Project 2IN70 – MDSE – 2022
The tire pressure monitoring system (TPMS)

In the present-day vehicle, there are anywhere from 60 to 100 sensors. These sensors are responsible for replacing most of the mechanical components from the older vehicle and increasing the complexity of the vehicles. One type of sensor used in modern vehicles is the tire pressure sensor, which is used by **the tire pressure monitoring system** (TPMS) in your vehicle, and to warn you that at least one or more tires are significantly under-inflated, possibly creating unsafe driving conditions. The TPMS low tire pressure indicator is a yellow symbol that illuminates the dashboard instrument panel in the shape of a tire cross-section (that resembles a horseshoe) with an exclamation point, see Fig. 1.

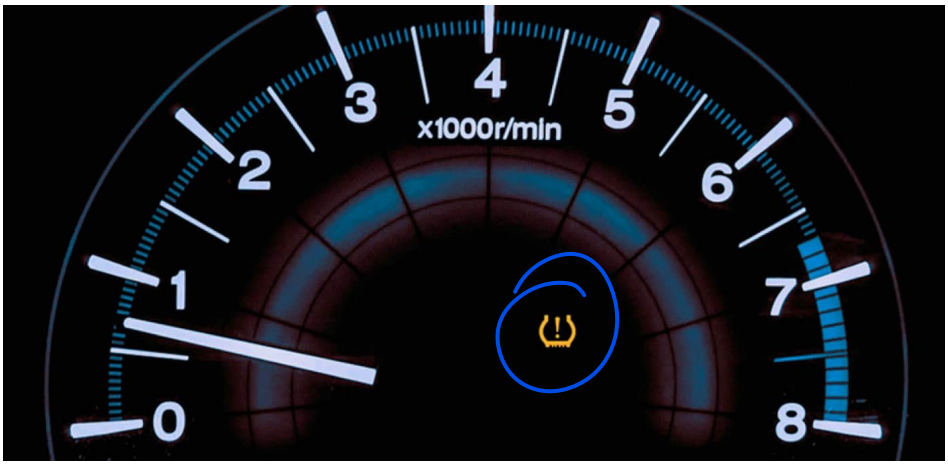

Figure 1. Tire pressure indicator on the vehicle's dashboard.

The illumination of the low tire pressure indicator represents the final step in the process of either an indirect TPMS or a direct TPMS.

In response to a surge in accidents due to underinflated tires, most vehicles sold in the United States since 2007 include a tire pressure monitoring system of some kind.

In this project, we consider a direct TPMS, which uses pressure monitoring sensors within each tire that monitor specific pressure levels.

Sensors in a direct TPMS also provide tire temperature readings. The direct tire pressure monitoring system sends all of this data to a TPMS's centralized control module where it's analyzed, interpreted, and, if tire pressure is lower than it should be, transmitted directly to your dashboard where the indicator light illuminates. A direct tire pressure monitor usually sends all

of this data wirelessly. Each sensor has a unique serial number. This is how the system not only distinguishes between itself and systems on other vehicles but also among pressure readings for each tire.

In this project, we consider a tire pressure sensor for every vehicle's wheel, which measures the actual tire pressure from inside the tire and the tire's temperature. The sensor has a battery inside which usually lasts for about a decade. Also, the sensor is placed in the vehicle's spare tire. The sensor communicates with the control unit wireless.

The TPMS uses pressure monitoring sensors within each tire that monitor specific tire pressure and temperature levels. In case of the tire's pressure or temperature is out of range, the TPMS displays the information on the dashboard, indicating the tire and its pressure and temperature.

You are asked to model and develop a TPMS system using the SYSMOD Methodology based on SysML language, using the following steps:

1. Elicitate the TPMS's requirements and model them.
2. Create the System Context of the TPMS.
3. Model the Use Cases:
    a. Determine the actors and the Use Cases. Create the Use Case diagram and the relationship between the Use Cases.
    b. Realize the Use Cases. Create the textual description using the template used in 2IN70 course (goals, actors, main, alternative flows, …etc). Use behavioral diagrams to model the Use cases.
4. Model the structure of the system using a block definition diagram.
5. Create a GUI in IBM Rhapsody to interact with TPMS' model.
6. Execute and test the SysML models.
7. Create a video of a maximum of 10 minutes, demonstrating the functionality of the TPMS models.
8. Upload all the deliverables on Canvas.
9. Create a short technical report describing the project and its deliverables.