

PID Controller Project

***Presentation contains GIF files of the car behavior created using Movavi Video converter software.

PID Controller Porject

- 1) PID controller logic taught in the classroom has been implemented.**
- 2) Static variables were created within the PID class to store the cte from previous time step, total cte and the number of times the controller is used.**
- 3) Six cases have been tested using the controller**
 - a. All gains set to zero.**
 - b. Non-zero P gain**
 - c. Non-zero I gain**
 - d. Non-zero D gain**
 - e. Initial random PID gains**
 - f. Fine tuned PID gains**

a) When all the gains are set to zero, the car goes in a straight line without any change in steering angle and thus eventually going off track.

b) When only the P gain is used, the car seems to go in an oscillatory path and before turns goes off-track.



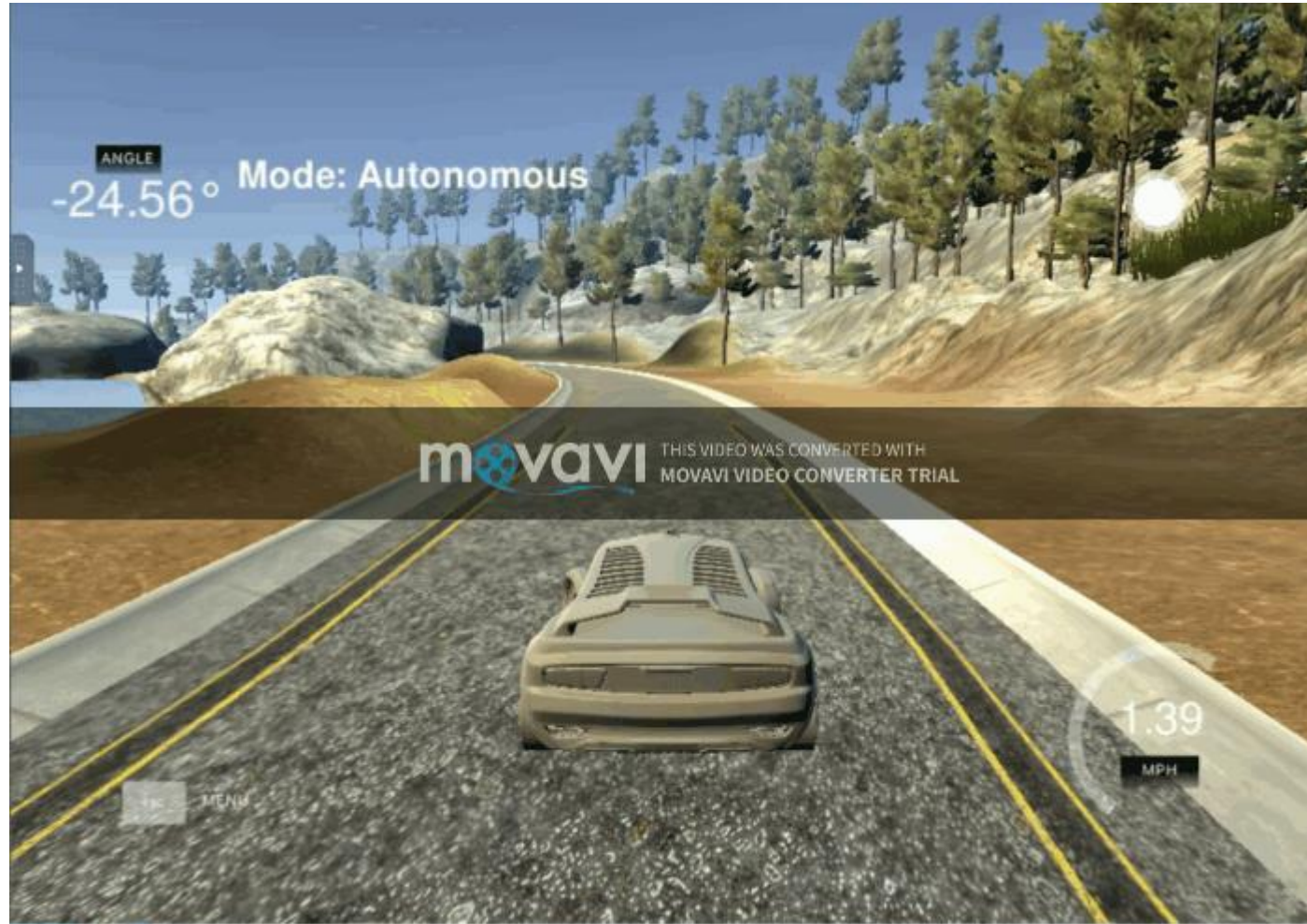
c) When only the I gain is used, the car seems to go off-track from the very beginning.



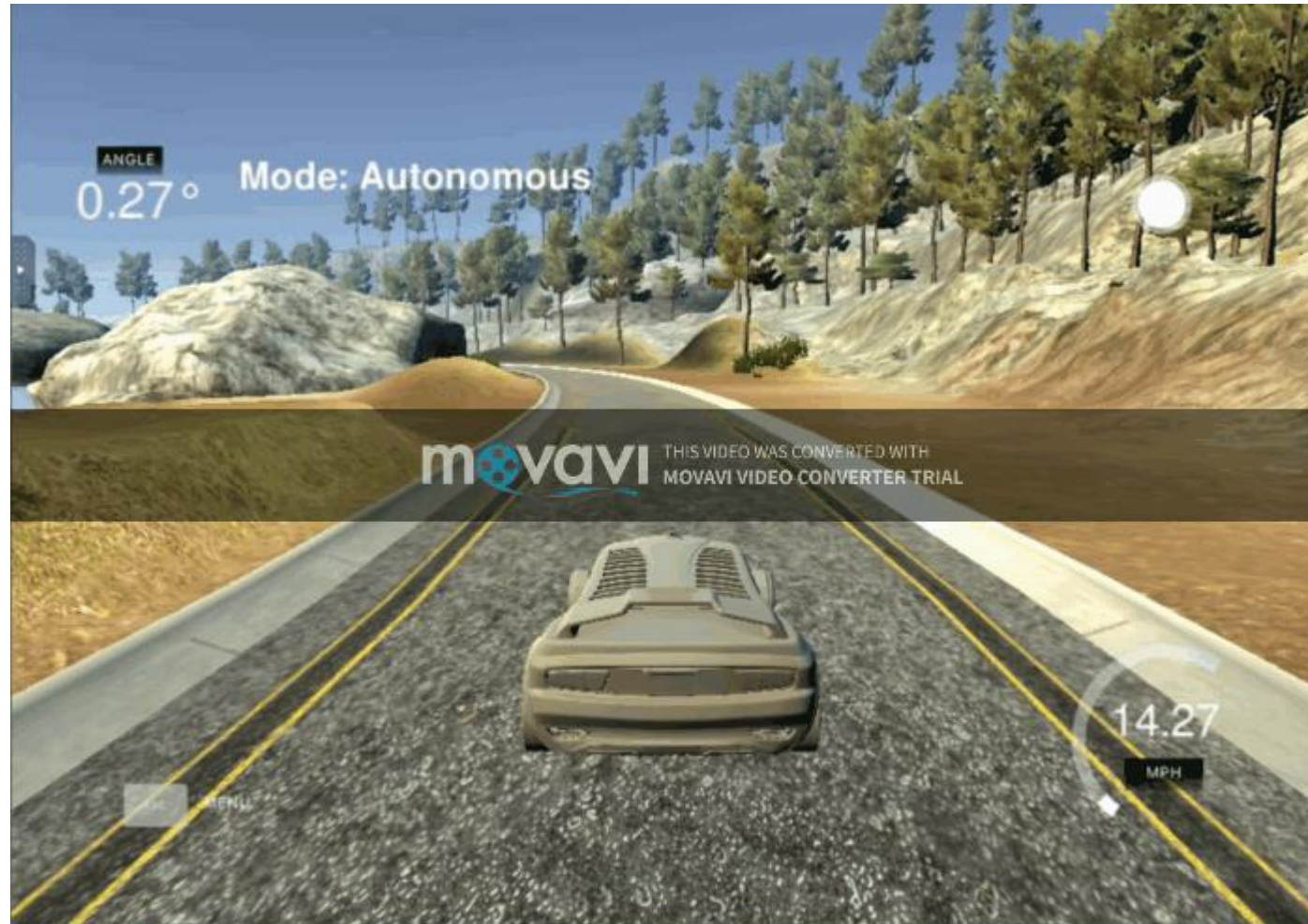
d) When only the D gain is used, the car seems to move towards the edge of the lane and goes off-track.



e) When all gains are used (PID = 0.5, 0.5,0.5), the car starts in a wavy motion and goes off track and hence the parameters need to be fine tuned.



f) With P, I, & D gains equal to 0.5, 0.001 and 10 respectively, the car follows the lane without going off-track. The large D gain is to dampen the oscillatory motion of the car. Since the car starts in the middle of the lane an I gain comparable to P gain or D gains seems to destabilize the car system.



- The steer_value is calculated as

$$\text{Steer_value} = -P * \text{cte} - D * d(\text{cte})/d(t) - I * \sum \text{cte}$$

Any steer_value greater than 1 or less than -1 have been omitted and the maximum (1) and minimum (-1) values are used.

- The final gain values have been arrived at by manually tuning the parameters based on the behavior of the car on the track.
- Starting with PID gains of 0.5,0.5,0.5 the values have been finally set to 0.5,0.001,10.
- Logic behind the final gain values:
 - Since the car started from the middle of the lane the integral gain value has been reduced to a very low number
 - As observed the car seems to osciallte even with a small value of I gain, hence the damping force need had to be increased (D gain raised to 5)
 - A further increment in the value of D gain (to 10) resulted in a smoother ride.

