



Institute of Engineering and Technology

# Fundamentals of Automation

Finite State Machine Report

Submitted by:

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# Problem statement:

Mission: Implement and test an FSM (Finite State Machine), which has at least 4 states and 4 transitions

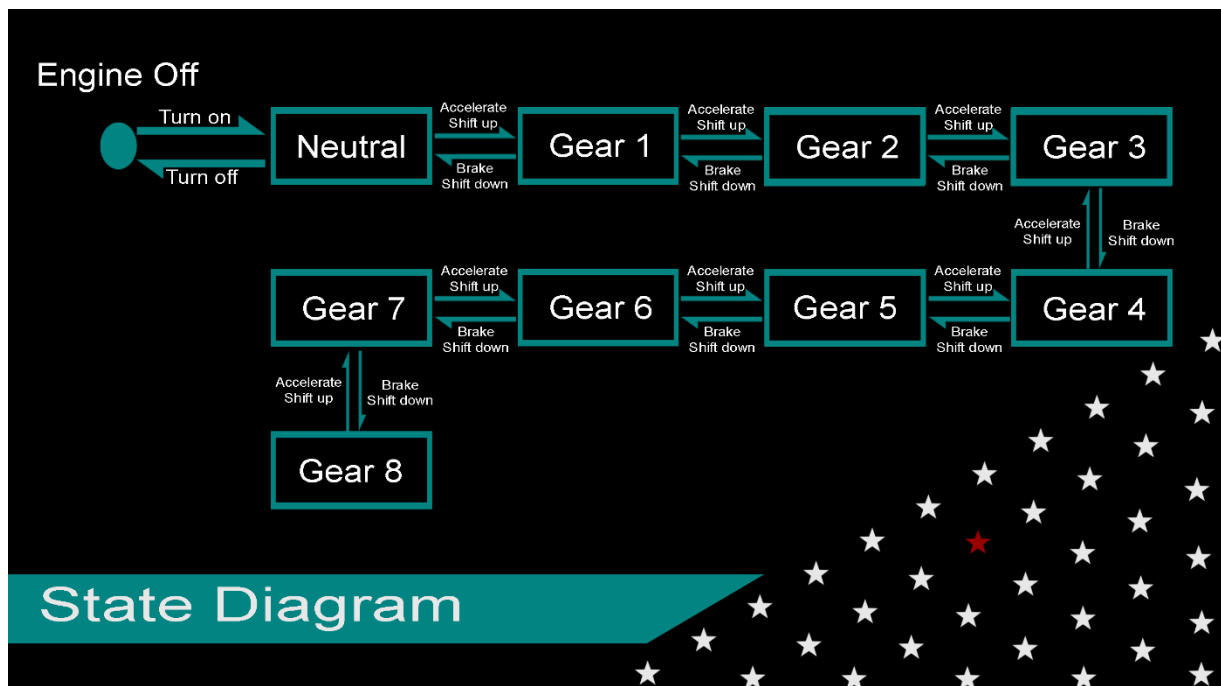
## Project description:



Formula 1 is the highest class of single-seater autonomous racing sanctioned by the FIA. It is the pinnacle of motorsports technology, and modern Formula 1 cars are among the finest pieces of technology ever made. A Bugatti or a Koenigsegg may be faster in terms of top speed, but there is no piece of human machinery that can beat a Formula 1 car around a track. The reason behind this is the insane amount of downforce that these cars produce. Theoretically, you can drive an F1 car upside down in a tunnel, as it will stick to the roof. After the 2014 engine regulations, these cars house turbo-supercharged hybrid V6 engines capable of producing up to 1000 horsepower, all going to the back wheels. It barely takes them 2.5 seconds to reach 10,000 RPM, and even while standing still, their engine usually runs at 4,000-5,000 RPM. Their transmission is complex and sensitive, but it is so fast and efficient that it takes an F1 car barely 8 milliseconds to shift gear. To put that into context, the human eye takes 300-400 milliseconds to blink.

Also, one of us is a huge F1 fan (Paarth), so it was already an interesting project to work on. We went back and forth with the GUI until we finally settled to create an F1 steering wheel, because that's what we'd be working on. The wheel is inspired by 7-time World Champion Lewis Hamilton's wheel, aboard the 2015 championship winning Mercedes-AMG W06 EQ Performance. Although an F1 wheel contains many buttons, we added separate buttons for ease.

# State Diagram:

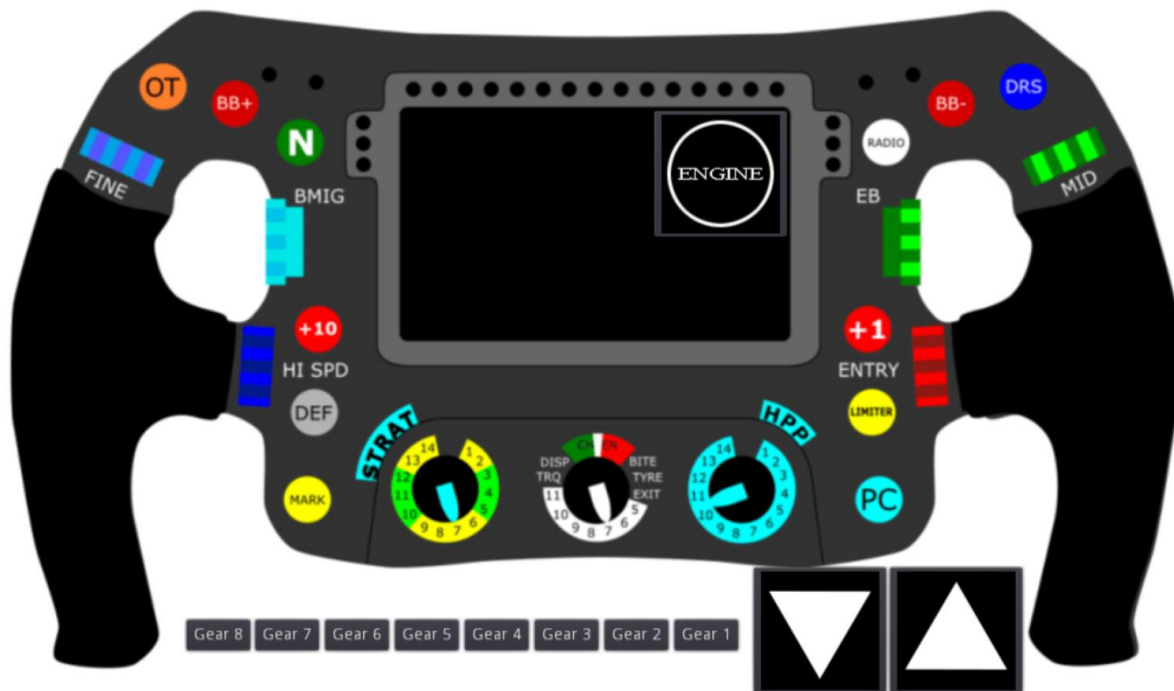


This depicts the states and the transitions in our FSM. As the engine is turned on, the first state we reach through the first transition is Neutral, when the engine is revving, and the car is stationary. Then, as we press the accelerator and shift up, we reach our second state, Gear 1. By holding down the pedal and shifting up, we reach Gear 2, then Gear 3, and so on up to Gear 8, each gear being in its own state. To reach the previous state, let's say from Gear 8 to Gear 7, we hold down the brake pedal and shift down, and this process can be applied till Gear 1 and then Neutral, when the car is stationary.

A little bit about the diagram itself, the theme is inspired from Mercedes-AMG W11's livery. Though Mercedes have always been represented by silver, and even nicknamed "The Silver Arrows", in 2020, they changed their livery to support the Black Lives Matter initiative, which in the motorsport world, was led by the 7-time World Champion Lewis Hamilton. The car had black color with teal accent, representing their primary sponsor PETRONAS Oil. The subtle red star was placed in honor of Niki Lauda, a legendary Formula 1 driver who passed away in 2019. Niki was a senior advisor for Mercedes, and Lewis Hamilton's mentor since he joined the team in 2013.



## GUI:



The GUI contains 11 buttons, one for turning on/off the engine, two for accelerator and brake, and 8 buttons controlling the gears. To begin the launch procedure, we hold down the Engine button until it turns on, and the status can be seen on the display, to the left of the button. As the engine is turned on, the car is in neutral. We then press Accelerate and press Gear 1 to get the car moving, and subsequently change gears till 8. During any time, we can press the Brake button to lower the speed and shift down to a lower gear, or to stop the car overall.

The GUI was made using the Godot Engine, an open-source development engine by the Massachusetts Institute of Technology, and programmed using GDScript, Godot's own script which is very similar to Python.

The app itself is readily distributable and works across all windows platforms, and it is available to download here:

[https://drive.google.com/file/d/1SCmXzWYjrj\\_TemkTo3l9\\_j0KoOuC5VY0/view?usp=sharing](https://drive.google.com/file/d/1SCmXzWYjrj_TemkTo3l9_j0KoOuC5VY0/view?usp=sharing)

# Challenges and lessons learned:

The biggest challenge we faced during the making of this GUI was sound, as there were no free sound libraries available on the internet, and without sounds, an F1 car is no good. So, we had to record vehicle sounds from the official F1 2020 game. Another huge issue was the time constraint, from which we recovered through great time management and smart distribution of work.

## References:

[Godot Engine - Free and open source 2D and 3D game engine](#)

[Mercedes-AMG Petronas Formula One Team \(mercedesamgf1.com\)](#)

[Lewis Hamilton - F1 Driver for Mercedes \(formula1.com\)](#)