Final Year Project

**Full unit – Report**

**F1Tenth car hardware, sensors, and communication Report**

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A report submitted in part fulfilment of the degree of

**BSc (Hons) in Computer Science (Software Engineering)**

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# ­­­Introduction

In this report, I will be discussing the hardware components of the F1Tenth, mainly their importance of how they work together to create an autonomous vehicle. It will cover the basis of the robot’s chassis, describing the different features that create the smooth manoeuvrability on different indoor surfaces. Afterwards, I will discuss how the hardware’s aspects may appear similar within the F1Tenth simulator, seeing how similar their performances can be transferred from testing in the virtual environment and the live one.

# F1Tenth Hardware

The car has multiple components that are combined to create the final product, I will discuss the main ones that have a major impact on its performance (as highlighted in Figure 1).

## Traxxas Slash 4x4 Premium Chassis

Figure 1 - Bill of Contents showing F1Tenth components. Main components highlighted

The car chassis is based off the Traxxas Slash 4x4 Premium Chassis[[1]](#footnote-1) (Figure 2), where all its components are attached onto its body. This chassis was created to have a low centre of gravity be having the battery and electronics to be held low to position the weight of car low in the chassis. Because of the low centre of gravity, it is possible that the car’s stability and ability to take on corners at an increased speed is improved. The chassis itself is ultra-smooth, which documented by the Traxxas says it reduces drag and improves ability to take on many types of terrain.

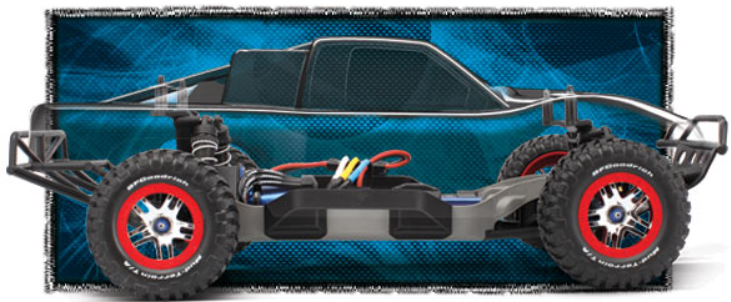
Included with the chassis, you have the GTR Shocks suspension system, a power system, wheels, and the body itself to hold all these components.

Figure 2 - Traxxas 4x4 Premium Chassis used for F1Tenth car

### High-capacity GTR Shocks (suspension)

The shock system has a near frictionless piston travel due to its “PTFE-coating”, allowing for smooth suspension work when driving through ridged terrain. This also allows for smooth and comfortable suspension action for extended periods of time before potential replacing. The shocks have an option to also change spring reload and ride height of the car, which can be done simply by turning threaded spring collars. This allows for fast and easy adjustment to the suspension, making the F1Tenth versatile.

### Traxxas Velineon Power System

The power system has been optimised for high-speed performance while maintaining smooth driving, to preserve control over the vehicle.

## LiPo batteries & Charger

These rechargeable lithium polymer (LiPo) batteries (Figure 3) are the main source of power for the car to work, along with a charger for these batteries. Due to them being rechargeable, it allows the car to be a long-term investment, saving up on money as you do not have to restock on additional batteries. With the two ‘5000mAh’ batteries, the car will have a possibility of reaching speeds of over 60mph (Figure 4).



Figure 3 - Traxxas EZ-Peak 3S "Completer Pack" Dual Multi-Chemistry Battery Charger w/Two Power Cell Batteries (5000mAh)

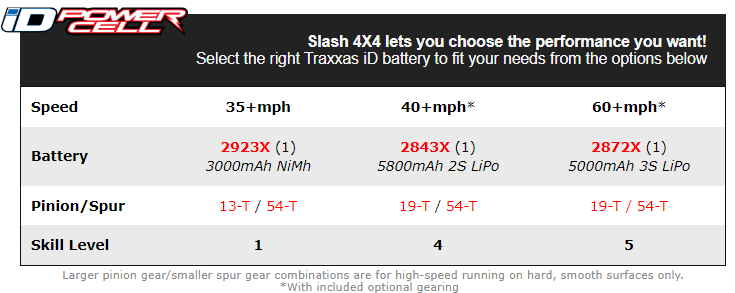


Figure 4 -Traxxas EZ-Peak 3S "Completer Pack" Dual Multi-Chemistry Battery Charger w/Two Power Cell Batteries (5000mAh)

## Hokuyo UST-10LX Scanning Laser Rangefinder

This Lidar light sensor[[2]](#footnote-2) can detect obstacles at a long distance of maximum being 30 metres, allowing the F1Tenth to conduct localisation of the car, with the scan being at a 270-degree angle (Figure 5). The sensor uses a light source as a way of obstacle detection, which in effect allows for a near immediate detection time, with scan speed measured to be 25ms.



Figure 6 - Hokuyo UST-10LX Scanning Laser Rangefinder



Figure 5 - Lidar UST-10LX Scanning Laser Rangefinder Specifications

## VESC 6 Mark5

## Jetson Xavier NX

The NVIDIA Jetson Xavier NX Developer Kit[[3]](#footnote-3) (will be simplified to JXNX) will be the primary component of the F1Tenth’s system, due to it having control over the VESC, which is a controller that oversees controlling and regulating the speed of the car’s motor[[4]](#footnote-4) (discussed in previous section). The JXNX will have the possibility to give out commands on the steering and speed control of the car due to having control over VESC, feeding it these commands. The JXNX also can receive information from the LIDAR sensor (Figure 6), which will be one of the primary sources of information that dictate the regulation of speed.

The way that JXNX receives these commands is through the host computer that will be used to code and control the software of the F1Tenth, connecting remotely through SSH.

# Hardware Communication with ROS

# F1Tenth Car Similarities to Simulator

1. <https://traxxas.com/products/models/electric/6804Rslash4x4platinum?t=details> – Traxxas chassis details [↑](#footnote-ref-1)
2. <https://www.robotshop.com/en/hokuyo-ust-10lx-scanning-laser-rangefinder.html> - Light sensor details [↑](#footnote-ref-2)
3. <https://developer.nvidia.com/embedded/jetson-xavier-nx-devkit> - JXNX details [↑](#footnote-ref-3)
4. <https://f1tenth.org/build.html> - Within the ‘Configure F1TENTH System’ tab [↑](#footnote-ref-4)