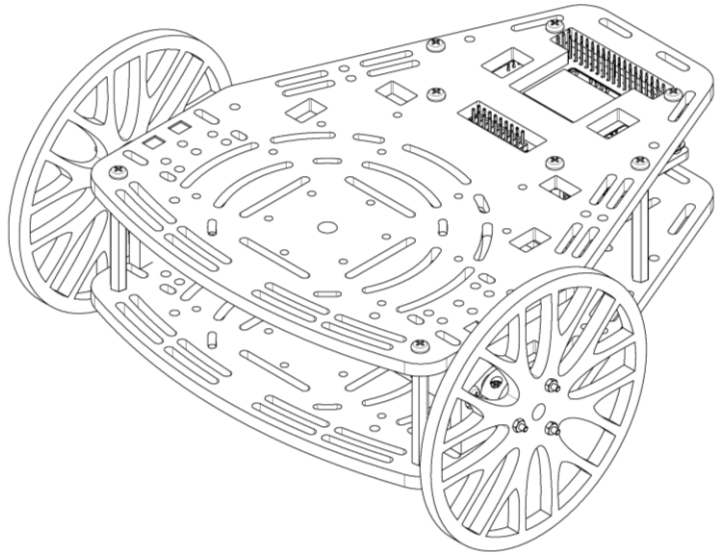
TE3001B: Robotics Foundation

Course description

{Learn, Create, Innovate};

Introduction

- This course, developed by Manchester Robotics ltd. (MCR2), introduces the basic concepts and general knowledge of the ROS environment to the user.
- This course is divided into five session, carefully designed for the user to learn about the different aspects of ROS from topics and messages to control and simulation and simulation using ROS..
- This course will be based on challenges to make the student aware of ROS basics and ROS communication with hardware.

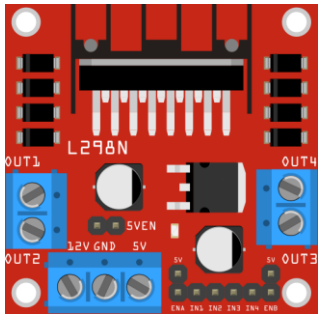


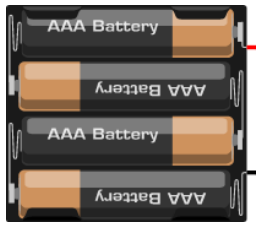
General Requirements

These are the general requirements. A set of requirements for each session will be shown in the following slides. (Some items may be repeated)

- Computer with access to Zoom (online classes).
- Computer with Ubuntu 18.04 and ROS Melodic or MCR2 virtual machine (installation instructions in the presentation MCR2_VM_ROS).
- Knowledge of Windows.
- Basic knowledge of Ubuntu (recommended).
- Basic understanding of robotics (recommended).
- Access to Hackerboard and a MCR2 DC motor.
  - In case you have no access to the Hackeborad, can be replaced for an Arduino Mega, a L298n Motor Driver and a DC motor brushed with encoder (More information in Session 2 Slide)

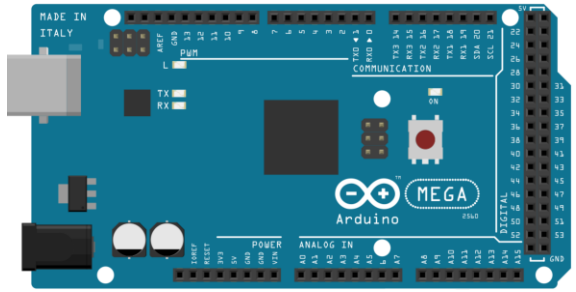
Motor Driver
L298n (Steren)





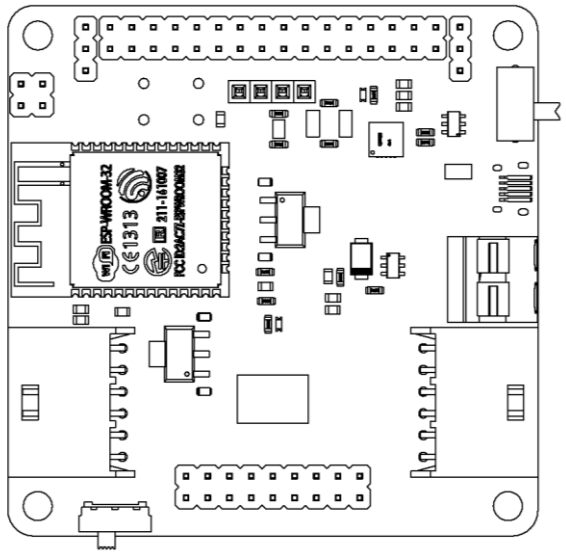
Battery Pack
5 to 12 V

Arduino Mega

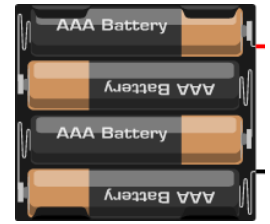


Dupont Wires
(M-F, M-M)

6VDC Brushed Motor
(Puzzlebot motor or equivalent)



MCR2
Hackerboard



Battery Pack
or Power bank
5 to 12 V

6VDC Brushed Motor
(Puzzlebot motor or equivalent)

Week 1: Introduction

Session 1:

- Who we are? Introduction to MCR2.
- Introduction to Robotics
- Introduction to VM, Ubuntu

Session 2:

- Introduction to ROS
- Overview of the ROS Environment: Topics, messages, ROS.
- Activity 1 (Talker and Listener)
- Launch files
- Activity 2: Launch Files
- Q&A
- Mini challenge: Generate a node that send a signal to another node to process it.

Requirements

- Computer with access to Zoom.
- Have Ubuntu 18.04 and ROS Melodic Installed (Full installation). Instructions on how to install Ubuntu and ROS can be found in the presentation MCR2_VM_ROS.
- In case Ubuntu 18.04 cannot be installed, MCR2 offers a Virtual Machine with ROS preinstalled (installation instructions in the presentation MCR2_VM_ROS).

Week 2: ROS Practicalities

Session 1:

- ROS Namespaces
- ROS Parameter Server
- Activity 1: Parametrise previous nodes
- ROS Custom Messages

Session 2:

- Control Basics: Continuous time only/ no theory just practicalities.
- Q&A
- Mini challenge: P/PI Controller from scratch to a 1st order simulated system.

Requirements

- Requirements of Session 1.

Week 3: ROS-Hardware Communication

Session 1:

- Motor Control Theory
- ROS Serial
- Arduino
- ROS Serial/Arduino Communication.
- Mini Challenge: Motor Speed regulation using ROS.

Session 2:

- Q&A Session.

Requirements

- Requirements of Session 1.
- Installation of the Arduino IDE and the Rosserial package in the VM or Ubuntu (See instructions on Session2 MCR2_Arduino_IDE_Confirguration),
- Access to Hackerboard and a MCR2 DC motor.
- In case you have no access to the Hackeborad, the hardware can be replaced for an Arduino Mega, a L298n Motor Driver and a DC motor brushed with encoder.

Week 4: ROS Data Acquisition

Session 1:

- Encoder Basic Theory
- Mini Challenge: Acquire data from the encoders using Arduino.
- Presentation of the Challenge: PID Controller using ROS and compare with simulation.

Session 2:

- Q&A Session.

Requirements

- Session 1 Requirements.
- Session 3 Requirements.

Week 5: Final Challenge

Session 1:

- Q&A Session.

Session 2:

- Final Challenge Presentation.

Requirements

- Session 1 Requirements.
- Session 3 Requirements