Final Year Project

**Full unit – Report**

**Installation and Configuration of ROS and the F1Tenth Simulator**

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# ­­­Introduction

In this report, I will be discussing the installation and configuration process to be able to use the ROS environment and implement it within the F1Tenth simulator that will be used within this project. From installation of a virtual machine, use of Linux operating system, to installing the necessary packages and software to use the F1Tenth simulator.

# Installation of Ubuntu Operating System

To use the ROS environment and F1Tenth simulator, the most stable way to use it is within the Ubuntu OS. This is because the simulator is only supported in Ubuntu at this moment in time, while ROS can only run natively in Linux [1]. Before installing the F1Tenth simulator, ROS is one of the prerequisites. Since the work on this report will be done locally, installing Ubuntu on a virtual machine would be most suitable.

## Installing Oracle VM VirtualBox

The Virtual Machine used will be Oracle VM VirtualBox (version used for this project is 6.1.38), which can easily be installed from their official website, selecting either the current most stable version (as of 22/11/2022, version 7.0.x is the most recent version), or selecting older version of the software from their website[[1]](#footnote-1). The installation type depends on the host OS. Having VirtualBox set-up is a pre-requisite, with the installation software having easy to follow steps.

## Ubuntu Installation – Version 18.04 LTS (Bionic Beaver)

To be able to emulate Ubuntu on the VM, it is required to install an ISO image file of the wanted OS as a pre-requisite, in our case Desktop image of Ubuntu Version 18.04 LTS (Bionic Beaver)[[2]](#footnote-2), the use for this specific version will be explained in the “Installation & Configuration of ROS Environment” section. This will download all the required installation files necessary for the Ubuntu OS that will be used in the next section.

## Ubuntu Virtual Machine Set-up on VirtualBox

Configuration of this program should be followed from the Oracle VirtualBox official documentation [2], with in-depth information regarding set-up of virtual machines after downloading the program. Once in the program, Press the ‘new’ button to create a virtual machine:

1. This will take you to a screen (Figure 1) where you enter the name of your VM, Type of OS and the OS version. In ‘Type’ select ‘Linux’ and ‘Version’ select ‘Ubuntu (64-bit)’.
2. Next, select the amount of RAM memory you wish to use for the VM and press next.
3. Afterwards, you need to create a new virtual hard disk for storage in the VM, select ‘Create a new hard disk now and select create.
4. In the next screen, select hard disk type ‘VDI (VirtualBox Disk Image)’.
5. For storage on physical hard disk section, allow storage to be ‘Dynamically Allocated’
6. Allow file location to remain default and select hard disk size (recommended 20GB)
7. Once created, go into settings:
   1. System 🡪 Processor, select Processor amount (4 Cores recommended)
   2. Display 🡪 Screen, select Video Memory to max
8. The virtual machine is now launchable, select Start for further set up of the VM
9. VM opened (Figure 2), select icon circled and find the ISO Image File saved on PC and press start
10. The final step is to follow the installation of Ubuntu so it can now be used within the virtual machine

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Figure 1 - Creation of new Virtual Machine

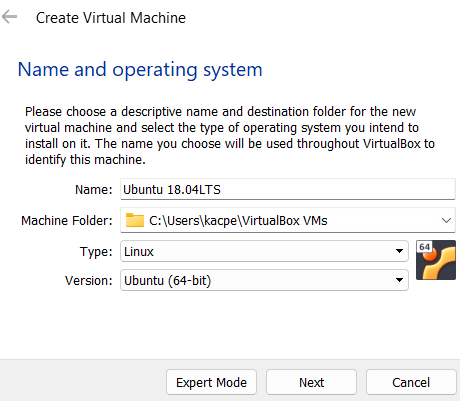


Figure 2 - New virtual machine start-up containing Ubuntu OS

After following these steps, you now can set up the ROS environment and the F1Tenth simulator that will use ROS.

# Installation & Configuration of ROS Environment

After the successful launch of the virtual machine, with full support of Ubuntu OS, the next step is to download all the required ROS packages. The ROS packages have been built on the Debian package format system, which is supported on Linux. To complete this installation, it required to use the terminal built in to download and configure all necessary files.

Within the F1Tenth build webpage, it is stated that the version of ROS required is ROS Melodic [1] , which is most stable within the Ubuntu 18.04 LTS Operating System, hence why this version was chosen.

The first step in set-up is to configure the Ubuntu system repositories to allow “restricted”, “universe” and “multiverse”. This can be done by opening Ubuntu Software & Updates and selecting all the required boxes (Figure 3)

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Figure 3 - Ubuntu repository configuration screen

The next step is to set-up the system to accept software from “packages.ros.org”. This sets up your system to allow these “.deb” packages to work on the machine. To do this, you must enter this command within the terminal:

sudo sh -c 'echo "deb http://packages.ros.org/ros/ubuntu $(lsb\_release -sc) main" > /etc/apt/sources.list.d/ros-latest.list'

Next, key set-up is needed and installation of curl – a tool for transferring data from server to host machine and vice versa, which will be used to transfer the GitHub content for ROS and use it to set up as a key.

sudo apt install curl # if you haven't already installed curl

curl -s https://raw.githubusercontent.com/ros/rosdistro/master/ros.asc | sudo apt-key add –

Now for installing ROS packages, you must first check that the package index of Debian is up to date by entering:

sudo apt update

Once the package index is up to date, the installation process can now begin. The recommended installation will be downloading the full desktop, which offers many different ROS tools and libraries, such as 2D/3D simulators and perception (which is one of the needed libraries for the F1Tenth simulator). This can be done by entering:

sudo apt install ros-melodic-desktop-full

Once installation is successful, you can check to find all the packages – in case any are missed out – installed by typing:

apt search ros-melodic

After installation, setting up so that the ROS environment variables are automatically added to the terminal when a new shell is launched, for easy use of ROS tools and software. This is done by entering:

echo "source /opt/ros/melodic/setup.bash" >> ~/.bashrc

source ~/.bashrc

If not necessary, you can change the environment of the current shell each time by typing:

source /opt/ros/melodic/setup.bash

It is later recommended to install additional dependencies for managing ROS workspaces, any necessary tools and requirements that are separate from the installation of ROS Melodic. This is done by:

sudo apt install python-rosdep python-rosinstall python-rosinstall-generator python-wstool build-essential

Finally, to use many of ROS’ tools, ‘rosdep’ needs to be initialised:

sudo apt install python-rosdep

To initialise rosdep:

sudo rosdep init

rosdep update

With ROS installed, the final section is to install the simulator itself.

# Installation of F1Tenth Simulator

With all the pre-requisites installed, the simulator will also be downloaded using terminal commands. Firstly, there are ROS dependencies that are required to run the simulator, all of which are from the ROS environment. This can be done through this command:

sudo apt-get install ros-melodic-tf2-geometry-msgs ros-melodic-ackermann-msgs ros-melodic-joy ros-melodic-map-server

Once completed, the next step is to install the simulator package. this is done by cloning the GitHub repository for this simulator onto a catkin workspace folder. A catkin folder is used to modify, build and install catkin packages, which is used within ROS, this folder needs to be created, then have the repository cloned into it.

mkdir ~/catkin\_ws

mkdir ~/catkin\_ws/src

cd ~/catkin\_ws/src

git clone <https://github.com/f1tenth/f1tenth_simulator.git>

Then catkin\_make command needs to be run to build the simulator:

cd ~/catkin\_ws

catkin\_make

source devel/setup.bash

The simulator is now ready to run through the command:

roslaunch f1tenth\_simulator simulator.launch

This command will launch all the required tools needed for the simulation: roscore, the simulator, a preselected map, a model of the racecar, and the joystick server [1].

Graphical user interface, application

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Figure 4 - F1Tenth simulator launched

# Bibliography

[1] J. Benson, Ed., “F1Tenth Build - Build Documentation,” f1tenth.org, 2020. [Online]. Available: https://f1tenth.org/build.html. [Accessed: 22-Nov-2022]. F1Tenth Community in the University of Pennsylvania compiled this documentation

[2] “Oracle® VM VirtualBox® - User Manual,” virtualbox.org, 2004. [Online]. Available: https://www.virtualbox.org/manual/UserManual.html. [Accessed: 22-Nov-2022]. Sections 1.5 to 1.8 of the documentation are relevant

[3] “Ubuntu install of ROS Melodic,” ros.org, 25-Mar-2020. [Online]. Available: http://wiki.ros.org/melodic/Installation/Ubuntu. [Accessed: 22-Nov-2022].

1. <https://www.virtualbox.org/wiki/Downloads> - VirtualBox download section. [↑](#footnote-ref-1)
2. <https://releases.ubuntu.com/18.04/?_ga=2.28871484.1441637138.1669127045-503508063.1662037585> – Ubuntu version 18.04 LTS Bionic Beaver ISO image file. [↑](#footnote-ref-2)