Landing Gear System

ROB301 Projet

Summary: This is the final report of the project of the course ROB301, which realizes the software part of a landing gear system. The total system is described in the operator "Total_System"
Some elements to be specified in addition to the file "landing_system.pdf":
The unity of all of the durations is 100ms
The handle is "true" means the handle is in the position "up". The handle is "false" means the handle is in the position "down".
The analogical switch is open when it is "true", the analogical switch is close when it is "false".
In the operator "Computing_Module", we assume that the handle cannot be changed within 100ms after each operation.

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1. General Project Description

In this project, we realize the functions proposed in a landing gear system with ANSYS SCADE.

2. Software Architecture

2.1. Project Architecture

This section displays the package hierarchy of projects.

Project ROB301_projet

2.2. Call Graph

This Call Graph displays the dependency tree of model operators.

1. Total_System
   1.1. Computing_Module [2]
   1.2. Generic_Monitor
      1.2.1. ifvalid_sensor [18]
   1.3. Health_Monitor
      1.3.1. Door_Monitor
         1.3.1.1. Case1_Doors
         1.3.1.2. Case2_Doors
         1.3.1.3. Case3_Doors
         1.3.1.4. Case4_Doors
      1.3.2. Gear_Monitor
         1.3.2.1. Case1_Gears
         1.3.2.2. Case2_Gears
         1.3.2.3. Case3_Gears
         1.3.2.4. Case4_Gears
      1.3.3. Pressure_Monitor
         1.3.3.1. Case1_Pressure
         1.3.3.2. Case2_Pressure
      1.3.4. Switch_Monitor
         1.3.4.1. Case1_Switch
         1.3.4.2. Case2_Switch

3. ROB301_projet Project

3.1. Root Elements

3.1.1. Case1_Doors Operator

Declared as **`public node`**

3.1.1.1. Comments and Information

Case1_Doors Comments:
This operator deals with the first case of anomaly in doors' motion monitoring.

3.1.1.2. Interface

Table 1: Inputs of Case1_Doors

Name	Type	Properties		Comments and Information
door_closed_f	bool			
door_closed_l	bool			
door_closed_r	bool			
open_EV	bool	last	open_EV	
duration	int8			

Table 2: Outputs of Case1_Doors

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.1.3. Locals

Table 3: Locals of Case1_Doors

Name	Type	Properties		Comments and Information
all_close_false	bool	default	false	
open_EV_change	bool	default	false	

3.1.1.4. Operator Hierarchy

diagram : Case1_Doors_1
  state-machine : all_close
    state : anomaly
    state : detecting
    state : Ordinary

3.1.1.5. Graphical and Textual Diagrams

3.1.1.5.1. View of Case1_Doors_1 (Case1_Doors)

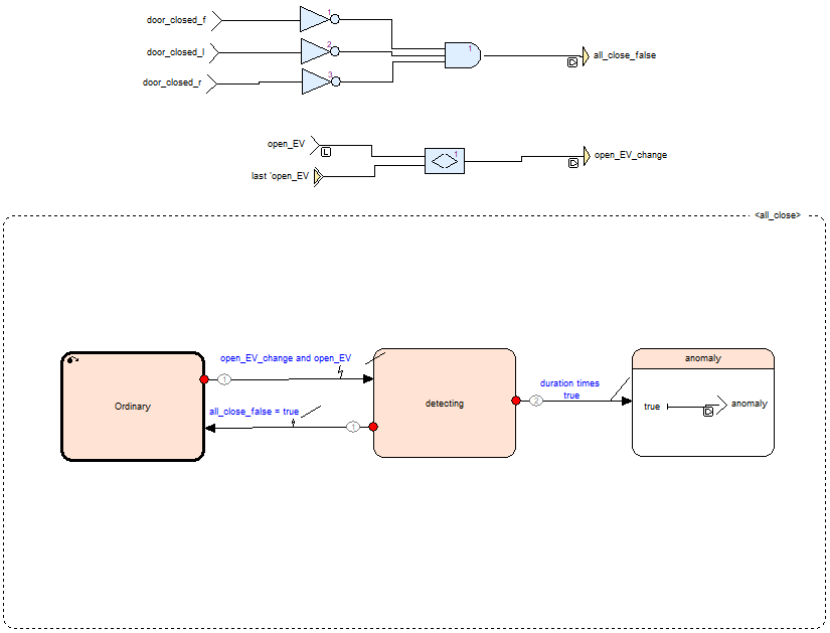


Figure 1: View of Case1_Doors_1 (Case1_Doors)

Table 4: State Machines of Case1_Doors_1

State Machine	Comments and Information
all_close	

Table 5: States of Case1_Doors_1

State	Comments and Information
all_close:anomaly	
all_close:detecting	
all_close:Ordinary	

Table 6: Transitions of Case1_Doors_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: all_close:detecting **Target:** all_close:Ordinary	1	**Condition:** all_close_false = true	
Source: all_close:detecting **Target:** all_close:anomaly	2	**Condition:** duration times true	
Source: all_close:Ordinary **Target:** all_close:detecting	1	**Condition:** open_EV_change and open_EV	

3.1.2. Case1_Gears Operator

Declared as **`public node`**

3.1.2.1. Comments and Information

Case1_Gears Comments:
This operator deals with the first case of anomaly in gears' motion monitoring.

3.1.2.2. Interface

Table 7: Inputs of Case1_Gears

Name	Type	Properties		Comments and Information
gear_extended_f	bool			
gear_extended_l	bool			
gear_extended_r	bool			
retract_EV	bool	last	retract_EV	
duration	int8			

Table 8: Outputs of Case1_Gears

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.2.3. Locals

Table 9: Locals of Case1_Gears

Name	Type	Properties		Comments and Information
all_extend_false	bool	default	false	
retract_EV_change	bool	default	false	

3.1.2.4. Operator Hierarchy

diagram : Case1_Gears_1
state-machine : all_close
state : anomaly
state : detecting
state : Ordinary

3.1.2.5. Graphical and Textual Diagrams

3.1.2.5.1. View of Case1_Gears_1 (Case1_Gears)

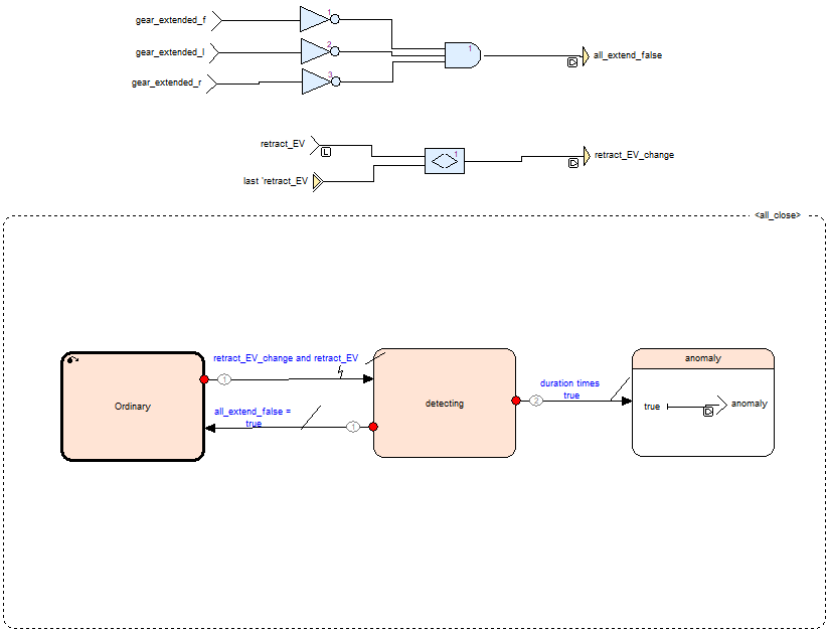


Figure 2: View of Case1_Gears_1 (Case1_Gears)

Table 10: State Machines of Case1_Gears_1

State Machine	Comments and Information
all_close	

Table 11: States of Case1_Gears_1

State	Comments and Information
all_close:anomaly	
all_close:detecting	
all_close:Ordinary	

Table 12: Transitions of Case1_Gears_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: all_close:detecting **Target:** all_close:Ordinary	1	**Condition:** all_extend_false = true	
Source: all_close:detecting **Target:** all_close:anomaly	2	**Condition:** duration times true	
Source: all_close:Ordinary **Target:** all_close:detecting	1	**Condition:** retract_EV_change and retract_EV	

3.1.3. Case1_Pressure Operator

Declared as **`public node`**

3.1.3.1. Comments and Information

Case1_Pressure Comments:
This case deals with the first case of anomaly of pressure sensor monitoring.

3.1.3.2. Interface

Table 13: Inputs of Case1_Pressure

Name	Type	Properties		Comments and Information
general_EV	bool	last	general_EV	
circuit_state	bool			
duration	int8			

Table 14: Outputs of Case1_Pressure

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.3.3. Locals

Table 15: Locals of Case1_Pressure

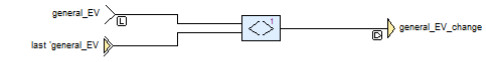
Name	Type	Properties		Comments and Information
general_EV_change	bool	default	false	

3.1.3.4. Operator Hierarchy

diagram : Case1_Pressure_1
state-machine : pressure_monitor
state : abnormal
state : detecting
state : Ordinary

3.1.3.5. Graphical and Textual Diagrams

3.1.3.5.1. View of Case1_Pressure_1 (Case1_Pressure)



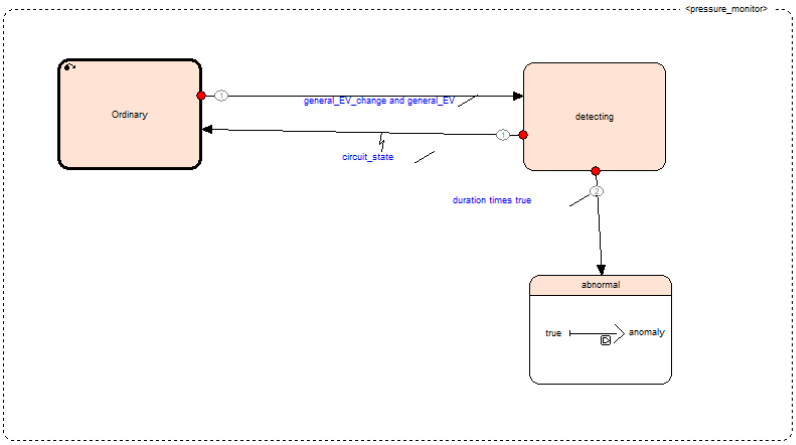


Figure 3: View of Case1_Pressure_1 (Case1_Pressure)

Table 16: State Machines of Case1_Pressure_1

State Machine	Comments and Information
pressure_monitor	

Table 17: States of Case1_Pressure_1

State	Comments and Information
pressure_monitor:abnormal	
pressure_monitor:detecting	
pressure_monitor:Ordinary	

Table 18: Transitions of Case1_Pressure_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: pressure_monitor:detecting **Target:** pressure_monitor:Ordinary	1	**Condition:** circuit_state	
Source: pressure_monitor:detecting **Target:** pressure_monitor:abnormal	2	**Condition:** duration times true	
Source: pressure_monitor:Ordinary **Target:** pressure_monitor:detecting	1	**Condition:** general_EV_change and general_EV	

3.1.4. Case1_Switch Operator

Declared as **`public node`**

3.1.4.1. Comments and Information

Case1_Switch Comments:
This operator deals with the first case of anomaly in analogical switch monitoring.
"handle_state=true" means the handle is "up", otherwise the handle is "down".
"switch_state=true" means the analogical switch is open, otherwise the switch is close.

3.1.4.2. Interface

Table 19: Inputs of Case1_Switch

Name	Type	Properties		Comments and Information
handle_state	bool	last	handle_state	
switch_state	bool			
duration	int8			

Table 20: Outputs of Case1_Switch

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.4.3. Locals

Table 21: Locals of Case1_Switch

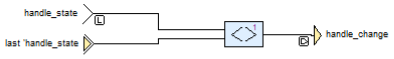
Name	Type	Properties		Comments and Information
handle_change	bool	default	false	

3.1.4.4. Operator Hierarchy

diagram : Case1_Switch_1
state-machine : Case1_Switch
state : Anomaly
state : detecting
state : Ordinary

3.1.4.5. Graphical and Textual Diagrams

3.1.4.5.1. View of Case1_Switch_1 (Case1_Switch)



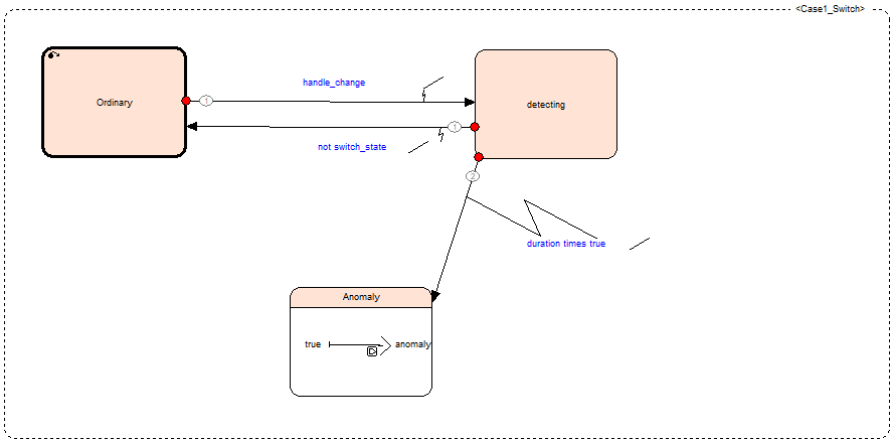


Figure 4: View of Case1_Switch_1 (Case1_Switch)

Table 22: State Machines of Case1_Switch_1

State Machine	Comments and Information
Case1_Switch	

Table 23: States of Case1_Switch_1

State	Comments and Information
Case1_Switch:Anomaly	
Case1_Switch:detecting	
Case1_Switch:Ordinary	

Table 24: Transitions of Case1_Switch_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: Case1_Switch:detecting **Target:** Case1_Switch:Ordinary	1	**Condition:** not switch_state	
Source: Case1_Switch:detecting **Target:** Case1_Switch:Anomaly	2	**Condition:** duration times true	
Source: Case1_Switch:Ordinary **Target:** Case1_Switch:detecting	1	**Condition:** handle_change	

3.1.5. Case2_Doors Operator

Declared as **`public node`**

3.1.5.1. Comments and Information

Case2_Doors Comments:
This operator deals with the second case of anomaly in doors' motion monitoring.

3.1.5.2. Interface

Table 25: Inputs of Case2_Doors

Name	Type	Properties		Comments and Information
door_open_f	bool			
door_open_l	bool			
door_open_r	bool			
open_EV	bool	last	open_EV	
duration	int8			

Table 26: Outputs of Case2_Doors

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.5.3. Locals

Table 27: Locals of Case2_Doors

Name	Type	Properties		Comments and Information
all_open_true	bool			
open_EV_change	bool	default	false	

3.1.5.4. Operator Hierarchy

diagram : Case2_Doors_1
state-machine : all_close
state : anomaly
state : detecting
state : Ordinary

3.1.5.5. Graphical and Textual Diagrams

3.1.5.5.1. View of Case2_Doors_1 (Case2_Doors)

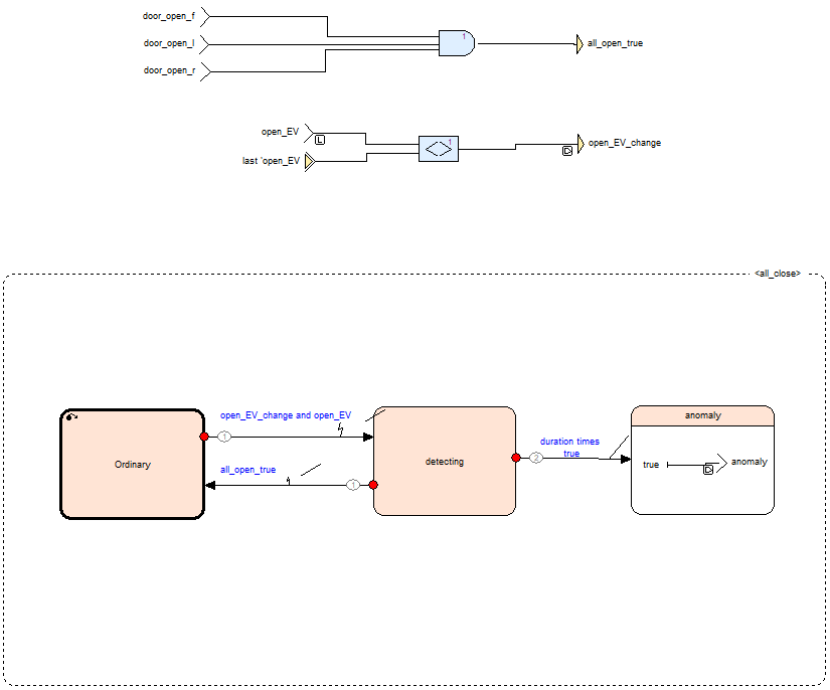


Figure 5: View of Case2_Doors_1 (Case2_Doors)

Table 28: State Machines of Case2_Doors_1

State Machine	Comments and Information
all_close	

Table 29: States of Case2_Doors_1

State	Comments and Information
all_close:anomaly	
all_close:detecting	
all_close:Ordinary	

Table 30: Transitions of Case2_Doors_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: all_close:detecting **Target:** all_close:Ordinary	1	**Condition:** all_open_true	
Source: all_close:detecting **Target:** all_close:anomaly	2	**Condition:** duration times true	
Source: all_close:Ordinary **Target:** all_close:detecting	1	**Condition:** open_EV_change and open_EV	

3.1.6. Case2_Gears Operator

Declared as **`public node`**

3.1.6.1. Comments and Information

Case2_Gears Comments:
This operator deals with the second case of anomaly in gears' motion monitoring.

3.1.6.2. Interface

Table 31: Inputs of Case2_Gears

Name	Type	Properties		Comments and Information
gear_retracted_f	bool			
gear_retracted_l	bool			
gear_retracted_r	bool			
retract_EV	bool	last	retract_EV	
duration	int8			

Table 32: Outputs of Case2_Gears

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.6.3. Locals

Table 33: Locals of Case2_Gears

Name	Type	Properties		Comments and Information
all_retract_true	bool			
retract_EV_change	bool	default	false	

3.1.6.4. Operator Hierarchy

diagram : Case2_Gears_1
  state-machine : all_close
    state : anomaly
    state : detecting
    state : Ordinary

3.1.6.5. Graphical and Textual Diagrams

3.1.6.5.1. View of Case2_Gears_1 (Case2_Gears)

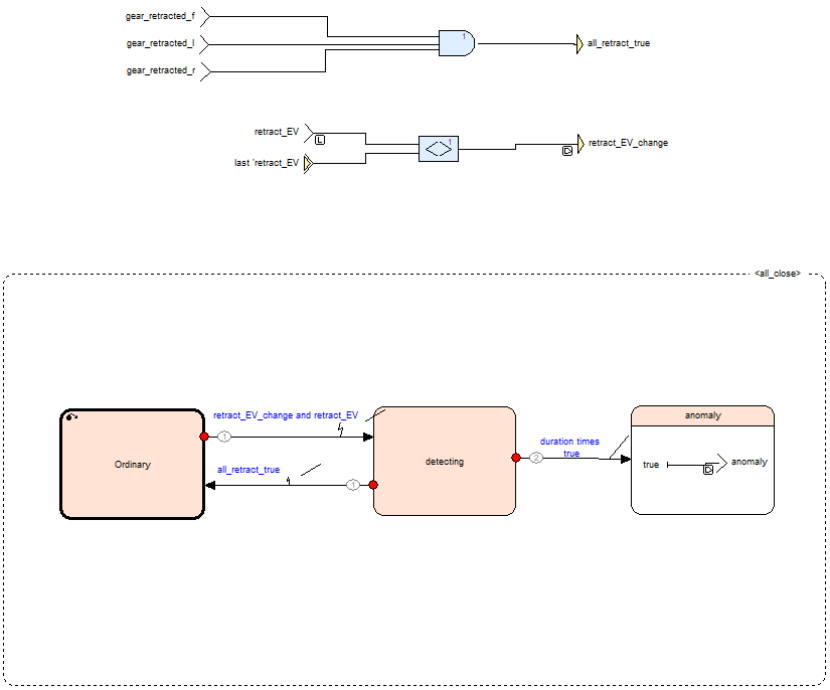


Figure 6: View of Case2_Gears_1 (Case2_Gears)

Table 34: State Machines of Case2_Gears_1

State Machine	Comments and Information
all_close	

Table 35: States of Case2_Gears_1

State	Comments and Information
all_close:anomaly	
all_close:detecting	
all_close:Ordinary	

Table 36: Transitions of Case2_Gears_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: all_close:detecting **Target:** all_close:Ordinary	1	**Condition:** all_retract_true	
Source: all_close:detecting **Target:** all_close:anomaly	2	**Condition:** duration times true	
Source: all_close:Ordinary **Target:** all_close:detecting	1	**Condition:** retract_EV_change and retract_EV	

3.1.7. Case2_Pressure Operator

Declared as **`public node`**

3.1.7.1. Comments and Information

Case2_Pressure Comments:
This case deals with the second case of anomaly of pressure sensor monitoring.

3.1.7.2. Interface

Table 37: Inputs of Case2_Pressure

Name	Type	Properties		Comments and Information
general_EV	bool	last	general_EV	
circuit_state	bool			
duration	int8			

Table 38: Outputs of Case2_Pressure

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.7.3. Locals

Table 39: Locals of Case2_Pressure

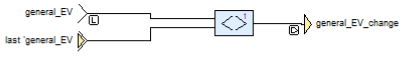
Name	Type	Properties		Comments and Information
general_EV_change	bool	default	false	

3.1.7.4. Operator Hierarchy

diagram : Case2_Pressure
  state-machine : pressure_monitor
    state : abnormal
    state : detecting
    state : Ordinary

3.1.7.5. Graphical and Textual Diagrams

3.1.7.5.1. View of Case2_Pressure (Case2_Pressure)



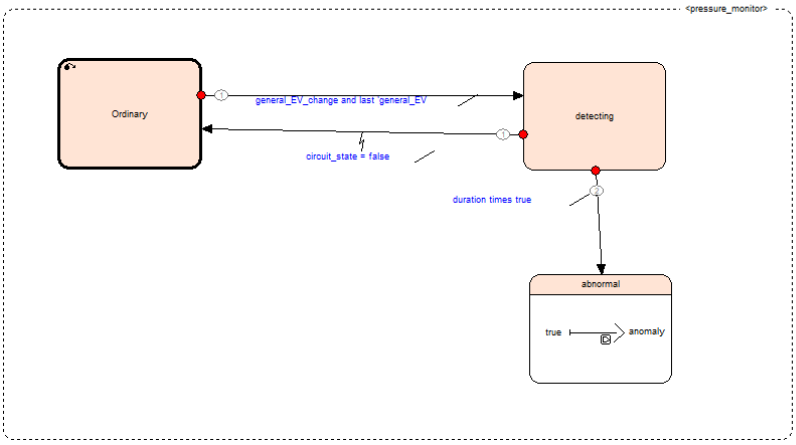


Figure 7: View of Case2_Pressure (Case2_Pressure)

Table 40: State Machines of Case2_Pressure

State Machine	Comments and Information
pressure_monitor	

Table 41: States of Case2_Pressure

State	Comments and Information
pressure_monitor:abnormal	
pressure_monitor:detecting	
pressure_monitor:Ordinary	

Table 42: Transitions of Case2_Pressure

Source/Target	#	Conditions/Actions	Comments and Information
Source: pressure_monitor:detecting **Target:** pressure_monitor:Ordinary	1	**Condition:** circuit_state = false	
Source: pressure_monitor:detecting **Target:** pressure_monitor:abnormal	2	**Condition:** duration times true	
Source: pressure_monitor:Ordinary **Target:** pressure_monitor:detecting	1	**Condition:** general_EV_change and last 'general_EV	

3.1.8. Case2_Switch Operator

Declared as **`public node`**

3.1.8.1. Comments and Information

Case2_Switch Comments:
This operator deals with the second case of anomaly in analogical switch monitoring.
"handle_state=true" means the handle is "up", otherwise the handle is "down".
"switch_state=true" means the analogical switch is open, otherwise the switch is close.

3.1.8.2. Interface

Table 43: Inputs of Case2_Switch

Name	Type	Properties		Comments and Information
handle_state	bool	last	handle_state	
switch_state	bool			
duration_1	int16			
duration_2	int16			

Table 44: Outputs of Case2_Switch

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.8.3. Locals

Table 45: Locals of Case2_Switch

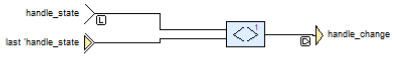
Name	Type	Properties		Comments and Information
handle_change	bool	default	false	

3.1.8.4. Operator Hierarchy

diagram : Case2_Switch_1
state-machine : Case2_Switch
state : abnormal
state : change
state : detecting
state : no_change

3.1.8.5. Graphical and Textual Diagrams

3.1.8.5.1. View of Case2_Switch_1 (Case2_Switch)



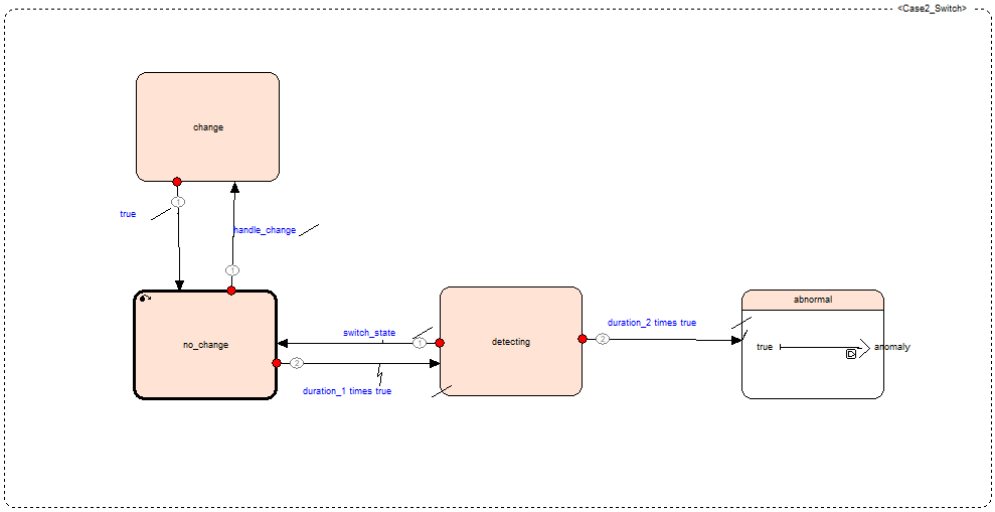


Figure 8: View of Case2_Switch_1 (Case2_Switch)

Table 46: State Machines of Case2_Switch_1

State Machine	Comments and Information
Case2_Switch	

Table 47: States of Case2_Switch_1

State	Comments and Information
Case2_Switch:abnormal	
Case2_Switch:change	
Case2_Switch:detecting	
Case2_Switch:no_change	

Table 48: Transitions of Case2_Switch_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: Case2_Switch:change **Target:** Case2_Switch:no_change	1	**Condition:** true	
Source: Case2_Switch:detecting **Target:** Case2_Switch:no_change	1	**Condition:** switch_state	
Source: Case2_Switch:detecting **Target:** Case2_Switch:abnormal	2	**Condition:** duration_2 times true	
Source: Case2_Switch:no_change **Target:** Case2_Switch:change	1	**Condition:** handle_change	
Source: Case2_Switch:no_change **Target:** Case2_Switch:detecting	2	**Condition:** duration_1 times true	

3.1.9. Case3_Doors Operator

Declared as **`public node`**

3.1.9.1. Comments and Information

Case3_Doors Comments:
This operator deals with the third case of anomaly in doors' motion monitoring.

3.1.9.2. Interface

Table 49: Inputs of Case3_Doors

Name	Type	Properties		Comments and Information
door_open_f	bool			
door_open_l	bool			
door_open_r	bool			
close_EV	bool	last	close_EV	
duration	int8			

Table 50: Outputs of Case3_Doors

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.9.3. Locals

Table 51: Locals of Case3_Doors

Name	Type	Properties		Comments and Information
all_open_false	bool	default	false	
close_EV_change	bool	default	false	

3.1.9.4. Operator Hierarchy

diagram : Case3_Doors_1
  state-machine : all_close
    state : anomaly
    state : detecting
    state : Ordinary

3.1.9.5. Graphical and Textual Diagrams

3.1.9.5.1. View of Case3_Doors_1 (Case3_Doors)

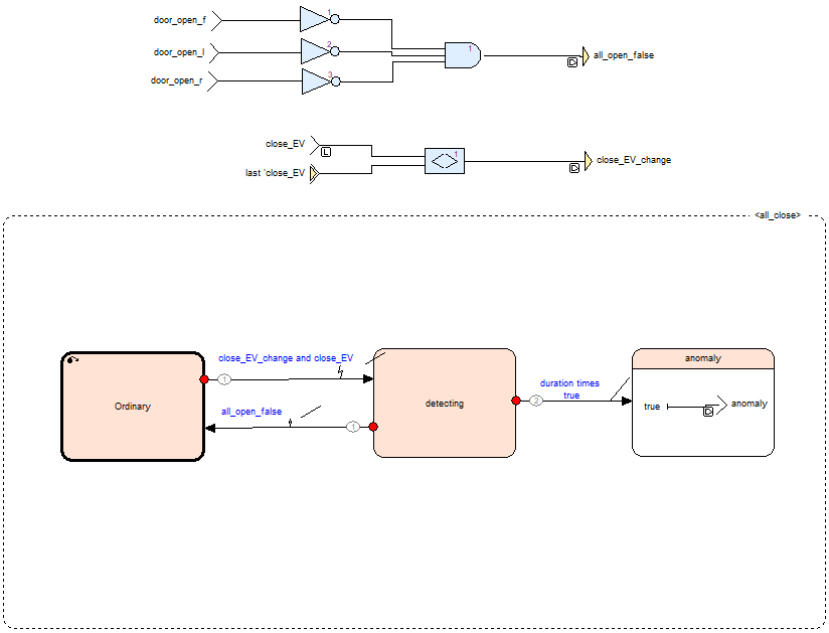


Figure 9: View of Case3_Doors_1 (Case3_Doors)

Table 52: State Machines of Case3_Doors_1

State Machine	Comments and Information
all_close	

Table 53: States of Case3_Doors_1

State	Comments and Information
all_close:anomaly	
all_close:detecting	
all_close:Ordinary	

Table 54: Transitions of Case3_Doors_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: all_close:detecting **Target:** all_close:Ordinary	1	**Condition:** all_open_false	
Source: all_close:detecting **Target:** all_close:anomaly	2	**Condition:** duration times true	
Source: all_close:Ordinary **Target:** all_close:detecting	1	**Condition:** close_EV_change and close_EV	

3.1.10. Case3_Gears Operator

Declared as **`public node`**

3.1.10.1. Comments and Information

Case3_Gears Comments:
This operator deals with the third case of anomaly in gears' motion monitoring.

3.1.10.2. Interface

Table 55: Inputs of Case3_Gears

Name	Type	Properties		Comments and Information
gear_retracted_f	bool			
gear_retracted_l	bool			
gear_retracted_r	bool			
extend_EV	bool	last	extend_EV	
duration	int8			

Table 56: Outputs of Case3_Gears

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.10.3. Locals

Table 57: Locals of Case3_Gears

Name	Type	Properties		Comments and Information
all_retract_false	bool	default	false	
extend_EV_change	bool	default	false	

3.1.10.4. Operator Hierarchy

diagram : Case3_Gears_1
  state-machine : all_close
    state : anomaly
    state : detecting
    state : Ordinary

3.1.10.5. Graphical and Textual Diagrams

3.1.10.5.1. View of Case3_Gears_1 (Case3_Gears)

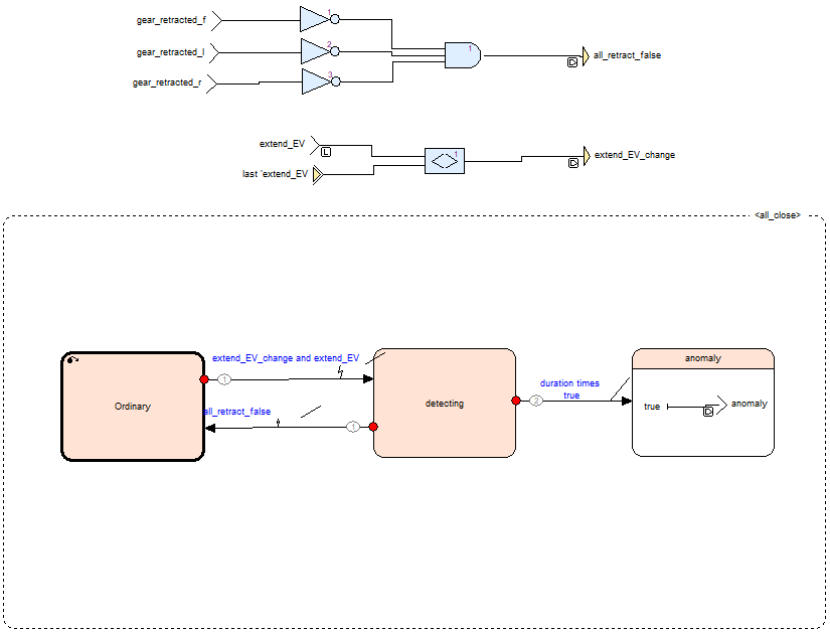


Figure 10: View of Case3_Gears_1 (Case3_Gears)

Table 58: State Machines of Case3_Gears_1

State Machine	Comments and Information
all_close	

Table 59: States of Case3_Gears_1

State	Comments and Information
all_close:anomaly	
all_close:detecting	
all_close:Ordinary	

Table 60: Transitions of Case3_Gears_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: all_close:detecting **Target:** all_close:Ordinary	1	**Condition:** all_retract_false	
Source: all_close:detecting **Target:** all_close:anomaly	2	**Condition:** duration times true	
Source: all_close:Ordinary **Target:** all_close:detecting	1	**Condition:** extend_EV_change and extend_EV	

3.1.11. Case4_Doors Operator

Declared as **`public node`**

3.1.11.1. Comments and Information

Case4_Doors Comments:
This operator deals with the fourth case of anomaly in doors' motion monitoring.

3.1.11.2. Interface

Table 61: Inputs of Case4_Doors

Name	Type	Properties		Comments and Information
door_close_f	bool			
door_close_l	bool			
door_close_r	bool			
close_EV	bool	last	close_EV	
duration	int8			

Table 62: Outputs of Case4_Doors

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.11.3. Locals

Table 63: Locals of Case4_Doors

Name	Type	Properties		Comments and Information
all_close_true	bool			
close_EV_change	bool	default	false	

3.1.11.4. Operator Hierarchy

diagram : Case4_Doors_1
  state-machine : all_close
    state : anomaly
    state : detecting
    state : Ordinary

3.1.11.5. Graphical and Textual Diagrams

3.1.11.5.1. View of Case4_Doors_1 (Case4_Doors)

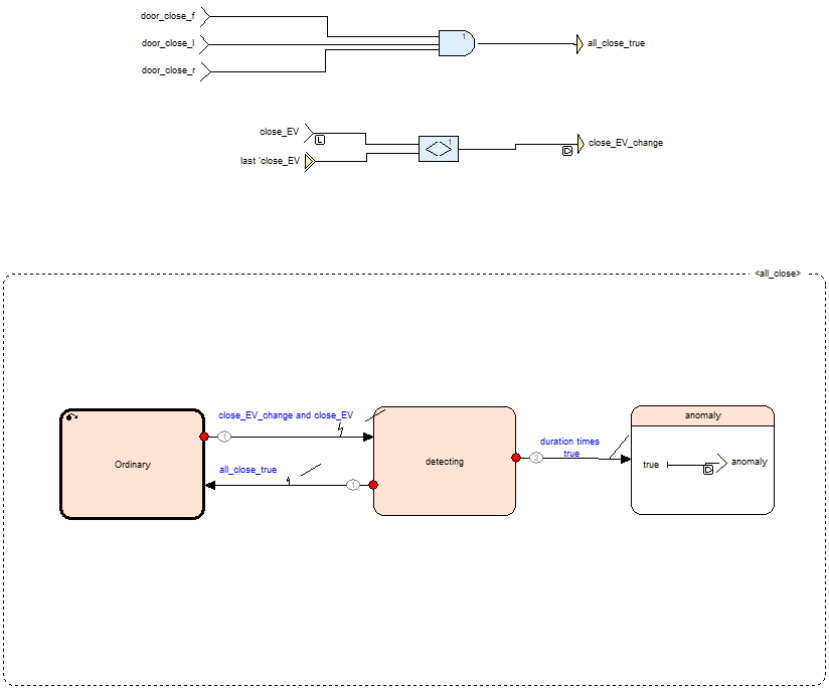


Figure 11: View of Case4_Doors_1 (Case4_Doors)

Table 64: State Machines of Case4_Doors_1

State Machine	Comments and Information
all_close	

Table 65: States of Case4_Doors_1

State	Comments and Information
all_close:anomaly	
all_close:detecting	
all_close:Ordinary	

Table 66: Transitions of Case4_Doors_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: all_close:detecting **Target:** all_close:Ordinary	1	**Condition:** all_close_true	
Source: all_close:detecting **Target:** all_close:anomaly	2	**Condition:** duration times true	
Source: all_close:Ordinary **Target:** all_close:detecting	1	**Condition:** close_EV_change and close_EV	

3.1.12. Case4_Gears Operator

Declared as **`public node`**

3.1.12.1. Comments and Information

Case4_Gears Comments:
This operator deals with the fourth case of anomaly in gears' motion monitoring.

3.1.12.2. Interface

Table 67: Inputs of Case4_Gears

Name	Type	Properties		Comments and Information
gear_extended_f	bool			
gear_extended_l	bool			
gear_extended_r	bool			
extend_EV	bool	last	extend_EV	
duration	int8			

Table 68: Outputs of Case4_Gears

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.12.3. Locals

Table 69: Locals of Case4_Gears

Name	Type	Properties		Comments and Information
all_extend_true	bool			
extend_EV_change	bool	default	false	

3.1.12.4. Operator Hierarchy

diagram : Case4_Gears_1
  state-machine : all_close
    state : anomaly
    state : detecting
    state : Ordinary

3.1.12.5. Graphical and Textual Diagrams

3.1.12.5.1. View of Case4_Gears_1 (Case4_Gears)

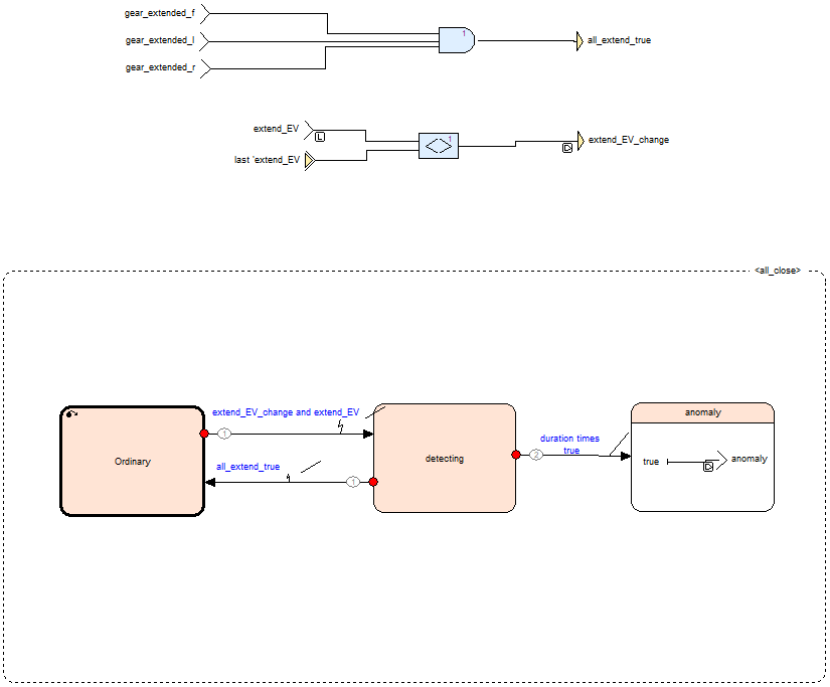


Figure 12: View of Case4_Gears_1 (Case4_Gears)

Table 70: State Machines of Case4_Gears_1

State Machine	Comments and Information
all_close	

Table 71: States of Case4_Gears_1

State	Comments and Information
all_close:anomaly	
all_close:detecting	
all_close:Ordinary	

Table 72: Transitions of Case4_Gears_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: all_close:detecting **Target:** all_close:Ordinary	1	**Condition:** all_extend_true	
Source: all_close:detecting **Target:** all_close:anomaly	2	**Condition:** duration times true	
Source: all_close:Ordinary **Target:** all_close:detecting	1	**Condition:** extend_EV_change and extend_EV	

3.1.13. Computing_Module Operator

Declared as **`public node`**

3.1.13.1. Comments and Information

Computing_Module Comments:
This operator realizes the functions described in 4.1 and repects the timing restraints in 4.2.
"handle_state=true" means the handle is "up", otherwise the handle is "down".

3.1.13.2. Interface

Table 73: Inputs of Computing_Module

Name	Type	Properties		Comments and Information
handle	bool	last	handle	
door_open_f	bool			
door_open_l	bool			
door_open_r	bool			
door_close_f	bool			
door_close_l	bool			
door_close_r	bool			
gear_extended_f	bool			
gear_extended_l	bool			
gear_extended_r	bool			
gear_retracted_f	bool			
gear_retracted_l	bool			
gear_retracted_r	bool			
gear_shock_absorber_f	bool			
gear_shock_absorber_l	bool			
gear_shock_absorber_r	bool			

Table 74: Outputs of Computing_Module

Name	Type	Properties		Comments and Information
gears_locked_down	bool	default	false	
gears_maneuvering	bool	default	false	
general_EV	bool	default	false	
open_EV	bool	default	false	
close_EV	bool	default	false	
extend_EV	bool	default	false	
retract_EV	bool	default	false	

3.1.13.3. Locals

Table 75: Locals of Computing_Module

Name	Type	Properties		Comments and Information
all_absorber_relax	bool	default	false	
all_close_true	bool	default	false	
all_extend_true	bool	default	false	
all_open_true	bool	default	false	
all_retract_true	bool	default	false	
handle_change	bool	default	false	

3.1.13.4. Operator Hierarchy

diagram : Computing_Module_1
state-machine : Computing_Module
state : Closing_Doors
state : door_closed
state : Extending_Gears
state : Initiation
state : Opening_Doors
state : Retracting_Gears
state : Stimulating_close_EV
state : Stimulating_extend_EV
state : Stimulating_gen_EV
state : Stimulating_open_EV
state : Stimulating_retract_EV
state : Stop_Close_Doors
state : Stop_extend_EV_stimulating_close_EV
state : Stop_Extend_Gears
state : Stop_gen_EV
state : Stop_Retracting_Gears
state : Stopping_Gen_EV

3.1.13.5. Graphical and Textual Diagrams

3.1.13.5.1. View of Computing_Module_1 (Computing_Module)

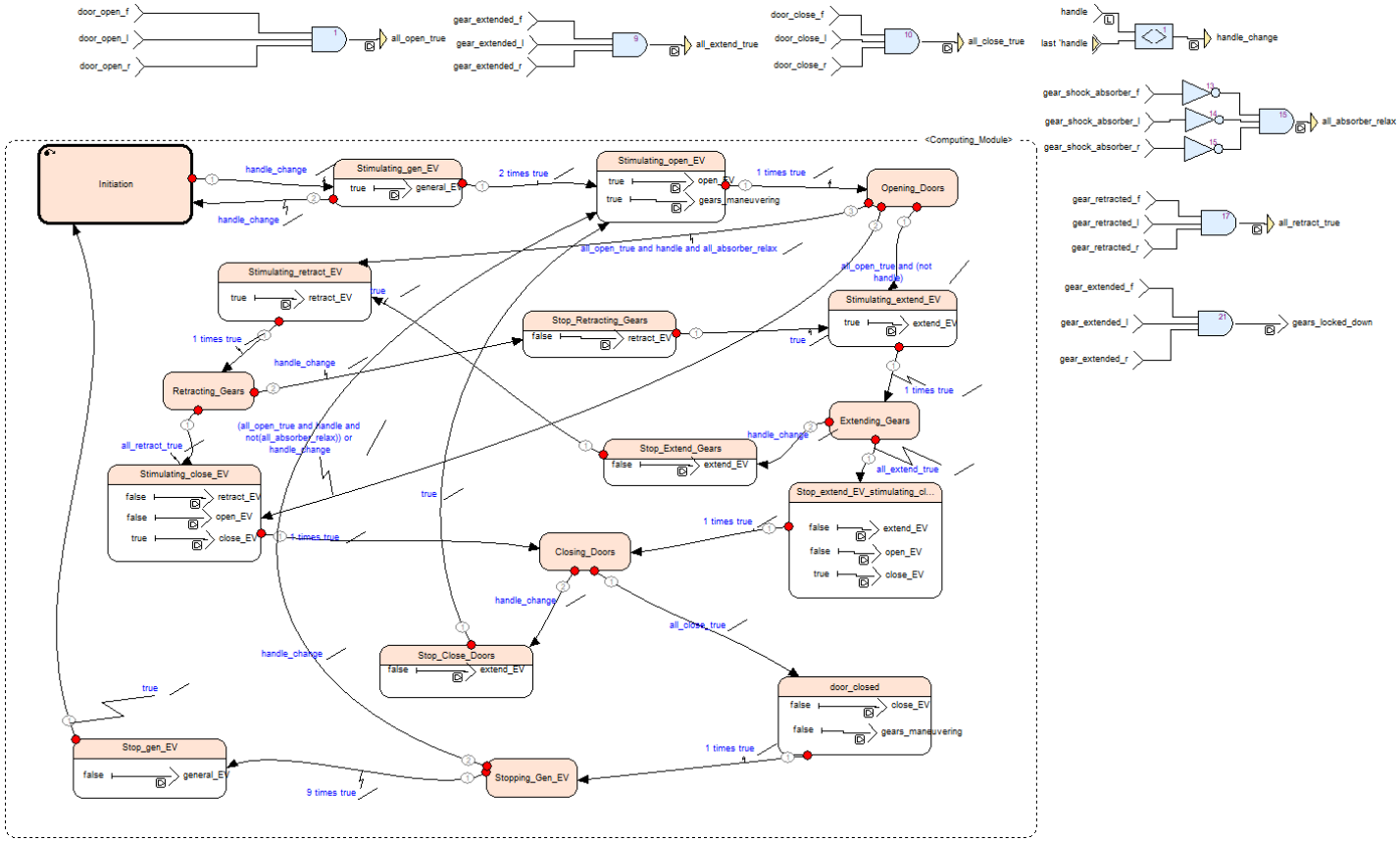


Figure 13: View of Computing_Module_1 (Computing_Module)

Table 76: State Machines of Computing_Module_1

State Machine	Comments and Information
Computing_Module	

Table 77: States of Computing_Module_1

State	Comments and Information
Computing_Module:Closing_Doors	
Computing_Module:door_closed	
Computing_Module:Extending_Gears	
Computing_Module:Initiation	
Computing_Module:Opening_Doors	
Computing_Module:Retracting_Gears	
Computing_Module:Stimulating_close_EV	
Computing_Module:Stimulating_extend_EV	
Computing_Module:Stimulating_gen_EV	
Computing_Module:Stimulating_open_EV	
Computing_Module:Stimulating_retract_EV	
Computing_Module:Stop_Close_Doors	
Computing_Module:Stop_extend_EV_stimulating_close_EV	
Computing_Module:Stop_Extend_Gears	
Computing_Module:Stop_gen_EV	
Computing_Module:Stop_Retracting_Gears	
Computing_Module:Stopping_Gen_EV	

Table 78: Transitions of Computing_Module_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: Computing_Module:Closing_Doors **Target:** Computing_Module:door_closed	1	**Condition:** all_close_true **Actions:**	
Source: Computing_Module:Closing_Doors **Target:** Computing_Module:Stop_Close_Doors	2	**Condition:** handle_change	
Source: Computing_Module:door_closed **Target:** Computing_Module:Stopping_Gen_EV	1	**Condition:** 1 times true	
Source: Computing_Module:Extending_Gears **Target:** Computing_Module:Stop_extend_EV_stimulating_close_EV	1	**Condition:** all_extend_true **Actions:**	

Source: Computing_Module:Extending_Gears **Target:** Computing_Module:Stop_Extend_Gears	2	**Condition:** handle_change	
Source: Computing_Module:Initiation **Target:** Computing_Module:Stimulating_gen_EV	1	**Condition:** handle_change	
Source: Computing_Module:Opening_Doors **Target:** Computing_Module:Stimulating_extend_EV	1	**Condition:** all_open_true and not handle **Actions:**	
Source: Computing_Module:Opening_Doors **Target:** Computing_Module:Stimulating_close_EV	2	**Condition:** all_open_true and handle and not all_absorber_relax or handle_change **Actions:**	
Source: Computing_Module:Opening_Doors **Target:** Computing_Module:Stimulating_retract_EV	3	**Condition:** all_open_true and handle and all_absorber_relax **Actions:**	
Source: Computing_Module:Retracting_Gears **Target:** Computing_Module:Stimulating_close_EV	1	**Condition:** all_retract_true **Actions:**	
Source: Computing_Module:Retracting_Gears **Target:** Computing_Module:Stop_Retracting_Gears	2	**Condition:** handle_change	
Source: Computing_Module:Stimulating_close_EV **Target:** Computing_Module:Closing_Doors	1	**Condition:** 1 times true	
Source: Computing_Module:Stimulating_extend_EV **Target:** Computing_Module:Extending_Gears	1	**Condition:** 1 times true	
Source: Computing_Module:Stimulating_gen_EV **Target:** Computing_Module:Stimulating_open_EV	1	**Condition:** 2 times true	
Source: Computing_Module:Stimulating_gen_EV **Target:** Computing_Module:Initiation	2	**Condition:** handle_change	
Source: Computing_Module:Stimulating_open_EV **Target:** Computing_Module:Opening_Doors	1	**Condition:** 1 times true	
Source: Computing_Module:Stimulating_retract_EV **Target:** Computing_Module:Retracting_Gears	1	**Condition:** 1 times true	
Source: Computing_Module:Stop_Close_Doors **Target:** Computing_Module:Stimulating_open_EV	1	**Condition:** true **Actions:**	
Source: Computing_Module:Stop_extend_EV_stimulating_close_EV **Target:** Computing_Module:Closing_Doors	1	**Condition:** 1 times true	
Source: Computing_Module:Stop_Extend_Gears **Target:** Computing_Module:Stimulating_retract_EV	1	**Condition:** true	
Source: Computing_Module:Stop_gen_EV **Target:** Computing_Module:Initiation	1	**Condition:** true	
Source: Computing_Module:Stop_Retracting_Gears **Target:** Computing_Module:Stimulating_extend_EV	1	**Condition:** true	
Source: Computing_Module:Stopping_Gen_EV **Target:** Computing_Module:Stop_gen_EV	1	**Condition:** 9 times true **Actions:**	
Source: Computing_Module:Stopping_Gen_EV **Target:** Computing_Module:Stimulating_open_EV	2	**Condition:** handle_change	

3.1.14. Door_Monitor Operator

Declared as **`public node`**

3.1.14.1. Comments and Information

Door_Monitor Comments:
This operator realizes Doors Motion Monitoring

3.1.14.2. Interface

Table 79: Inputs of Door_Monitor

Name	Type	Comments and Information
door_closed_f	bool	
door_closed_l	bool	
door_closed_r	bool	
door_open_f	bool	
door_open_l	bool	
door_open_r	bool	
open_EV	bool	
close_EV	bool	

Table 80: Outputs of Door_Monitor

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.14.3. Operator Hierarchy

diagram : Door_Monitor_1

3.1.14.4. Graphical and Textual Diagrams

3.1.14.4.1. View of Door_Monitor_1 (Door_Monitor)

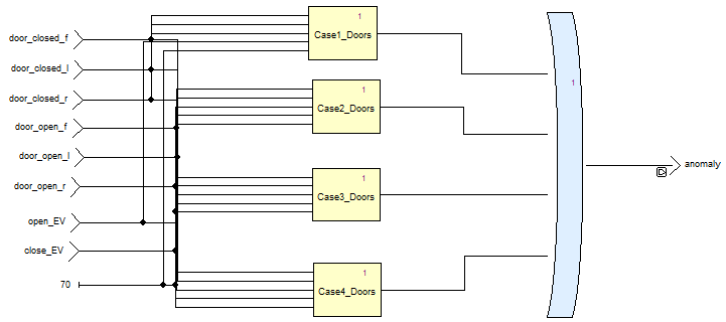


Figure 14: View of Door_Monitor_1 (Door_Monitor)

3.1.15. Gear_Monitor Operator

Declared as **`public node`**

3.1.15.1. Comments and Information

Gear_Monitor Comments:
This operator realizes Gears Motion Monitoring

3.1.15.2. Interface

Table 81: Inputs of Gear_Monitor

Name	Type	Comments and Information
gear_extended_f	bool	
gear_extended_l	bool	
gear_extended_r	bool	
gear_retracted_f	bool	
gear_retracted_l	bool	
gear_retracted_r	bool	
retract_EV	bool	
extend_EV	bool	

Table 82: Outputs of Gear_Monitor

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.15.3. Operator Hierarchy

diagram : Gear_Monitor_1

3.1.15.4. Graphical and Textual Diagrams

3.1.15.4.1. View of Gear_Monitor_1 (Gear_Monitor)

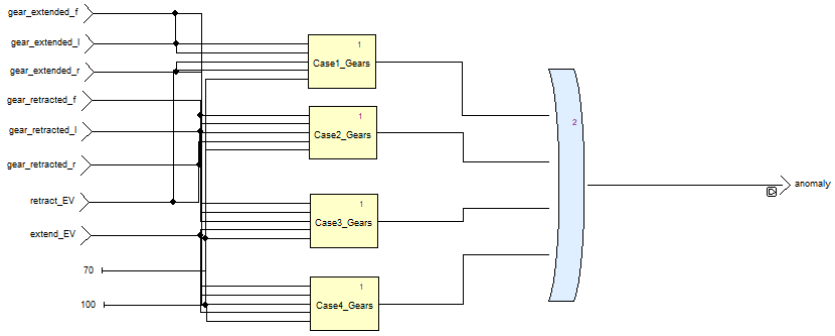


Figure 15: View of Gear_Monitor_1 (Gear_Monitor)

3.1.16. Generic_Monitor Operator

Declared as **`public node`**

3.1.16.1. Comments and Information

Generic_Monitor Comments:
This operator realizes Generic Monitoring

3.1.16.2. Interface

Table 83: Inputs of Generic_Monitor

Name	Type	Comments and Information
handle_1	bool	
handle_2	bool	
handle_3	bool	
analogical_switch_1	bool	
analogical_switch_2	bool	
analogical_switch_3	bool	
gear_extended_f1	bool	
gear_extended_f2	bool	
gear_extended_f3	bool	
gear_extended_l1	bool	
gear_extended_l2	bool	
gear_extended_l3	bool	
gear_extended_r1	bool	
gear_extended_r2	bool	
gear_extended_r3	bool	
gear_retracted_f1	bool	
gear_retracted_f2	bool	
gear_retracted_f3	bool	
gear_retracted_l1	bool	
gear_retracted_l2	bool	
gear_retracted_l3	bool	
gear_retracted_r1	bool	
gear_retracted_r2	bool	
gear_retracted_r3	bool	
gear_shock_absorber_f1	bool	
gear_shock_absorber_f2	bool	
gear_shock_absorber_f3	bool	
gear_shock_absorber_l1	bool	
gear_shock_absorber_l2	bool	
gear_shock_absorber_l3	bool	

gear_shock_absorber_r1	bool	
gear_shock_absorber_r2	bool	
gear_shock_absorber_r3	bool	
door_closed_f1	bool	
door_closed_f2	bool	
door_closed_f3	bool	
door_closed_l2	bool	
door_closed_l1	bool	
door_closed_l3	bool	
door_closed_r1	bool	
door_closed_r2	bool	
door_closed_r3	bool	
door_open_f1	bool	
door_open_f2	bool	
door_open_f3	bool	
door_open_l1	bool	
door_open_l2	bool	
door_open_l3	bool	
door_open_r1	bool	
door_open_r2	bool	
door_open_r3	bool	
circuit_pressurized_1	bool	
circuit_pressurized_2	bool	
circuit_pressurized_3	bool	

Table 84: Outputs of Generic_Monitor

Name	Type	Properties	Comments and Information
handle_state	bool		
switch_state	bool		
extend_state_f	bool		
extend_state_l	bool		
extend_state_r	bool		
retract_state_f	bool		
retract_state_l	bool		
retract_state_r	bool		
absorber_state_f	bool		
absorber_state_l	bool		
absorber_state_r	bool		
close_state_f	bool		
close_state_l	bool		
close_state_r	bool		
open_state_f	bool		
open_state_l	bool		
open_state_r	bool		
circuit_state	bool		
anomaly	bool	default false	

3.1.16.3. Operator Hierarchy

diagram : Generic_Monitor_1

3.1.16.4. Graphical and Textual Diagrams

3.1.16.4.1. View of Generic_Monitor_1 (Generic_Monitor)

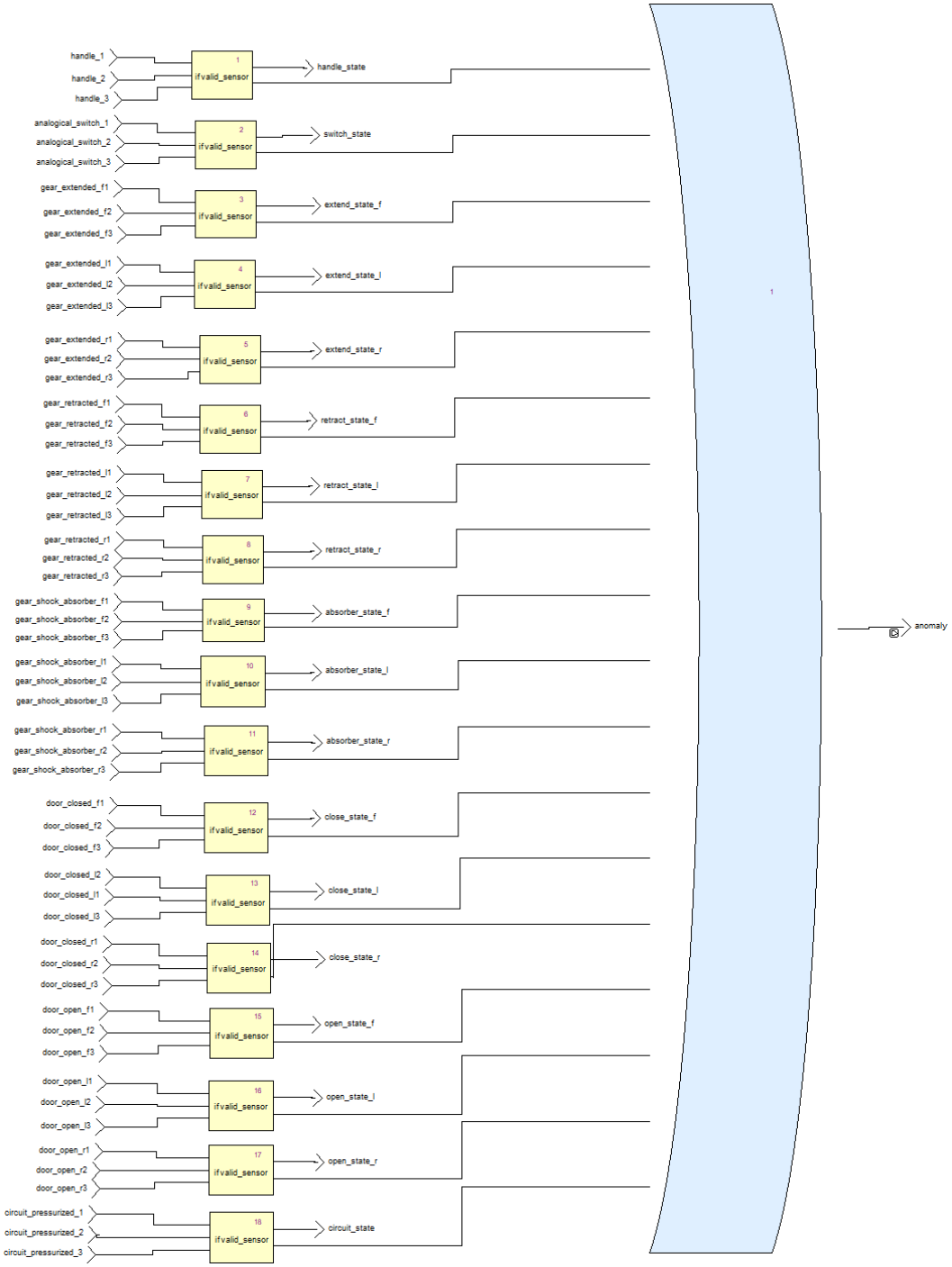


Figure 16: View of Generic_Monitor_1 (Generic_Monitor)

3.1.17. Health_Monitor Operator

Declared as **`public node`**

3.1.17.1. Comments and Information

Health_Monitor Comments:
This operator realizes health monitoring described in 4.3.

3.1.17.2. Interface

Table 85: Inputs of Health_Monitor

Name	Type	Comments and Information
door_closed_f	bool	
door_closed_l	bool	
door_closed_r	bool	
door_open_f	bool	
door_open_l	bool	
door_open_r	bool	
gear_extended_f	bool	
gear_extended_l	bool	
gear_extended_r	bool	
gear_retracted_f	bool	
gear_retracted_l	bool	
gear_retracted_r	bool	
circuit_state	bool	
handle_state	bool	
switch_state	bool	
open_EV	bool	
close_EV	bool	
retract_EV	bool	
extend_EV	bool	
general_EV	bool	

Table 86: Outputs of Health_Monitor

Name	Type	Properties	Comments and Information

anomaly	bool	default	false	

3.1.17.3. Operator Hierarchy

diagram : Health_Monitor_1

3.1.17.4. Graphical and Textual Diagrams

3.1.17.4.1. View of Health_Monitor_1 (Health_Monitor)

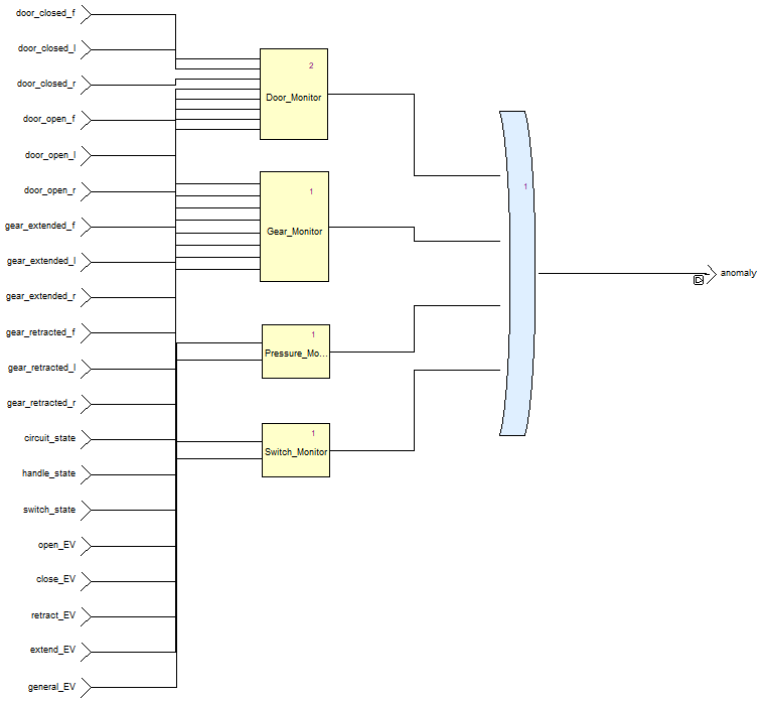


Figure 17: View of Health_Monitor_1 (Health_Monitor)

3.1.18. ifvalid_sensor Operator

Declared as **`public node`**

3.1.18.1. Comments and Information

ifvalid_sensor Comments:
This operator tests the validity of each kind of sensor.

3.1.18.2. Interface

Table 87: Inputs of ifvalid_sensor

Name	Type	Comments and Information
sensor_1	bool	
sensor_2	bool	
sensor_3	bool	

Table 88: Outputs of ifvalid_sensor

Name	Type	Properties		Comments and Information
output	bool			
anomaly	bool	default	false	

3.1.18.3. Locals

Table 89: Locals of ifvalid_sensor

Name	Type	Comments and Information
diff_12	bool	
diff_13	bool	
diff_23	bool	
equal_12	bool	
equal_13	bool	
equal_23	bool	

3.1.18.4. Operator Hierarchy

diagram : ifvalid_sensor_1
state-machine : test_valiid
state : Eliminate_1
state : Eliminate_2
state : Eliminate_3
state : Invalid
state : valid_all

3.1.18.5. Graphical and Textual Diagrams

3.1.18.5.1. View of ifvalid_sensor_1 (ifvalid_sensor)

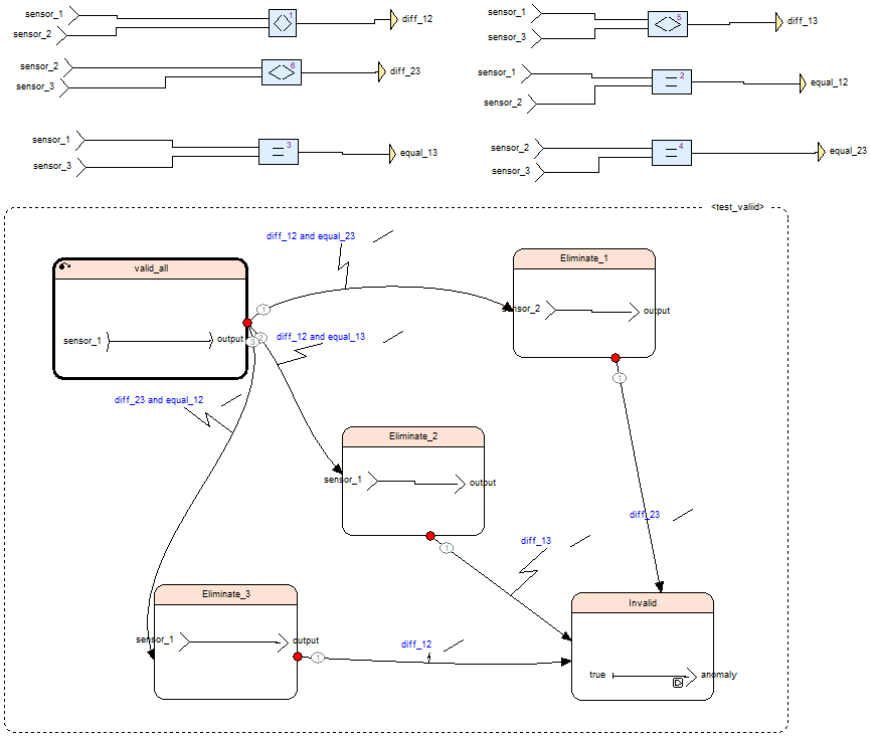


Figure 18: View of ifvalid_sensor_1 (ifvalid_sensor)

Table 90: State Machines of ifvalid_sensor_1

State Machine	Comments and Information
test_valiid	

Table 91: States of ifvalid_sensor_1

State	Comments and Information
test_valiid:Eliminate_1	
test_valiid:Eliminate_2	
test_valiid:Eliminate_3	
test_valiid:Invalid	
test_valiid:valid_all	

Table 92: Transitions of ifvalid_sensor_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: test_valiid:Eliminate_1 **Target:** test_valiid:Invalid	1	**Condition:** diff_23	
Source: test_valiid:Eliminate_2 **Target:** test_valiid:Invalid	1	**Condition:** diff_13	
Source: test_valiid:Eliminate_3 **Target:** test_valiid:Invalid	1	**Condition:** diff_12	
Source: test_valiid:valid_all **Target:** test_valiid:Eliminate_1	1	**Condition:** diff_12 and equal_23	
Source: test_valiid:valid_all **Target:** test_valiid:Eliminate_2	2	**Condition:** diff_12 and equal_13	
Source: test_valiid:valid_all **Target:** test_valiid:Eliminate_3	3	**Condition:** diff_23 and equal_12	

3.1.19. Pressure_Monitor Operator

Declared as **`public node`**

3.1.19.1. Comments and Information

Pressure_Monitor Comments:
This operator realizes Pressure Sensor Monitoring

3.1.19.2. Interface

Table 93: Inputs of Pressure_Monitor

Name	Type	Comments and Information
circuit_state	bool	
general_EV	bool	

Table 94: Outputs of Pressure_Monitor

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.19.3. Operator Hierarchy

diagram : Pressure_Monitor_1

3.1.19.4. Graphical and Textual Diagrams

3.1.19.4.1. View of Pressure_Monitor_1 (Pressure_Monitor)

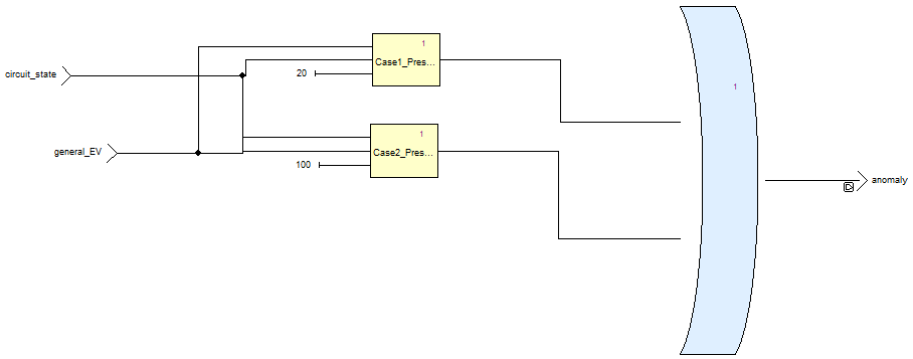


Figure 19: View of Pressure_Monitor_1 (Pressure_Monitor)

3.1.20. Switch_Monitor Operator

Declared as **`public node`**

3.1.20.1. Comments and Information

Switch_Monitor Comments:
This operator realizes analogical switch monitoring

3.1.20.2. Interface

Table 95: Inputs of Switch_Monitor

Name	Type	Comments and Information
handle_state	bool	
switch_state	bool	

Table 96: Outputs of Switch_Monitor

Name	Type	Properties		Comments and Information
anomaly	bool	default	false	

3.1.20.3. Operator Hierarchy

diagram : Switch_Monitor_1

3.1.20.4. Graphical and Textual Diagrams

3.1.20.4.1. View of Switch_Monitor_1 (Switch_Monitor)

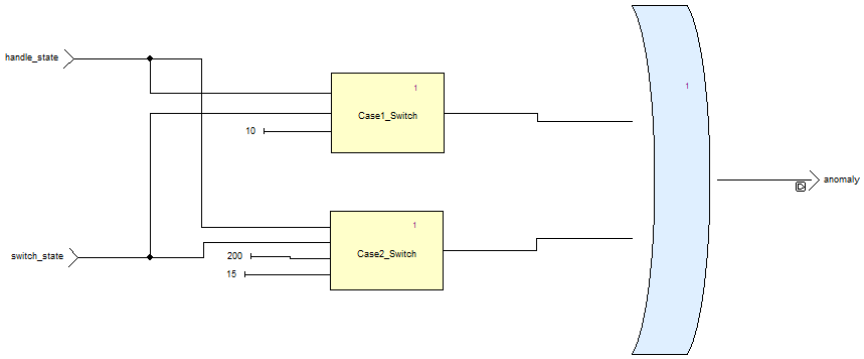


Figure 20: View of Switch_Monitor_1 (Switch_Monitor)

3.1.21. Total_System Operator

Declared as **`public node`**

3.1.21.1. Comments and Information

Total_System Comments:
This operator is the total system that uses all of other operators created in this project.

3.1.21.2. Interface

Table 97: Inputs of Total_System

Name	Type	Comments and Information
handle_1	bool	
handle_2	bool	
handle_3	bool	
analogical_switch_1	bool	
analogical_switch_2	bool	
analogical_switch_3	bool	
gear_extended_f1	bool	
gear_extended_f2	bool	
gear_extended_f3	bool	
gear_extended_l1	bool	
gear_extended_l2	bool	
gear_extended_l3	bool	
gear_extended_r1	bool	
gear_extended_r2	bool	
gear_extended_r3	bool	
gear_retracted_f1	bool	
gear_retracted_f2	bool	
gear_retracted_f3	bool	
gear_retracted_l1	bool	
gear_retracted_l2	bool	
gear_retracted_l3	bool	
gear_retracted_r1	bool	
gear_retracted_r2	bool	
gear_retracted_r3	bool	
gear_shock_absorber_f1	bool	
gear_shock_absorber_f2	bool	
gear_shock_absorber_f3	bool	
gear_shock_absorber_l1	bool	
gear_shock_absorber_l2	bool	
gear_shock_absorber_l3	bool	
gear_shock_absorber_r1	bool	
gear_shock_absorber_r2	bool	
gear_shock_absorber_r3	bool	

door_closed_f1	bool	
door_closed_f2	bool	
door_closed_f3	bool	
door_closed_l1	bool	
door_closed_l2	bool	
door_closed_l3	bool	
door_closed_r1	bool	
door_closed_r2	bool	
door_closed_r3	bool	
door_open_f1	bool	
door_open_f2	bool	
door_open_f3	bool	
door_open_l1	bool	
door_open_l2	bool	
door_open_l3	bool	
door_open_r1	bool	
door_open_r2	bool	
door_open_r3	bool	
circuit_pressurized_1	bool	
circuit_pressurized_2	bool	
circuit_pressurized_3	bool	

Table 98: Outputs of Total_System

Name	Type	Properties		Comments and Information
gears_locked_down	bool	default	false	
gears_maneuvering	bool	default	false	
anomaly	bool	default	false	

3.1.21.3. Operator Hierarchy

diagram : Total_System_1

3.1.21.4. Graphical and Textual Diagrams

3.1.21.4.1. View of Total_System_1 (Total_System)

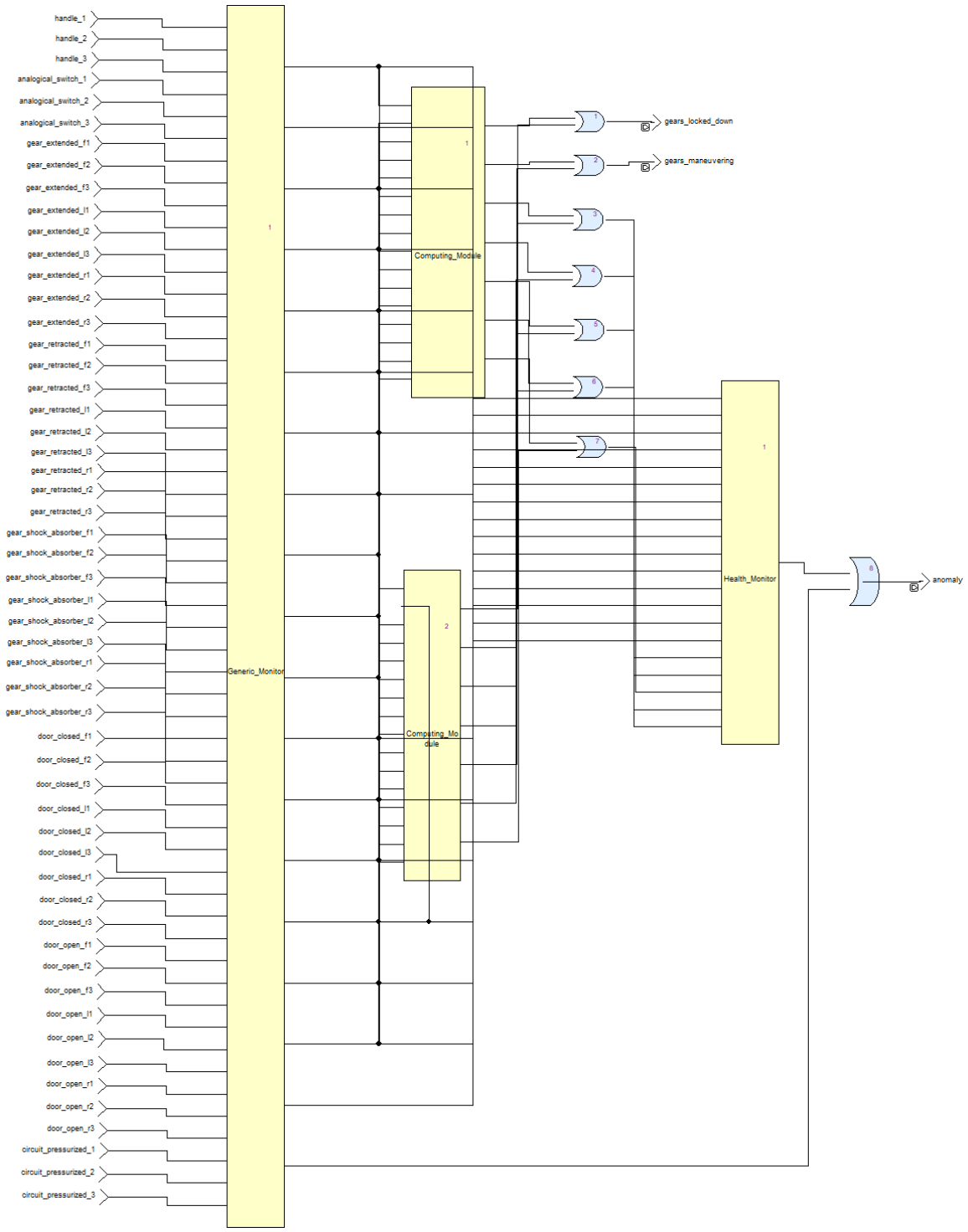


Figure 21: View of Total_System_1 (Total_System)

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