Automatic Guided Vehicle

ME 714 - CIM
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Outline

AGVs: Introduction & Applications

Navigation Technologies used in AGVs

Line Follower AGVs

Industrial Navigation of AGVs

CAD Model of the AGV

IR Sensors

PID Controller

Video & Simulation

Problem Statement

- ➔ Research about existing AGVs
- ➔ Making a CAD of the AGV using SolidWorks
- ➔ Simulating a line follower
- ➔ Making a prototype using Line following mechanism:

1) IR sensors identifying the line of the vehicle
2) PID controller for changing the direction and travelling

AGVs (Automatic Guided Vehicles)

- ➔ AGVs are load carriers, travelling without a driver
- ➔ A combination of software and sensor-based guidance systems direct their movements
- ➔ AGVs have gained popularity in the recent years due to:

1) Repeatability
2) High control
3) Less human interference
4) Reduction in labour costs

Applications of AGVs

- ➔ Raw material handling
- ➔ Intermediate product handling
- ➔ Hazardous material handling
- ➔ Heavy objects handling
- ➔ Final products handling
- ➔ Medical & Pharmaceutical industry

Types of Navigation

- **Wired:** Wire laid inside cut slot, which transmits radio signal making the AGV follow a specific path
- **Guiding tape:** Magnetic tapes and Coloured tapes, appropriate sensors are used to detect the path
- **Laser target:** Reflective tapes at various locations, the AGV has a laser transmitter and receiver
- **Inertial:** Internal gyroscopes used to detect the change in direction and give necessary inputs
- **Vision control:** Uses recorded video of features along the route and uses this to control the path

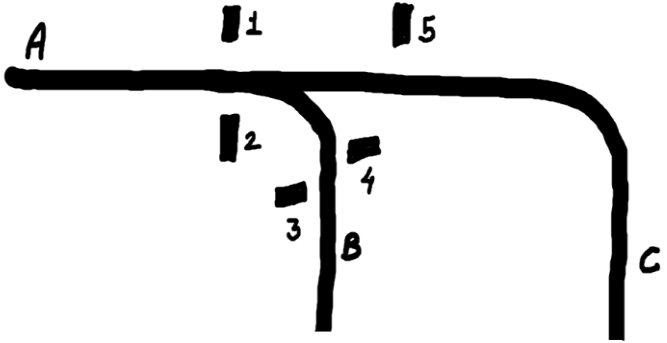
Guide Tapes: Line Follower AGVs

- ➔ There are two principles used in guide tapes:

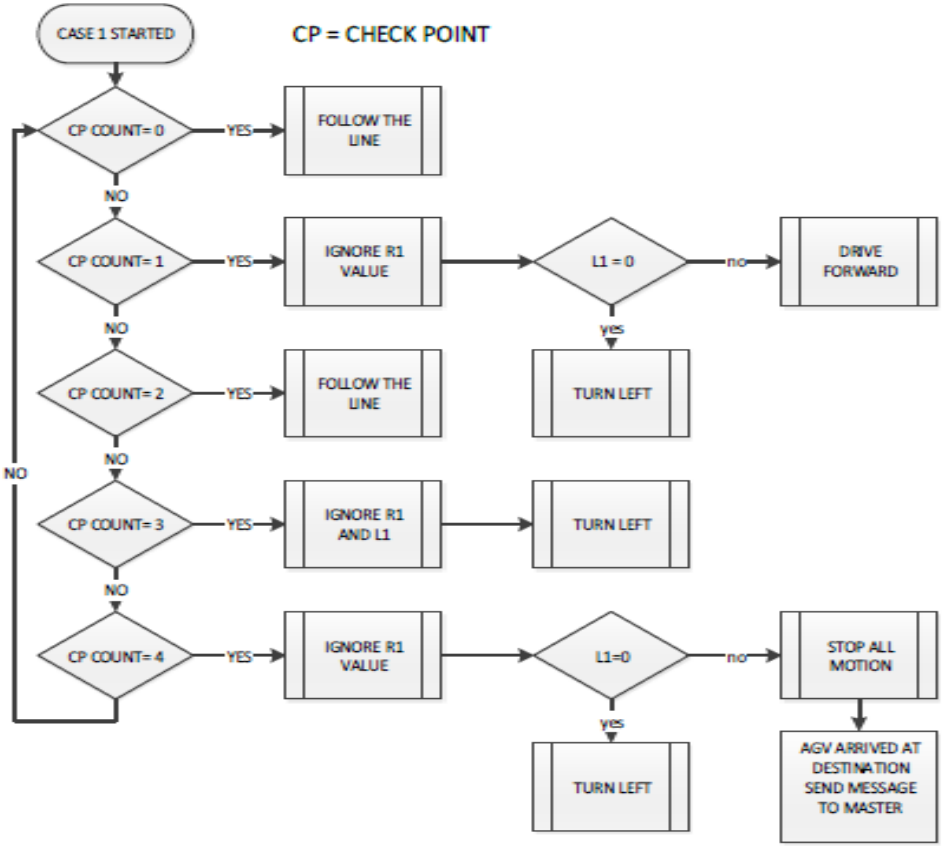
1) Magnetic tapes
2) Coloured tapes

- ➔ In both these types, appropriate sensors are used to detect the path
- ➔ Tapes can be relocated if change in path is required
- ➔ Coloured tapes are very inexpensive but can get damaged very easily & may need replacing

AGV Navigation

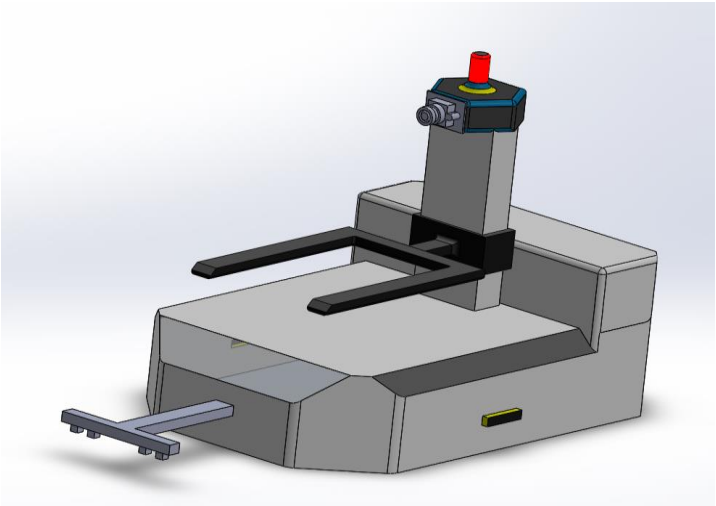


Industrial example of an AGV Navigation

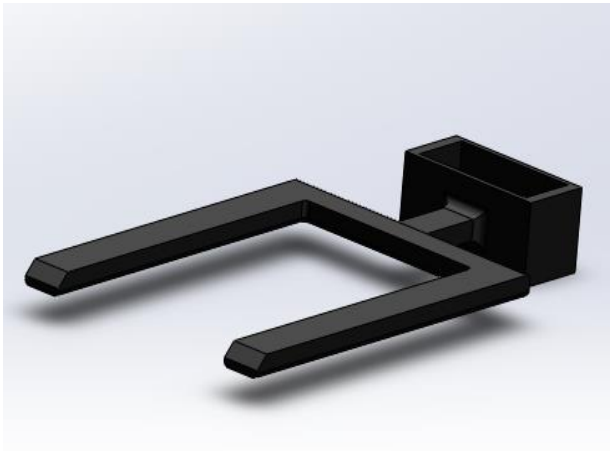


Our Prototype

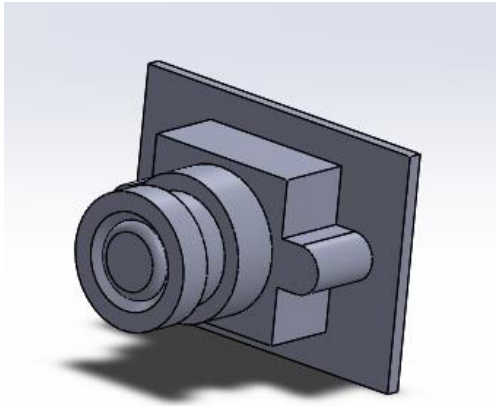
AGV: CAD Model



CAD Model of an AGV



Robotic lifting arm



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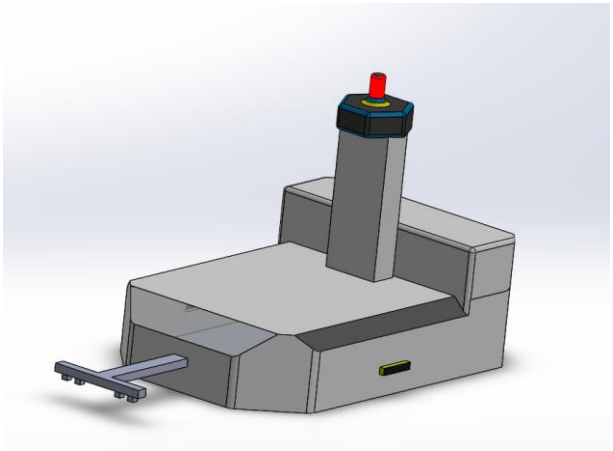
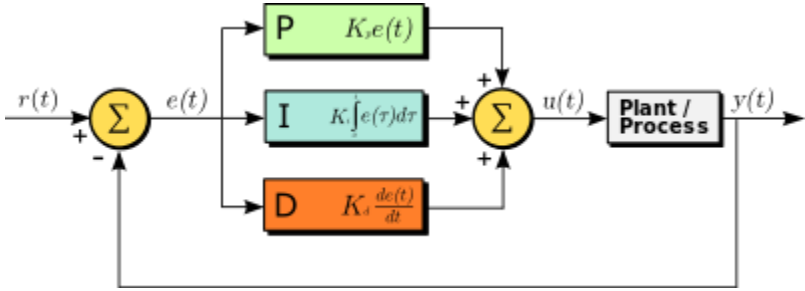


Main vehicle

IR Sensors

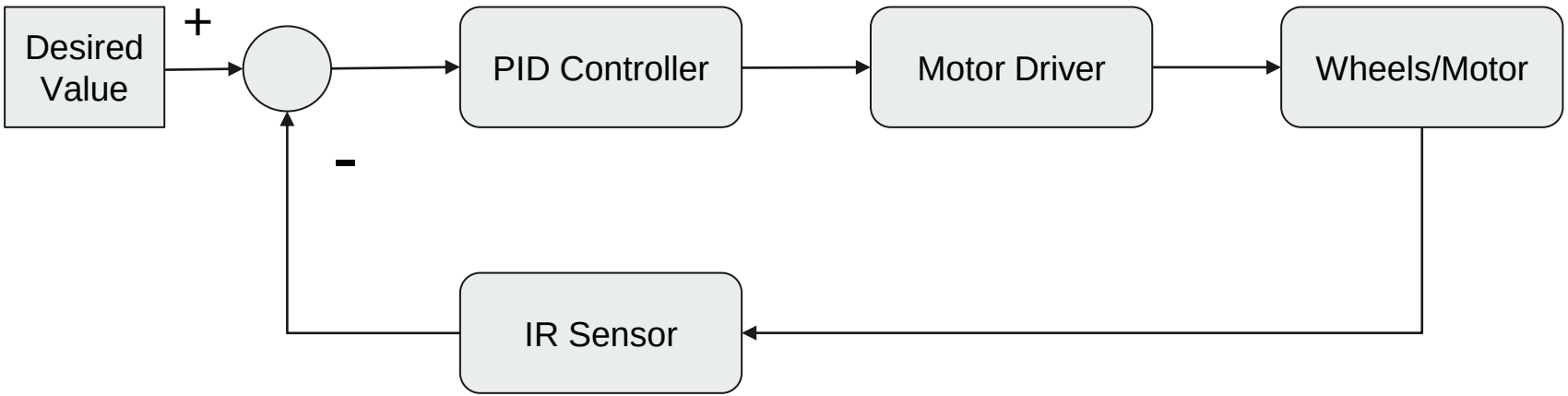
- ➔ Sensors are required to detect position of the line to be followed with respect to the robot's position
- ➔ Most widely used sensors for the line follower robot are photosensors
- ➔ "The white surface reflects the light and the black surface absorbs it"
- ➔ IR sensors are used preferably to avoid interference with visible light
- ➔ Sensor circuit contains an emitter and a detector. Photodetector is used to detect the intensity of light reflected. The corresponding analog voltage is induced based on the intensity of reflected light
- ➔ The analog voltage is converted to digital voltage by ADC

PID Controller



- A Proportional–Integral–Derivative controller (PID controller or three-term controller) is a control loop mechanism employing feedback
- Error value e(t) as the difference between a desired setpoint [SP = r(t)] and a measured process variable [PV=y(t)]. So, e(t)=r(t)-y(t)
- Term P is proportional to the current value of the SP − PV error
- Term I accounts for past values of the SP − PV error and integrates them over time to produce the I term
- Term D is the best estimate of the future trend of the SP − PV error, based on its current rate of change

Control Loop

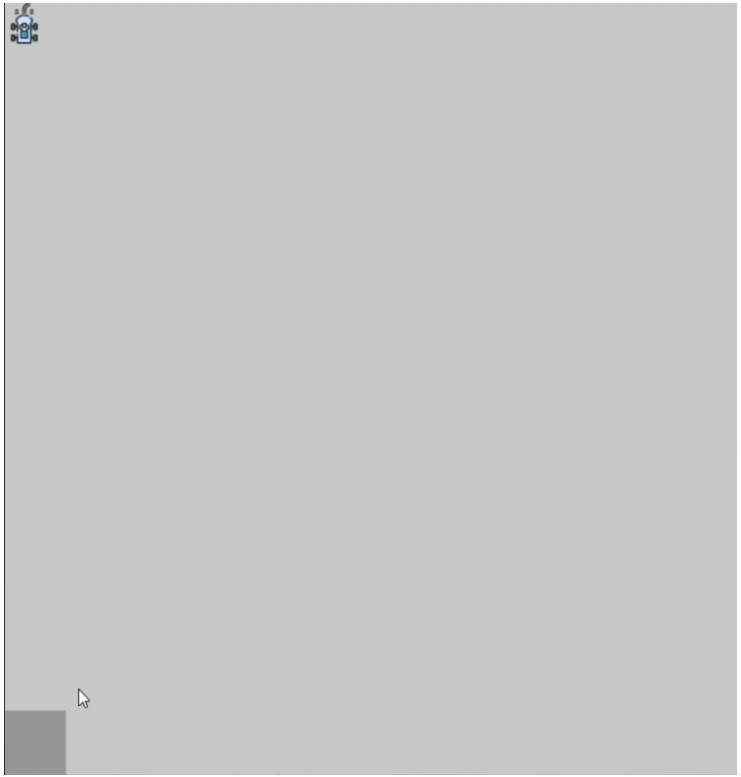


Video & Simulation

- **Prototype Video:** https://drive.google.com/file/d/1bUWcbWhm8hWQvqSjaGneLKYYBGbxuOWb/view?usp=sharing

Video & Simulation

- **Simulation Video:** https://drive.google.com/file/d/1Bh15w4bdqqDB3SJEKmXUUqOJQ6U4W66E/view?usp=sharing



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Thank you

Have a nice day!