

Concepts in Mobile Robots

Course Objectives	<ul style="list-style-type: none">• Gain proficiency about AI and IoT based Mobile Robot Applications• Provides a hands-on project based experiential learning for individuals• Offers a complete step by step guidance to the creation of an Autonomous Mobile Robot
Course Outcomes	<ul style="list-style-type: none">• Design and manufacture a custom micro controller board using Open-Source Hardware for robotic applications by integrating Industry 4.0 facility.• Utilize various concepts such as interrupts and interface sensors and actuators in programming.• Programmatically fuse multi sensor data and develop algorithms for controlling robots.• Build a robot by Integrating various sensors and actuators with a mechanical system to complete the given task.• Demonstrate building of basic mobile robot and develop path planning and navigation using RoS and visualize in RVIZ/ Gazebo.

Course Duration: 45 Hours

Course Content:

Unit 1: Mobile Robotic System: Anatomy

Types, Kinematics, Navigation Methods, Locomotion, SLAM Mechanism, Localization

Unit 2: Sensors in Mobile Robots

Types, Sensor Mapping and Scaling, Calibration and Interfacing, Time of Flight

Unit 3: Controllers & Actuators

Electrical Drives, Pin Configuration of Microcontroller, Grippers and its Mechanisms

Unit 4: Applications

Wheeled and legged Robots, Facial expression, Hands and Manipulation, Human activity Recognition using Vision and Voice, Cobots

Unit 5: IDE & ML Programming and Mobile Robots Project Development

Installation, Sketch Basic Structure, Embedded Codes, ML Techniques, Interfacing with Controller. Design and Development of 9 Mobile Robots for Industrial and Commercial Applications

Test Projects:

Use Cases

1. Designing of an Autonomous Automated Guided Vehicle Mobile Robot for Industrial Material Handling Processes: Selection of Sensors, Actuators, Drives, Controller with Pin Configuration, Assembling of Robot Body and Chassis
2. Implementation of Laser Target Navigation Method using Ultrasonic and LIDAR Sensor: Circuit Designing & Connection, Sensor Kinematics and its Calculations, Integration with Controller, Software Initialization and Setup
3. Implementation of Laser Target Navigation Method using Ultrasonic and LIDAR Sensor: Software Programming (Embedded C) to read the values from Sensor, Sensor Scaling and Mapping

4. Autonomous Robot Locomotion: Interface of Motor Driver with DC Gear Motors, Identifying Driver Pin Purpose and Circuit Connection
5. Autonomous Robot Locomotion: Interface of Motor Driver, DC Gear Motor with Controller, Controller Programming to establish a communication, speed testing & calibration, direction controlling.
6. Selection of Power Source: Testing the Operating and Input Voltage, Current Rating of Sensors, Driver, Motors and Controller, Selection of Battery based on the ratings and final integration
7. Implementation of Laser Target Navigation Method using Ultrasonic and IR Sensor and Robot Locomotion using DC Gear Motors: Path Planning, Obstacle Detection & Recognition, Obstacle Avoidance, Speed Controlling based on the Obstacles.
8. Full Robot Assembly and Circuit Connection: Interface of Sensors, Actuators, Driver, Battery with Controller
9. Autonomous Mobile Robot Final Sketch: Creating a full code to make the robot moves physically based on the sensor values and calibrating autonomously in real-Time
10. Alpha & Beta Testing: Identifying and adjusting the robot motion based on the sensor performance and its tracking
11. Building an Autonomous Mobile Robot without using Controller and Interfacing of Programming for Industrial Material Handling Processes
12. Adding an Array Sensor and build a RF Navigation Autonomous Robot for Industrial Material Handling Processes: Interfacing of Array Sensor and Actuators with Controller with Programming with real-time simulation
13. Adding an IR Sensor and build an Autonomous Robot for Edge and Surface Detection for Industrial Material Handling Processes: Interfacing of IR Sensor and Actuators with Controller with Programming
14. Adding a Proximity Sensor and build an Autonomous Robot for Home Surveillance and Household Applications: Interfacing of Proximity Sensor and Actuators with Controller with Programming with real-time simulation
15. Designing of IoT based Mobile Robot: Controlling the Robot using Text Commands, Designing of Mobile App, Interfacing of BLE/WIFI Modules, Actuators with Controller with Programming with real-time simulation
16. Designing of Voice Controlled Mobile Robot: Controlling the Robot using Voice Commands, setting up and Training of Voice Commands, Designing of Mobile

App, Interfacing of BLE/WIFI Modules, Actuators with Controller with Programming with real-time simulation

17. Implementation of Vision Camera for AI based Autonomous Self Driving Car Applications: Obstacle Shape and Size Tracking using OpenCV Python Tools (Software Programming and Simulation)
18. Gesture and Face Controlling Mobile Robots using AI: Implementing AI and ML algorithms to control the motion of Robot (Hardware Setup, Software Programming and Simulation)
19. Designing of Advanced Hybrid Mobile + Industrial Robot using AI: Component Selections, Circuit Connection, Controller Programming, ML Algorithm Coding, Training the data sets
20. Implementing a real time movable pick and place robot for Industrial and Commercial Material Handling Purpose (Advanced Cobot)