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| ROBOT OPERATING SYSTEM (ROS) | | | |
| Day/Session | Topic | Description | Task |
| 1 | **INTRODUCTION** | * What is ROS? * Why we prefer ROS for robots | Basic information about ROS and its history and future applications, etc. |  |
| 2 | **Catkin** | * Creating a workspace for catkin * Creating a ROS package * Building and using catkin packages in a workspace | Introduction to catkin tool chain and its architecture. Creation and building of workspace. |  |
| 3 | **ROS computation graph level** | * ROS nodes * ROS messages * ROS topics * ROS services * ROS bags * Understating ROS Master and ROS parameter server | ROS terminologies and their uses are discussed |
| 4 | **Creating and Building a ROS Package** | * Creating a catkin Package * Building a catkin workspace and sourcing the setup file * package dependencies * Customizing the Package * Building the package | This chapter covers using roscreate-pkg or catkin to create a new package, and rospack to list package dependencies and toolchain to build a package. |
| 5 | **Understanding ROS Nodes** | * Prerequisites * Quick Overview of Graph Concepts * Nodes * Client Libraries * roscore * using rosnode and rosrun | This chapter introduces ROS graph concepts and discusses the use of roscore, rosnode, and rosrun commandline tools. |
| 6 | **Understanding ROS Topics** | * Setup * ROS Topics * ROS messages * Using rqt\_plot | This chapter introduces ROS topics as well as using the rostopic and rqt\_plot commandline tools. |
| 7 | **Understanding ROS Services and Parameters** | * **ROS Services** * **Using rosservice** * **Using rosparam** | This tutorial introduces ROS services, and parameters as well as using the rosservice and rosparam commandline tools. |
| 8 | **Using rqt\_console and roslaunch** | * Prerequisites rqt and turtlesim package * Using rqt\_console and rqt\_logger\_level * The Launch File | This tutorial introduces ROS using rqt\_console and rqt\_logger\_level for debugging and roslaunch for starting many nodes at once. |
| 9 | **Creating a ROS msg and srv** | * Introduction to msg and srv * Using msg & rosmsg * Using srv & rossrv * Common step for msg and srv | This tutorial covers how to create and build msg and srv files as well as the rosmsg, rossrv and roscp commandline tools. |
| 10 | **Writing a Simple Publisher and Subscriber** | * Writing the Publisher Node * Writing the Subscriber Node * Building the nodes * Running the Publisher * Running the Subscriber | This tutorial covers how to write and run a publisher and subscriber node in C++/python. |
| 11 | **Writing a Simple Service and Client** | * Writing a Service Node * Writing the Client Node * Building the nodes * Running the Service * Running the Client | This tutorial covers how to write and run a service and client node in C++/python. |
| 12 | **Exercises in publisher, subscriber and server, client** | * Make the turtle bot to draw circle * Further examples on Service and Client nodes | Exercises were given to students to make them familiar with ROS |
| 13 | **Interfacing of Arduino with ROS** | * Understanding the Arduino-ROS interface * Setting up the interface package | Arduino board is interfaced with ROS by installing ros libraries in arduino IDE |
| 14 | **Arduino-ROS example programs** | * Chatter and Talker * Blink LED and PUSH button * Ultrasonic distance sensor | In this chapter various applications were done using ROS and Arduino board |
| 15 | **Getting started with vision sensor and ROS** | * ROS-OpenCV interfacing package * Interfacing USB webcam with ROS | ROS-OpenCV package is installed and its features are discussed |
| 16 | **Programming vision sensor using ROS and OpenCV** | * Working with ROS camera calibration * Converting image between ROS and OpenCV using CVbridge * Displaying image from webcam using OpenCV and CVbridge | The calibration of USB webcam is done using ROS camera calibration node and the output obtained from the camera is viewed using ROS package |
| 17 | **ROS package for robot modelling** | * Robot\_model * URDF * Joint\_state\_publisher * Kdl\_parser * Robot\_state\_publisher | The components of ROS robot modelling package are discussed |
| 18 | **Robot modelling using URDF** | * Link * Joint * Robot * gazebo | The important URDF tags are discussed |
| 19 | **Developing ROS package for robot description** | * Creating URDF model for simple robot * Visualising the robot in rviz * Interacting with pan&tilt joints | A robot description package is developed for simple robot with 2 DOF |  | |
| 20 | **Adding physical and collision properties to the URDF model** | * Addition of collision parameters * Addition of inertia parameters | The real physical and collision properties are added to the URDF model |