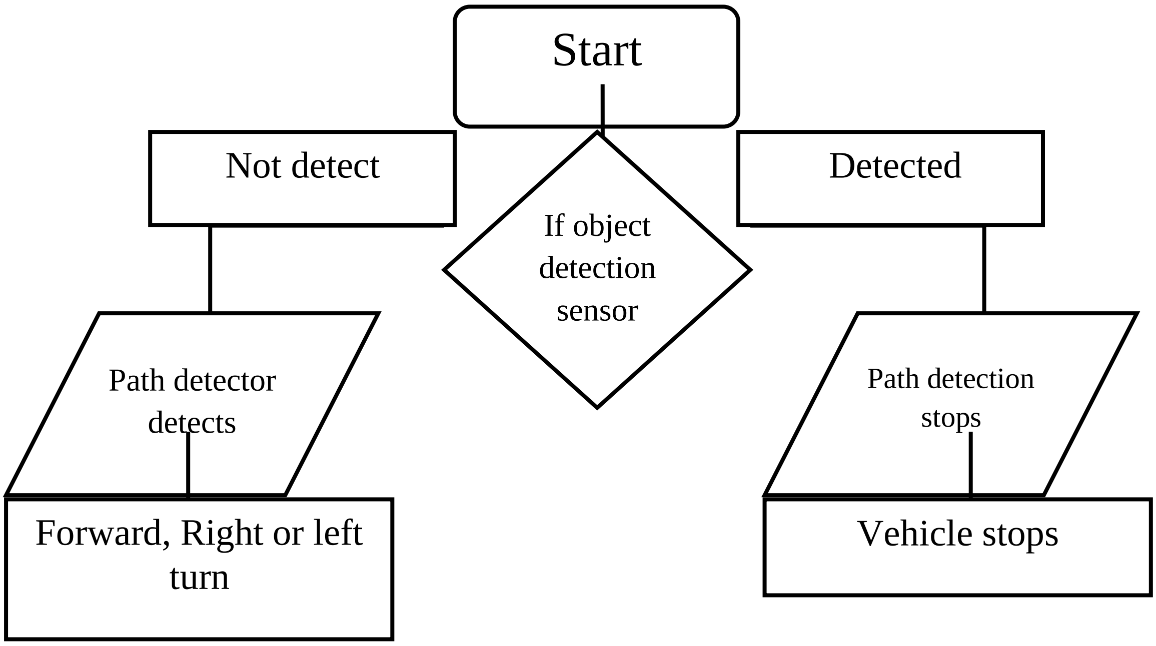

Figure 4.4 Flow chart

4.4 BLOCK DIAGRAM

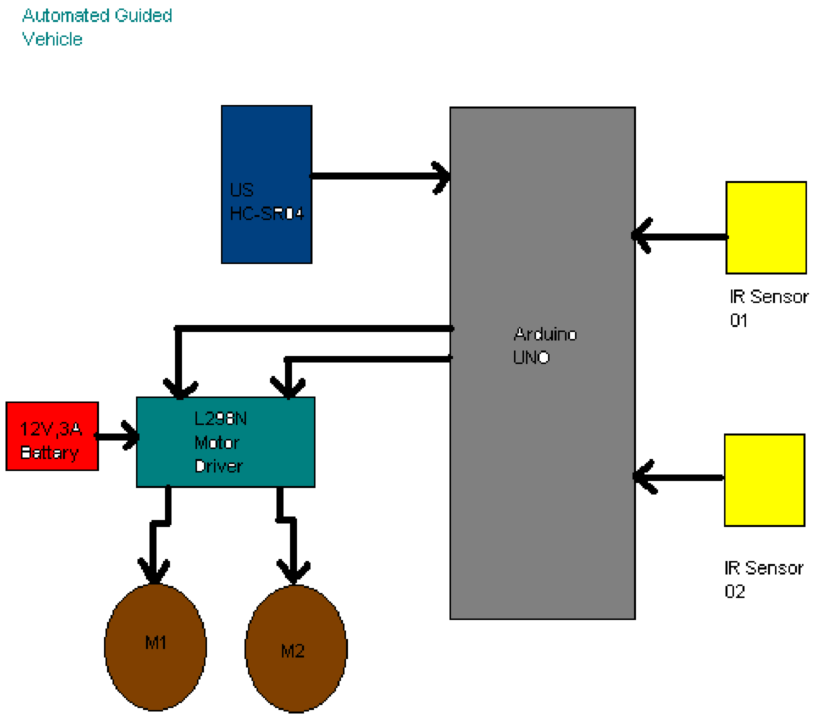

Figure 4.5 Block Diagram

Block diagram is a diagram of a system, in which the principal parts or functions are represented by blocks connected by lines that show the relationships of the blocks. They are heavily used in the engineering world in hardware design, electronic design, software design, and process flow diagrams. In this diagram direction of all arrows are either from or to the microcontroller.

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4.5 CIRCUIT DIAGRAM

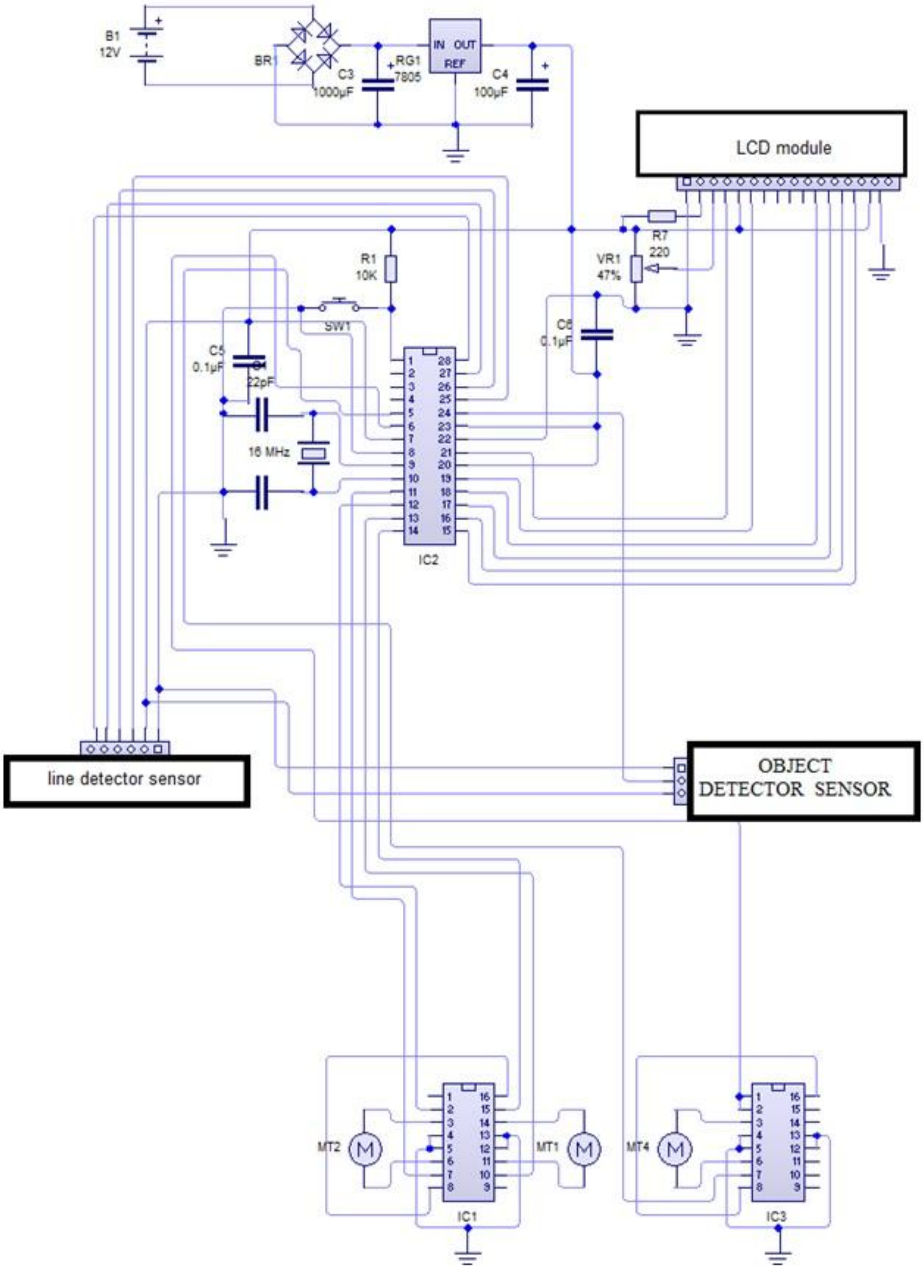

Figure 4.6 Circuit Diagram

The fully fabricated prototype of Automatic Guided Vehicle has possessed the intelligences such as following a particular line, loading and unloading at particular stations and collision avoidance etc.

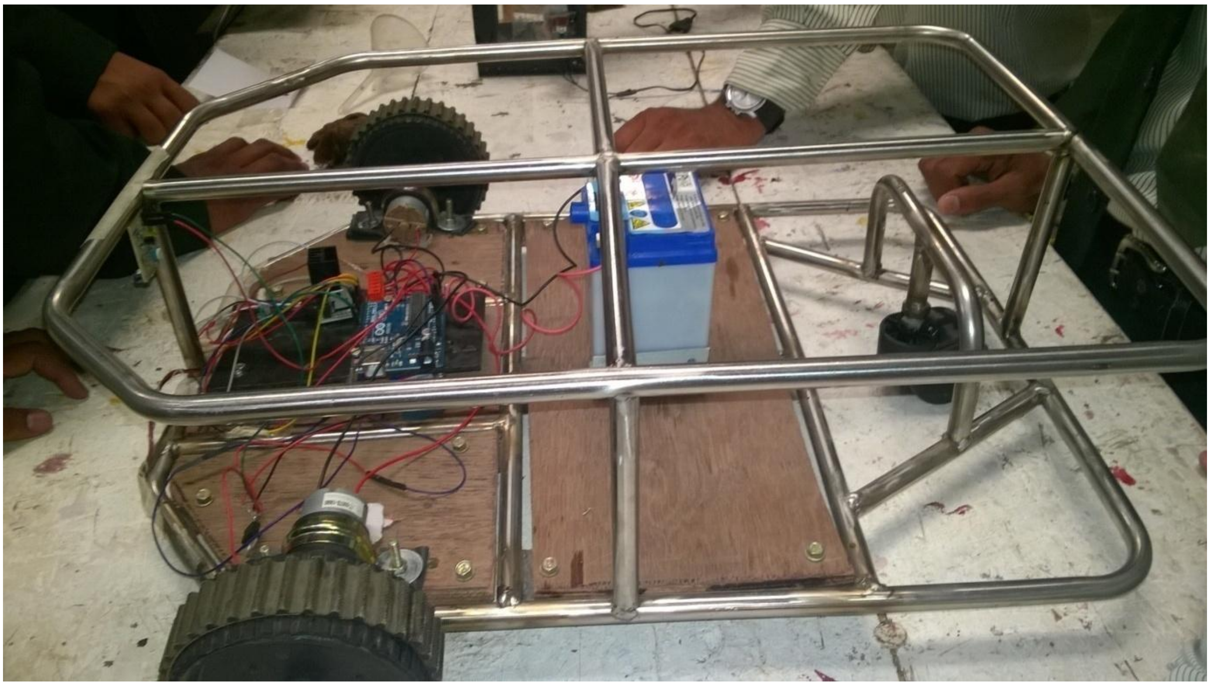

Figure 4.7 Fully Developed Prototype

4.6 THEORETICAL AND LOGICAL CALCULATIONS

Torque of DC motor used, T = 12Kg-cm
= 1.963N-m
Speed of motor, N = 60RPM
Angular Velocity, ω = 2ΠN/60
= (2*Π*60)/60
= 6.24 rad/sec

Physically Power is the rate of doing work. For linear motion, power is the product of force multiplied by the distance per unit time. In the case rotational motion, the analogous calculation for power is the product of Torque multiplied by the rotational distance per unit time.

Rotational Power, P = T * ω
= 1.963*6.24
=12.2491 W

No. of motors available for driving mechanism = 2 motors

So total power available for driving = 2* 12.2491
= 24.4982 W

Where,
T= Torque in Kg-cm
N= Speed in RPM
ω= Speed in rad/sec

We have relation, v = r*ω

Where, v= Linear velocity
R= Radius
ω= Angular velocity

Diameter of shaft, d= 0.6cm
Radius of shaft, r= 0.3cm
=0.3*10^ (-2)
∴ Linear velocity, v = (0.3*10^ (-2)) * 6.24
= 0.01872 m/s
= 1.872 cm/s

Weight of vehicle = 1.200 Kg
Width of line marking= 8.0cm

4.7 BILLING

Table 4.1 Billing Table

ITEM	NO. ITEM	COST/ITEM	TOTAL COST,(R.S)
DC Motor	2	1200	2400
Micro Controller	1	350	350
Driver IC	2	100	200
IR Sensors	5	175	875
Plywood sheet	1	160	160
Aluminum shaft	5 m	40	200
Battery	1	430	430
Fasteners		25	25
Sticking Glues	2	30	60
Electronic Components			400
Arduino board	1	1350	1350
Miscellaneous	-	-	600
Outsourced cost	-	-	2500
Total			9550

CHAPTER V

ADVANTAGES, DISADVANTAGES & APPLICATIONS

ADVANTAGES

The fabricated models have following advantages while comparing with the existing models of this kind. The analyzing of advantages helps to motivate the fabrication of AGV in the manufacturing industries. The important advantages of the prototype are given below

1. Reduce manpower
2. Increase productivity
3. Eliminate unwanted fork trucks
4. Reduce product damages
5. Maintain better control of material management
6. Traffic control is not needed in this system because of single carrier
7. Suitable to transfer frames

DISADVATAGES

Each of the machines has their own demerits. During the production we had faced many problems. Much of them were solved during the assembling. But still some of them stand here, which can’t be remove. The followings are the limitations of the prototype fabricated:

1. AGVs are fragile and should be handled with care.
2. Regular care, inspection and maintenance needed
3. Should be recharged periodically

4. AGV will stop delivery when it is forced off the path.
5. Battery should be recharged during intervals.
6. Sun light affect the movement.

APPLICATIONS

Automated guide vehicle can be used in wide variety of application to transport many different types of material including pallets, rolls, racks, carts and container.

1. **RAW MATERIAL HANDLING:**

AGV is commonly used to transport raw material such paper, steel, rubber, metal and plastic. This includes transporting material from receiving to ware house and delivering material to production line.

2. **PALLET HANDLING:**

It is an extremely popular application for AGVs as repetitive moment of pallets is very common in manufacturing and distribution facilities, AGV can move pallets from the palletizer to stretch wrapping to ware house.

3. **TRAILER LOADING:**

AGVs are used to transport and load pallets of finished goods directly in to standards. AGV s can pick up pallets from conveyor's racking or staging lanes and deliver them in to the trailer.

4. **ROLL HANDLING:**

It is used to transport roll in many type of plants including paper mills convertors printers, newspapers, steel producers and plastic manufactures. AGVs can store & stack rolls on the floor.

5. **CONTAINERS HANDLING:**

AGVs are used to moves sea container in some maritime container terminal. The main benefits are reducinglabor cost and a more reliable performance.

6. **HOSPITAL:**

AGVs are becoming increasingly popular in health care industry for efficient transport and are programed to be fully integrated to automatically operate doors, elevators, patient meals and surgical case carts.

CHAPTER VI
CONCLUSION

The AGV is a productivity increasing feature in a factory. During the manufacturing of this AGV we had identified many features of intelligence that can be given to it. We provide the basic functions like line follower and collision avoidance. The main function of this project is transportation of goods from station to station. The followings are the main features of the prototype which we fabricated.

1. Speed of delivery
2. Adjustment of vehicle speed
3. Flexibility of path
4. Adaptive to changes in factory layouts
5. Avoid collision with other objects
6. Reduction in labour cost
7. Reduction in running cost compared to conveyer systems
8. Ability to add sensors to detect the payload conditions
9. Ability to adjust the lifting time
10. Continues cycle of working

Conditions for line following can be change easily Automatic Guided Vehicle can be used in a wide variety of applications to transport many different types of material including pallets, rolls, racks, carts, and containers. AGVs excel in applications with the following characteristics:

1. Repetitive movement of material over a distance
2. Regular delivery of stable loads
3. Medium throughput/volume
4. When on time delivery is critical and late deliveries are causing inefficiencies
5. Operation with at least two shifts
6. Archive Systems
7. Cross Docking
8. Distribution

9. High Density Storage
10. High Speed Sortation
11. Material Flow and Transport
12. Production and Manufacturing Delivery Systems
13. Production and Manufacturing Support Systems
14. Warehouse Management and Control
15. Work-In-Process Buffers

CHAPTER VII

FUTURE SCOPE

The objective and scope of this project is to create an AGV model that can follow a trail of line on a flat surface horizontally. This AGV model is using microcontroller to control all navigation functions during its operation. In other words, the microcontroller acts just like the brain for the model that controls all operation of the system.

The model is a three-wheeled mobile robot that has the ability to follow line on floor. There are three wheels including two driving wheels controlled by two motors and a free wheel in front that is able to rotate 360°. With three wheels both driving wheels are always in contact with the surface, because of the robot's steering relies on both its driven wheels being in contact with the surface at all times.

This project consists of four main stages which are theoretical design, mechanical fabrication, electronic hardware design and as well as algorithm design in assembly language. The matter to be considered is how the robot can follow the trail of line continuously. It is also important to choose the most suitable microcontroller, actuators, and sensors to achieve the project objectives.

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