

## Chapter 1

# INTRODUCTION

### 1.1 Introduction to AGV:

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, carts or trucks were used with human drivers. Unreliability and inefficiency in this part of the assembly line forms the weakest link. To eliminate this weak link we use AGVs.

An Automated guided vehicle system (AGVS) is a material handling system that uses independently operated, self-propelled vehicles guided along defined pathways. The vehicles are powered by on-board batteries that allow many hours of operation between recharging. A distinguishing feature of an AGVS, compared to rail guided vehicle systems and most conveyor systems, is that the pathways are unobtrusive. An AGV is appropriate where different materials are moved from various load points to various unload points. An AGV is therefore suitable for automating material handling in batch production and mixed model production. An automated guided vehicle system (AGVS) is thought to be the most suitable material handling system for the FMS owing to its potential flexibility. The desired flexibility of the AGVS has to be determined and designed before the system is built. The material handling system physically integrates the manufacturing cells and the storage/retrieval system. Therefore, any activities in the manufacturing system may directly or indirectly affect the performance of the AGVS. The achievement of the desired flexibility of the AGVS does not have a trivial solution, and should be determined by considering many different aspects. Once the desired flexibility is determined, the transportation system must be able to move parts as required within the system. The designer has to embed this flexibility somewhere in the system.

In an AGVS, those, as long as they are built-in and dealing with the transferring of Work parts from one station to any other station, belong to the AGVS mechanism. Generally speaking, the AGVS mechanism has two important parts. One is to load (unload) work parts from a station (vehicle) to a vehicle (station), which is the transfer mechanism; the other is to transport work parts from one station to any other station,

which is the travel mechanism. A city with a well-designed transportation network system can reduce its traffic problems. An AGVS with a well-designed transportation network system may also decrease those conflicts which arise from the interactions of manufacturing system activities. The transportation network is the main structure of the travel mechanism. A robust travel mechanism is the answer to the above questions. The machine mechanism has been studied by the application of physical laws governing the motion of parts and the forces transmitted by these parts, but the concept of the AGVS mechanism is new. The system environmental effects on the machine have also been extensively studied. The work emphasised the development of the AGVS components; little effort has been put into the integration of the AGVS components. A successful integration means a good combination of the system components. A good combination of the AGVS components leads to a robust AGVS mechanism.

The term "automated guided vehicle" (AGV) is a general one that encompasses all transport systems capable of functioning without driver operation. The term "driverless" is often used in the context of automated guided vehicles to describe industrial trucks, used primarily in manufacturing and distribution settings that would conventionally have been driver-operated. Since their introduction in 1955, automated guided vehicles have found widespread industrial applications. AGVs are now found in all types of industries, with the only restrictions on their use mainly resulting from the dimensions of the goods to be transported or spatial considerations. Many applications of AGVs are technically feasible, but the purchase and implementation of such systems is usually based on economic considerations.

The use of AGVs can be divided into four main areas of application: 1) supply and disposal at storage and production areas, 2) production-integrated application of AGV trucks as assembly platforms, 3) retrieval, especially in wholesale trade, and 4) supply and disposal in special areas, such as hospitals and offices. In all of these settings, AGVs have been found to reduce the damage to inventory, make production scheduling more flexible, and reduce staffing needs. But, as with any other major capital decision, implementation of these systems must be undertaken cautiously.

AGVs can carry loads or 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 motorized rollers (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). In Germany the technology is also called Fahrerlose Transport system (FTS) and in Sweden foreclose trucker. Lower cost versions of AGVs are often called Automated Guided Carts (AGCs) and are usually guided by 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.

## 1.2 Why AGV?

Automating the routine movement of goods frees up truck drivers for more demanding and flexible work, while reducing errors and accidents and rendering operations transparent. The greatest benefits are gained in multi-shift work.

- Cost effective

An AGV solution is highly cost-effective when multiple Pick & Deposit locations are required. Direct cost savings include labor savings, elimination of the costs related to product and plant damage caused by material handling, and saving the costs associated with fork trucks (e.g. training, maintenance, vehicle purchases/leases, etc.). The indirect cost savings include improved safety, increased efficiency, and improved product track recording.

- Flexible

Easy to adjust to changing transport needs and capable of handling any load from standard pallets to paper reels, tote boxes and car bodies.

- Safe

AGVs are probably the safest and most reliable means of transport available within industrial plants. The vehicle safety features must strictly apply to the safety standard EN1525: "Safety of industrial trucks – Driverless trucks and their systems".

- Expansion & Changes

Adding extra routes or vehicles to meet new layout and performance requirements is easily implemented without production loss.

- 24 Hour Service

Battery power and automatic charging ensure continuous, reliable operation.

- Reduction in Labor costs

The reduction in labor costs is simply the number of operator's times the hourly rate times the number of hours worked per year. In using the hourly rate, you should use the rate which includes all the costs like benefits, holidays, vacations, etc.

- Careful Handling

AGVs are precise in positioning, securing just-in-time, damage-free handling. The calculation for reduction in damage with guided vehicles vs. manual handling should include damage to product, racks/containers/totes, plant structure, and plant equipment (conveyors, lifts, etc.).

- Excellent trace & tracking

Product track recording is also one element in most of the quality certificates. This tracking will reduce material costs, expediting charges and "redo" orders (required to replace lost product).

- Integration

AGVs provide an excellent interface to automated production and distribution systems.

- High Availability

AGVs are virtually immune to single point failure – if one vehicle malfunctions, the rest of the fleet will continue to operate.

- Load Scheduling & Priorities

AGVs can respond to calls for pick-up and delivery, this improves material handling efficiency. Just on time.

- Accessible Layout

AGV systems keep floor areas totally accessible to pedestrians and other traffic. No blockage and less investment in fixed mechanical installations.

### **1.3 Introduction to Line follower:**

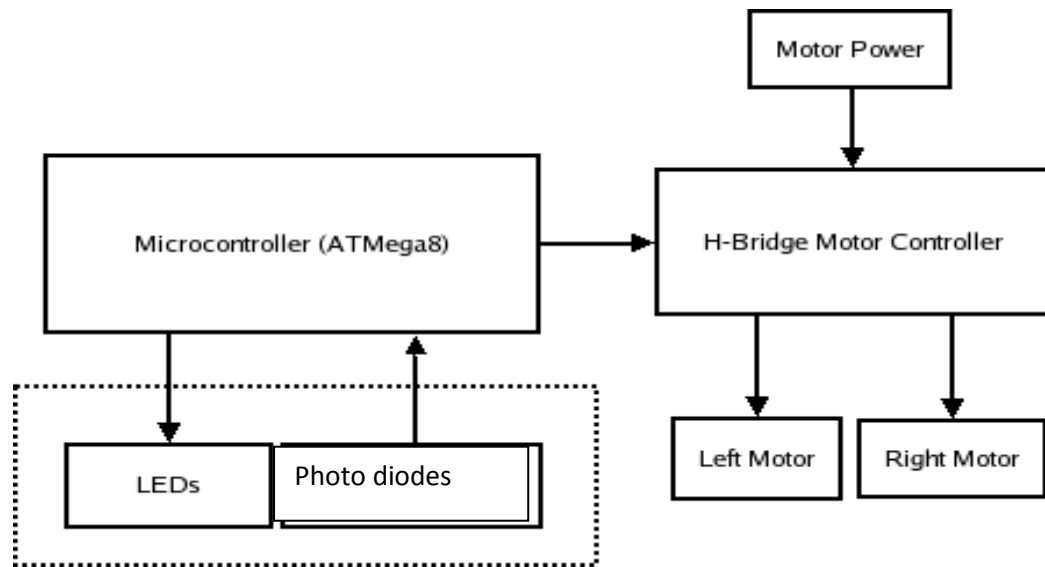
Line follower is a machine that can follow a path. The path can be visible like a black line on a white surface (or vice-versa) or it can be invisible like a magnetic field. Sensing a line and manoeuvring the robot to stay on course, while constantly correcting wrong moves using feedback mechanism forms a simple yet effective closed loop system.

Common features required for line followers:

- Follow a black line
- Stop if the line disappears
- Stop if an obstacle is present
- Do not fall off the edge of the table
- If an obstacle is present, use brute force!

All of these features for a line following robot are easy to accomplish with BEAM robots. Obviously the line following robot will need to see the line, therefore we require a light detector of some sort. We also would like it if the line following robot could do this regardless of the ambient conditions (is the room dark or light? is it lit by sunlight or artificial light?). So the robot will also need its own illumination source. The weapon of choice here will be Infra Red (IR) light. To make this easy for ourselves the light only needs to be constant, if a white line is present then it will reflect a lot of IR from our source. If the line is black then we see the opposite effect.

The sensors used for the project are Reflective Object Sensors. The single sensor consists of an infrared emitting diode and a NPN Darlington phototransistor. When a light emitted from the diode is reflected off an object and back into the phototransistor, output current is produced, depending on the amount of infrared light, which triggers the base current of the phototransistor. In many case, the amount of light reflected off a black line is much less than that of a white background, so it can detect the black line somehow by measuring the current.



**Figure 1.1** Block diagram of Line Follower

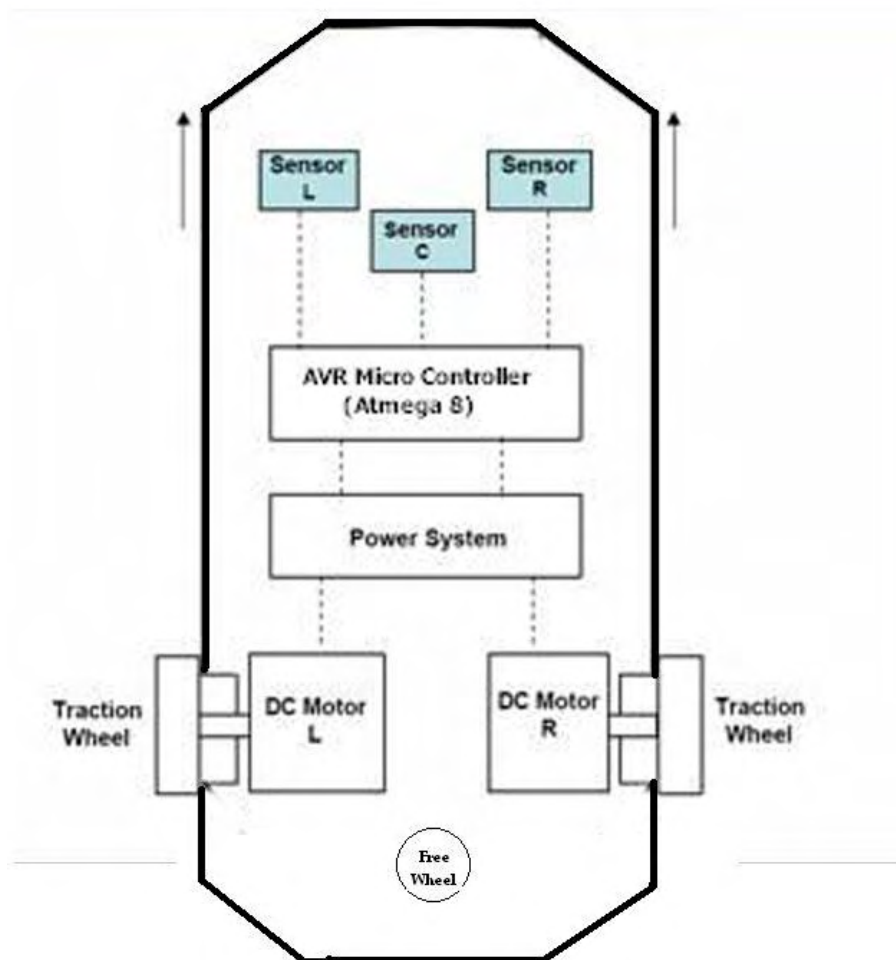
The robot has sensors installed underneath the front part of the body, and two motors drive wheels moving forward. A circuit inside takes input signal from sensors and controls the speed of wheels' rotation. The control is done in such a way that when a sensor senses a white background, the motor slows down or even stops. Then the difference of rotation speed makes it possible to make turns.

Main components used in line follower:

- Sensor circuit
- AVR microcontroller (ATmega8)
- H-Bridge Motor controller
- DC motors

The line following robot, operates as the name specifies. It is programmed to follow a dark line on a white background and detect turns or deviations and modify the motors appropriately. The sensor is an array of 3 IR LED-Phototransistor pairs arranged in the form of an inverted V. The output of each sensor is fed into an analog comparator with the threshold voltage (used to calibrate the intensity level difference of the line with respect to the surface). These 3 signals (from each photo-reflective sensor) is given to a priority encoder, the output of which to the microcontroller.

The core of the robot is the AVR microcontroller (ATmega8). The speed control of the motors is achieved by the two PWM modules in the  $\mu\text{C}$ . The direction control is provided by 2 I/O pins. The H-Bridge motor driving/control chip takes these signals and translates it into current direction entering the motor armature. The motors require separate supply for operation.



**Figure 1.2** General structure of line follower

The differential steering system is used to turn the robot. In this system, each back wheel has a dedicated motor while the front wheels are free to rotate. To move in a straight line, both the motors are given the same voltage (same polarity). To manage a turn of different sharpness, the motor on the side of the turn required is given lesser voltage. To take a sharp turn, its polarity is reversed. The actual action is caused by

controlling the direction/speed of the two motors (the two back wheels), thus causing a turn.

## **1.4 Statement and Objective :**

Line follower is a machine that can follow a path. The path can be visible like a black line on a white surface (or vice-versa) or it can be invisible like a magnetic field. Sensing a line and manoeuvring the robot to stay on course, while constantly correcting wrong moves using feedback mechanism forms a simple yet effective closed loop system. The line follower has sensors installed underneath the front part of the body, and two motors drive wheels moving forward. A circuit inside takes input signal from sensors and controls the speed of wheels' rotation. The control is done in such a way that when a sensor senses a white background, the motor slows down or even stops. Then the difference of rotation speed makes it possible to make turns.

### **Objective:**

- To maintain the activation of both motors corresponding to lateral (L&R) sensors instantly hence retain the automated guided vehicle on the pathways consistently.
- To resolve the difficulty due to central sensor.
- To make use of micro-controller unit to activate the both lateral motors to resolve malfunctioning of lateral sensors takes place.
- To make use algorithms in the operation process monitoring which plots curve line gives directions related to movements.
- To eliminate the difficulty if the movement of the vehicle against obstacles on the pathway by making use of Infrared Sensors.