# Wall Following Logic

### Slide 1: Algorithms and Logic

LiDAR stands for Light Detection and Ranging. It’s a remote sensing method that measures distances by emitting laser light and analyzing the reflected signals. We use LiDAR to detect distances in specific directions, which helps the robot ‘see’ its environment.

It is mostly used in robotics for navigation and obstacle detection.

Slide 2: Sensor on turtle bot slide:

Our robot uses a 360° LiDAR system to scan the surrounding area continuously, providing distance measurements in all directions.

1. The sensor emits a laser beam toward an object.
2. The beam hits the object and reflects back to the sensor.
3. The sensor calculates the distance based on the time taken for the light to return (time-of-flight principle).

Since it uses lasers, LIDAR can operate in the dark, unlike cameras that rely on bright light.

### Slide 3: LiDAR Wall Following Angles

This slide explains the wall-following logic.

how

* The LIDAR detects the distance between the robot and the walls on its sides.
* It identifies objects directly in front of the robot, helping it stop or re-route.

- Front (355° to 360°): Detects obstacles directly ahead.  
- Front-Left (0° to 70°): Measures proximity to the left wall.  
- Front-Right (270° to 340°): Measures proximity to the right wall.  
- Side Distances: Detects the end of walls.

This logic is important for autonomous navigation, ensuring the robot avoids obstacles and adjusts its path based on environment.

### Slide 4: Decision Making

This slide outlines the decision-making process in three steps, based on LiDAR distance measurements:

1. If an obstacle is detected in front at a minimum distance of 0.15 meter, the robot stops.  
2. If the left/right distance is too small (0.03 meter), the robot adjusts using angular velocity:  
 - Right turn: +0.65 meters/second  
 - Left turn: -0.65 meters/second  
3. Move Forward: When the path is clear, it moves with a linear velocity of 0.5 meters/second.

These decisions are important for the robot to navigate safely in a dynamic environment.

## Line Following Logic

This slide explains the line-following algorithm using camera data processed with OpenCV.

The RGB(red, green and blue) image is converted to HSV(hue, saturation and value) to detect a specific color (e.g., green).

- Detects contours in the masked image and identifies the largest one.  
- Computes the centroid of the contour and calculates the error relative to the camera center.  
- A Proportional-Integral-Derivative (PID) controller adjusts the robot's angular velocity to correct the error and stay on the path.  
- Velocity limitation is from 0.65 meter/sec to -0.65 meter/sec

This logic allows the robot to follow a predefined line, mostly used in scenarios like maze solving or path-following tasks.

## Conclusion

By integrating LiDAR and PID-controlled camera systems, the robot can navigate using wall-following and line-following logic. The LiDAR ensures precise distance detection for walls and obstacles, while the PID controller ensures smooth corrections for line tracking.