Simulink Onramp Project
Automotive Performance Modes

Uche G. Emmanuel
MATLAB Academy Online Program

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Introduction

In the design and development of any engineering system, an utmost concern is how efficient the system is with respect to performance and cost. With over 1 billion passenger cars traveling the streets and roads of the world today, the automotives are considered very sensitive and vital systems to be designed with high accuracy and precision.

Furthermore, every engineer or designer is concerned with delivering a product that exceeds the user's expectation in terms of service rendering and product experience. The adoption of cutting edge technologies such as Artificial Intelligence (AI), Data Science, Diagnostics and so on, embedded in operating systems termed computers have revolutionized the driving experience, increasing safety, comfort and reducing environmental impact.

Automotive systems of the present day are designed with numerous built-in sensors and these sensors are synchronized with electronic computers to read and interpret data and adjust the behavior of the automotive systems to maintain or increase efficiency.

Project Description

This project is part of the training course on Simulink hosted by Mathworks. In this project, I simulated the logic control for the performance of an automotive system. The sensors of concentration in this project were the speed and lateral acceleration. The lateral acceleration for left and right turns were assumed to be the same. The purpose of this simulation was to determine how the control system chooses between high performance and economy at a specified speed and lateral acceleration condition.

Methodology

Hence, the lateral acceleration for left and right turns were assumed to be the same, so I took an absolute value of the lateral acceleration input from the Sensor Data using an Absolute Value block.

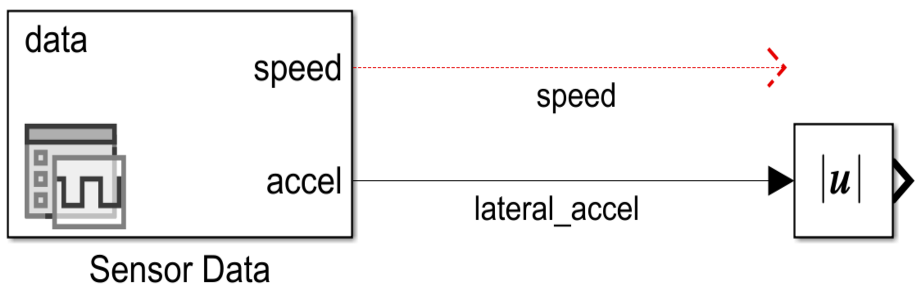

figure 1 Lateral Acceleration (Absolute)

Modeled the boolean statement using compare to constant blocks describing the mode selection for the automotive system to match the pseudocode as written below:

speed >= 100km/hr
speed >= 35km/hr
abs(lateral acceleration >= 3m/s^2)

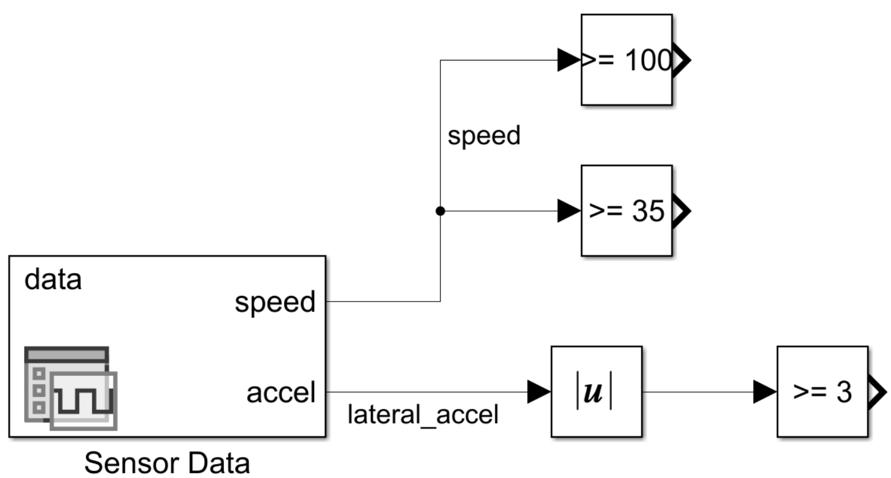

figure 2 speed and lateral acceleration configure

Added the AND logic control block to the model to justify the pseudocode as described below.

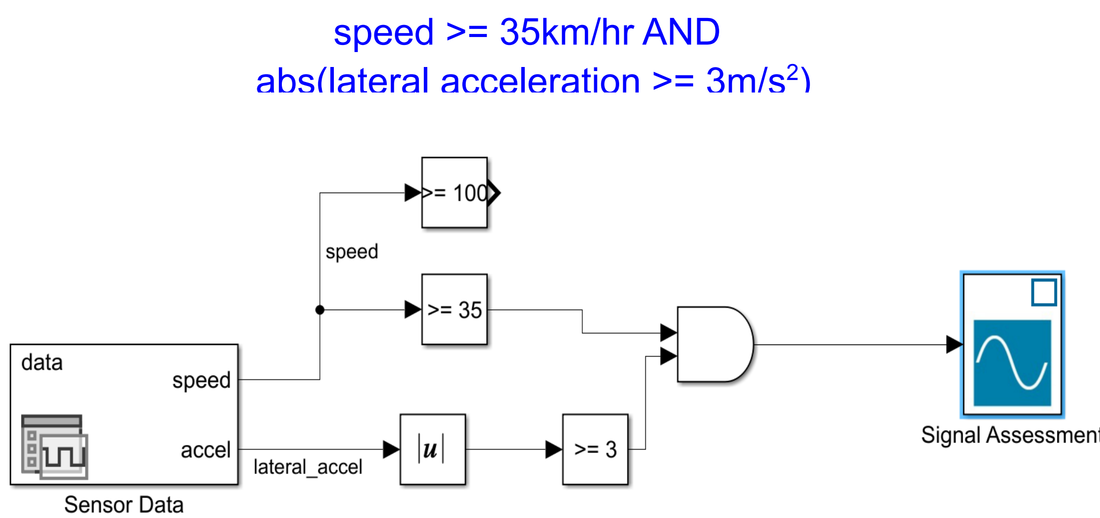

figure 3 AND Logic Operator

The simulation of the model above yielded the graphical representation as shown in figure 4.

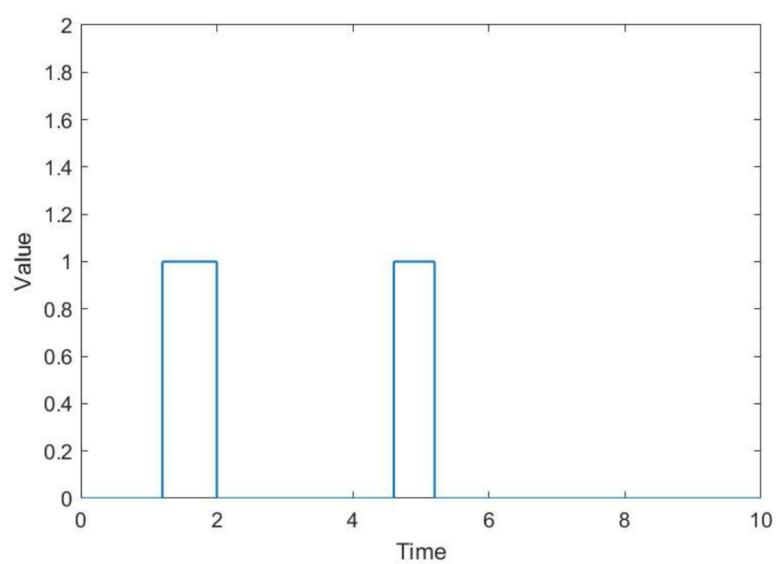

figure 4 Value vs Time

From the graphical representation above, we can deduce that the algorithm is true for the condition specified for speed and the absolute value of the lateral acceleration.

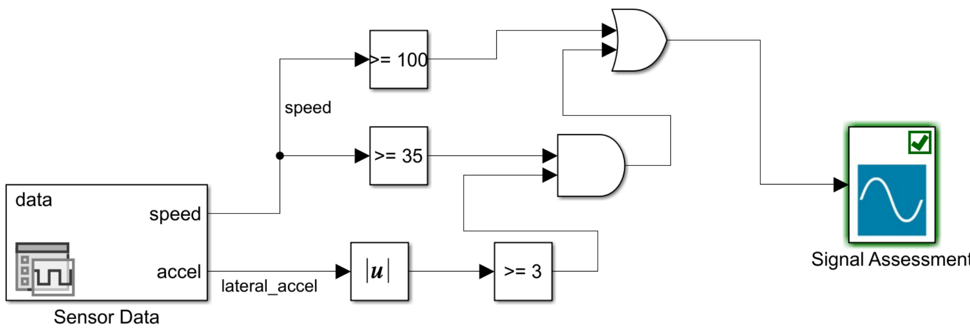

figure 5 AND, OR Operators

The above image signifies the addition of an OR logical operator to execute the pseudocode as written below.

if (speed >= 100km/hr) OR
(speed >= 35km/hr AND
abs(lateral acceleration >= 3m/s^2)

Using constant blocks and a switch block, the system can automatically change the mode of the automobile if the conditions are met. From the simulation model shown in figure 6, we can deduce that there are two modes, one for economy and high performance. If the speed of the automobile is greater than or equal to 100km/hr OR speed is 35km/hr AND the absolute value of the lateral acceleration is greater than or equal to 3m/s^2 then the condition is True and if not, then the condition is False.

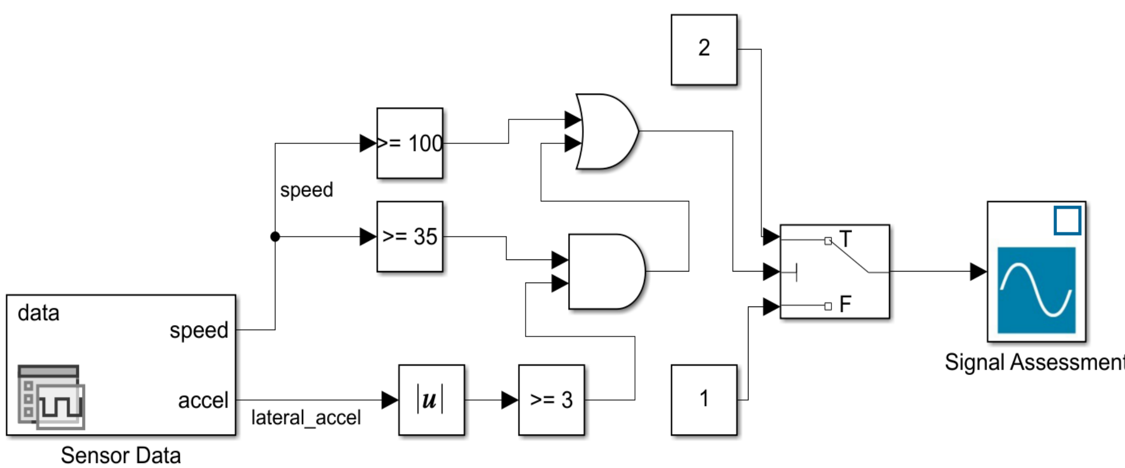

Figure 6 AND, OR Operator, Switch Functions

Result

The graphical representation in figure 7 is a result of the simulation model in figure 6. From the graphical representation, we can deduce that when the conditions are met, the system switches to using driving mode 2 and when the conditions are not met, it switches to using driving mode 1. Furthemore, we can deduce that for approximately 1.5 of Time, the driving mode is at default 1 and for the next 0.5 the driving mode is switched to 2.

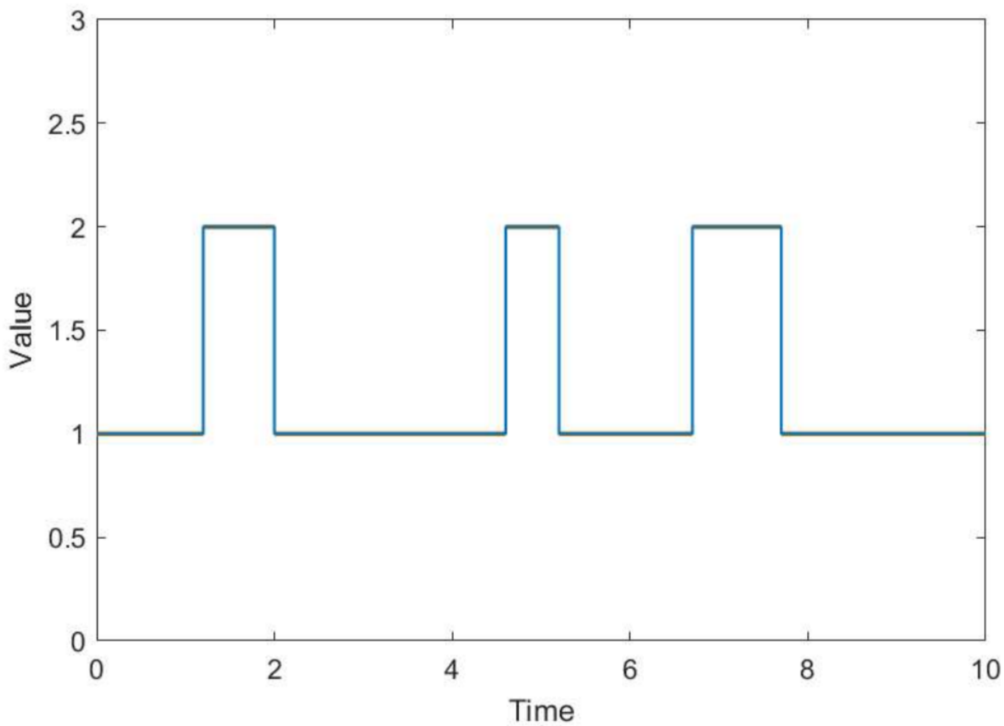

figure 7 Performance Modes

Conclusion

In this project, I have developed my technical skills in problem assessment, analysis and model development. Solving a challenging problem starts with first, understanding the problem from the root-cause, properly assessing the problem and innovatively creating a solution to solve the problem.

More so, this project has sharpened my skills on using compare-to-constant blocks in creating boolean models, absolute value blocks in obtaining the absolute value of a defined parameter, switch blocks for executing statements that follow the matching case label and the AND, OR logic operators.