Trucks Platooning

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*Abstract*— Platooning for trucks on highways has been increasingly investigated in lots of research projects. While many projects mainly focus on proposing new strategies to ensure road safety, traffic congestion and pollution, conversely little work is done on what are the basic ideas, requirements or how to form these platoons. This paper specifies detailed on diagrams and implement part of the behavior based on real situations. Explanation for platoon initialization, joining, leaving and splitting.

Keywords—Urban Platooning, C-ACC, platoon split up, …

# Introduction

Truck platooning has been aware in recent years as a leading area and both automated and cooperative vehicle technologies largely apply this technique into this category. Because trucking costs a lot and has dangerous situations, potential financial savings, and road safety have already demonstrated proof of concept of truck platooning, makes trucking an area that is attractive to apply this skill.

# Model based design with SysMl

## Specification of the analysis model in SysML

## Specify at least 10 requirements

1. Platoon formation and within the range of platoon
2. Uniform distance between the platoons
3. Uniform speed between the platoons
4. Constant communication between the trucks - information sharing
5. Uniform lateral and longitudinal control
6. Platoon maneuver coordinator
7. Gap adaptation
8. Emergency braking
9. Disengaging the platoon
10. Identification of road properties like sign recognition, Pedestrian detection, traffic light detection etc.
11. Fuel monitoring between the platoons
12. Safe Parking of platoons

## Define the context/ use cases of the system

1. Gap adaptation using object detection

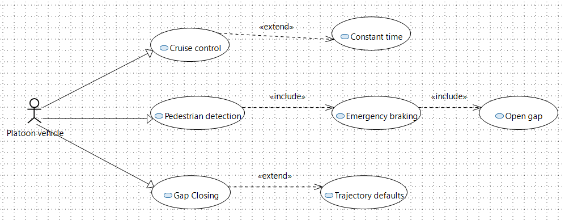
Use cases:  


Fig. ?. Use cases for gap adaptation using object detection.

Activity diagram:

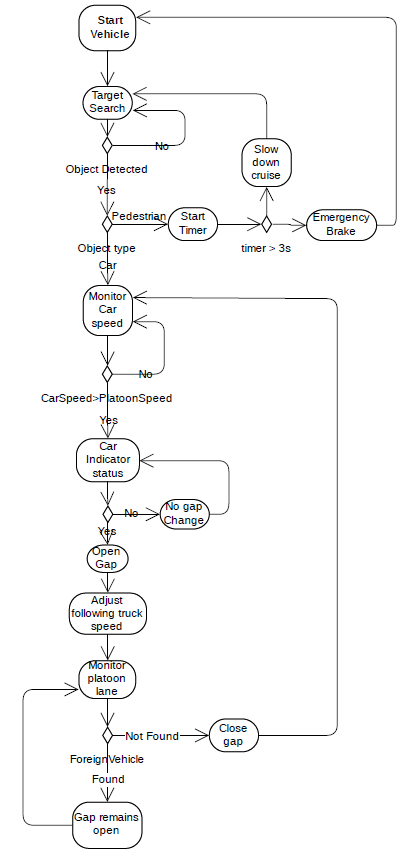


Fig. ?. Activity diagram for gap adaptation using object detection.

1. Saul’s part

Use cases

Activity diagram

1. Parking system

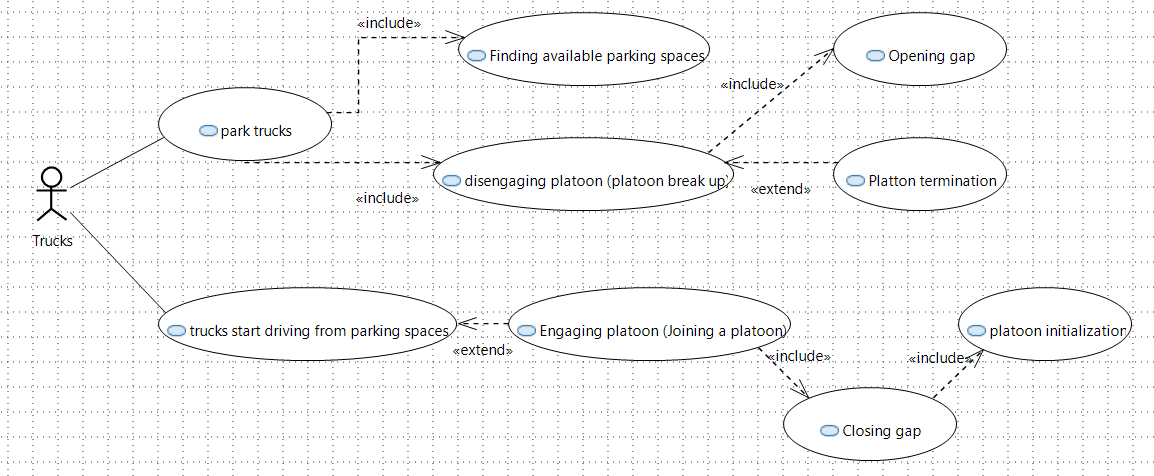
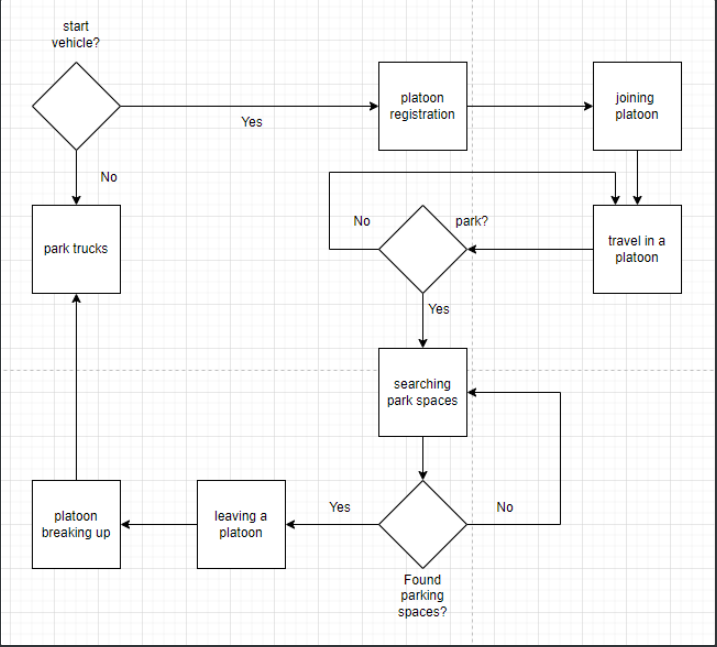
Use cases:  


Fig. ?. Use cases for parking system.

Activity diagram  
**  
Fig. ?. Activity diagram for parking system.

## Define the analysis architecture

* 1. Gap adaptation using object detection

Block diagram:

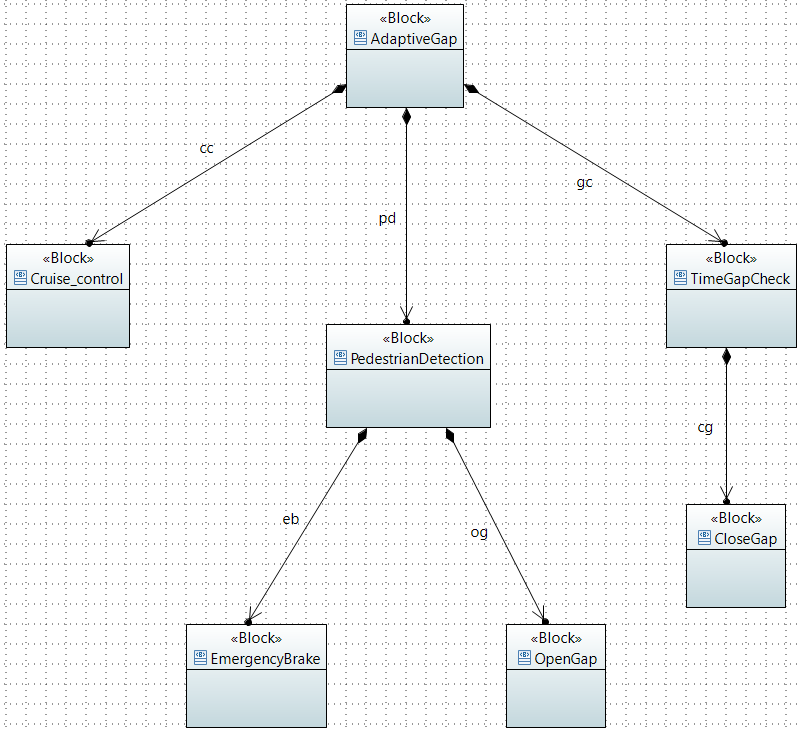


Fig. ?. Block diagram for gap adaptation using object detection.

Sequence diagram:

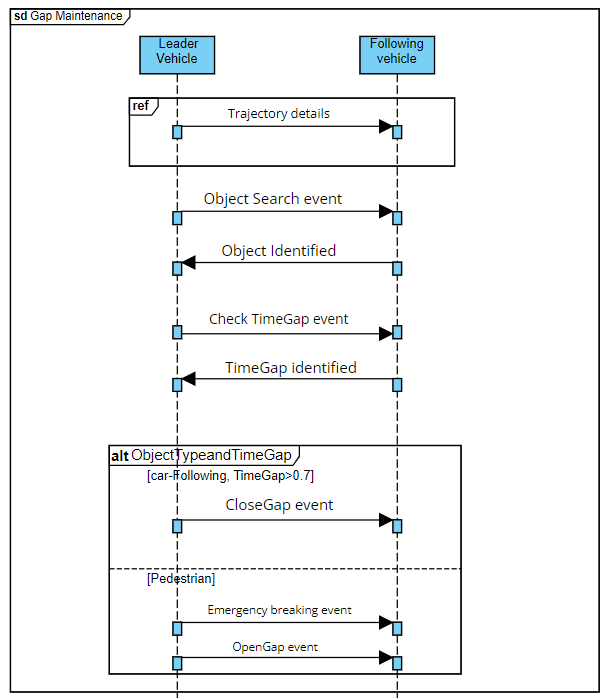


Fig. ?. Sequence diagram for gap adaptation using object detection

* 1. Saul

Block diagram:

Sequence diagram:

* 1. Parking system

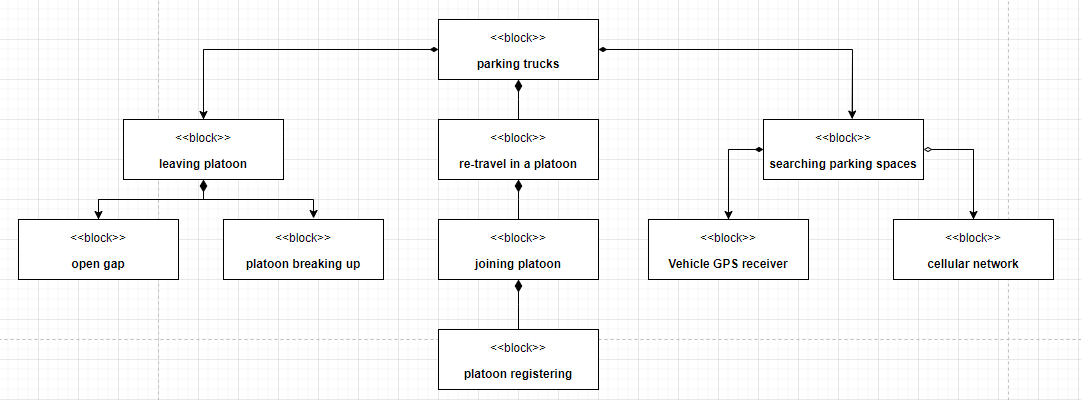
Block diagram:  


Fig. ?. Block diagram for parking system

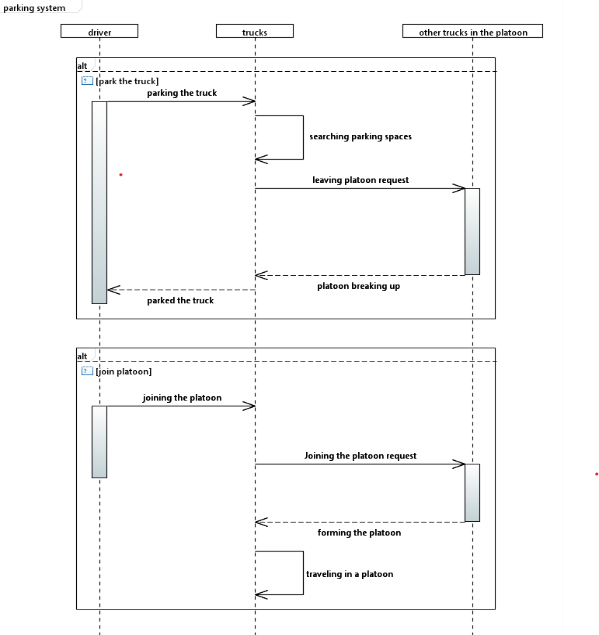
Sequence diagram:  


Fig. ?. Sequence diagram for parking system

## Specification of the analysis model in SysMl

1. *Parametric constraint diagrams*

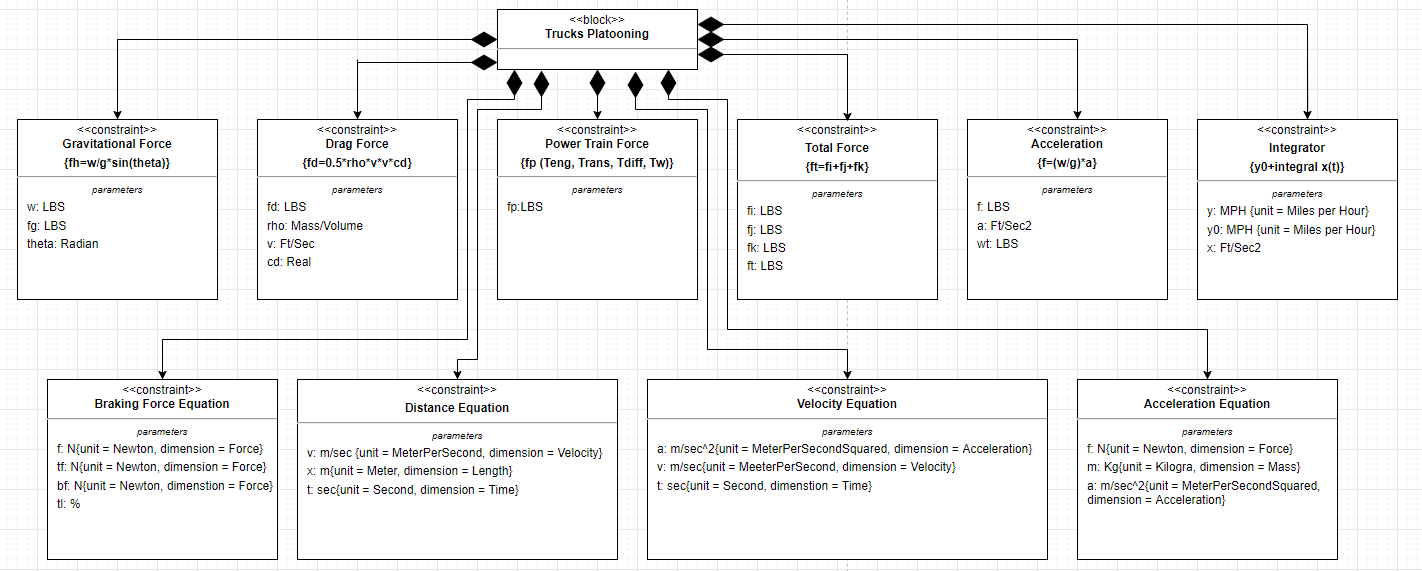


Fig. ?. block definition diagram for parametric constraint diagram.

1. *Allocation diagram*

## Design model from analysis model

1. *Architecture with the help of internal block diagrams*
2. Gap adaptation using object detection

Block diagram with internal block diagram:

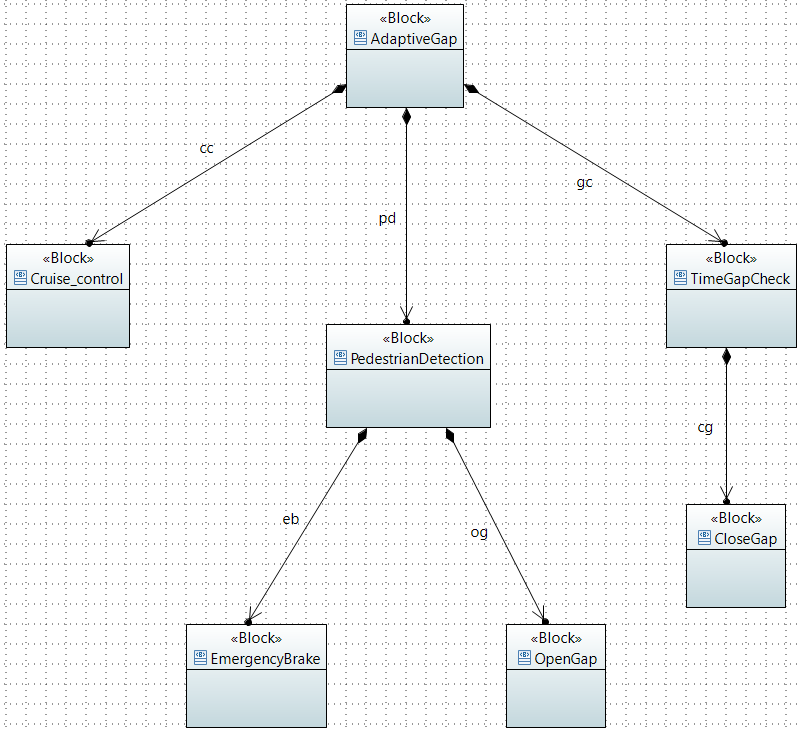


Fig. ?. Block diagram for gap adaptation using object detection.

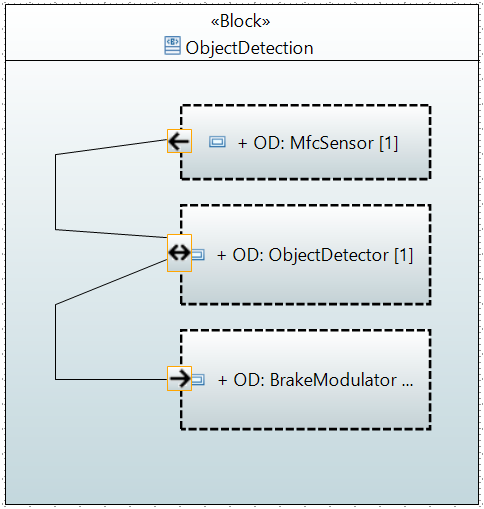


Fig. ?. Internal block diagram for object detection.

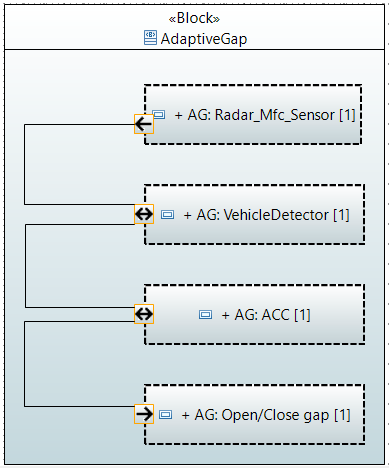


Fig. ?. Internal block diagram for adaptive gap.

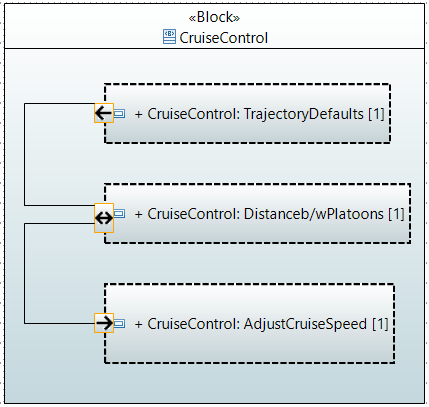


Fig. ?. Internal block diagram for cruise control.

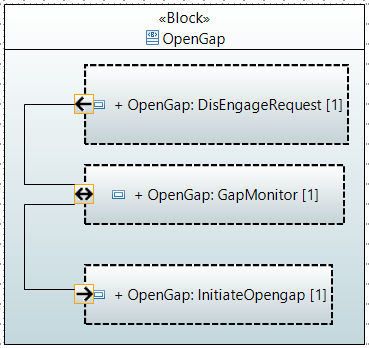


Fig. ?. Internal block diagram for open gap.

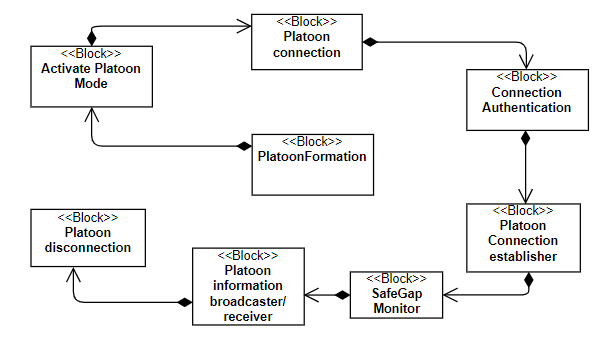


Fig. ?. Block diagram for platoon formation.

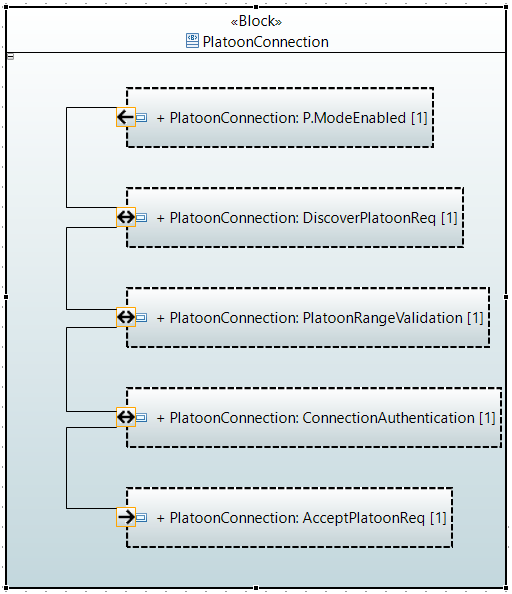


Fig. ?. Internal block diagram for platoon connection.

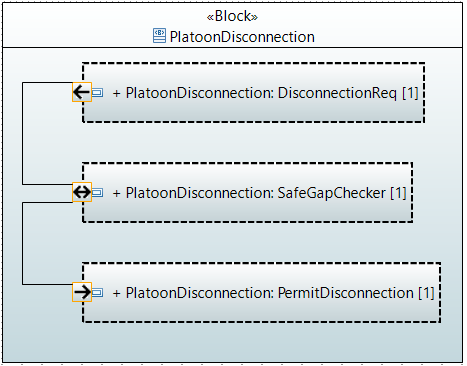
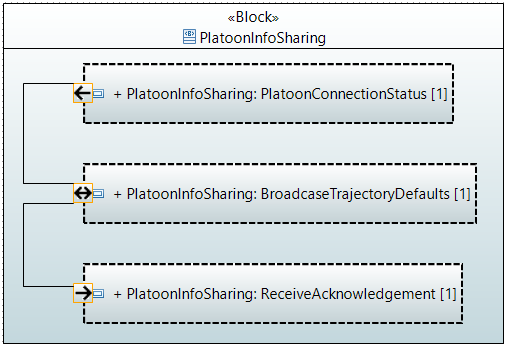


Fig. ?. Internal block diagram for platoon disconnection.

  
Fig. ?. Internal block diagram for platoon sharing.

1. Saul

Block diagram with internal block diagram:

1. Parking system

Block diagram with internal block diagram:

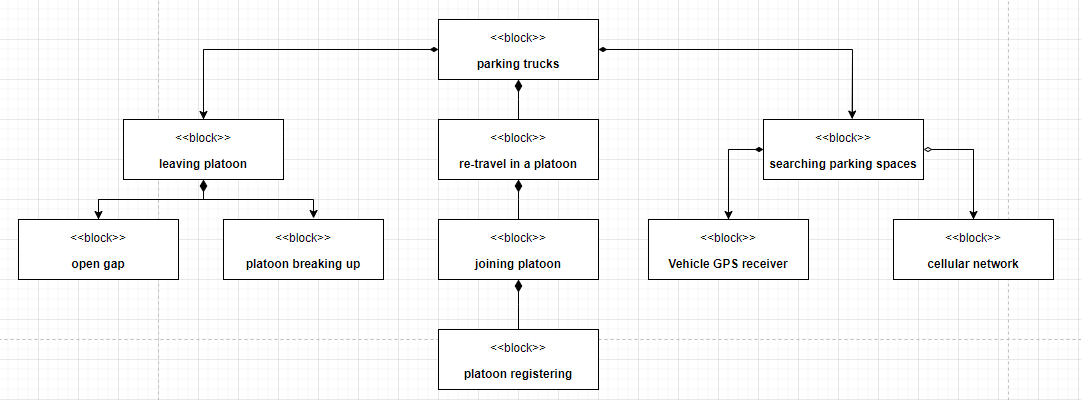


Fig. ?. Block diagram for parking system.

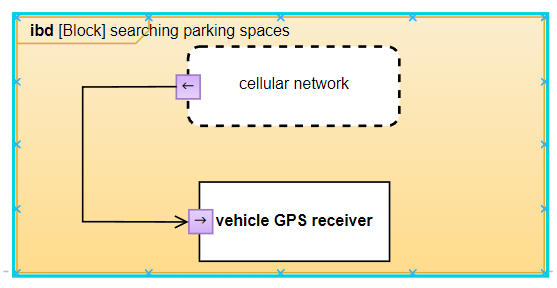


Fig. ?. Internal block diagram for searching parking spaces

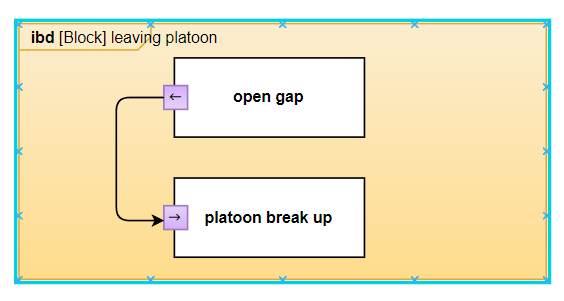


Fig. ?. Internal block diagram for leaving platoon

1. *Behavior with state machines*
2. Gap adaptation using object detection

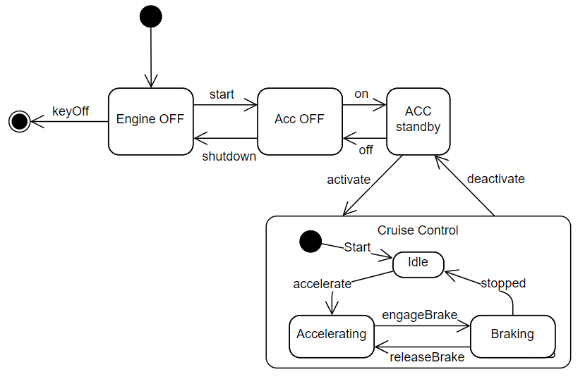


Fig. ?. State machine for gap adaptation using object detection

1. *Saul*

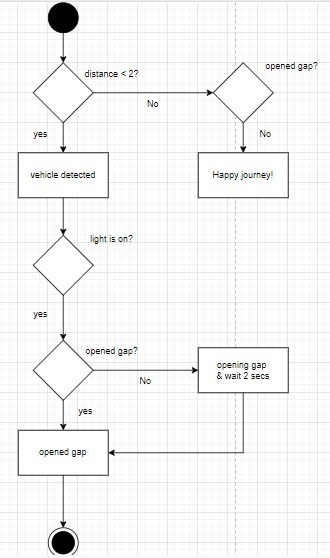


Fig. ?. ???

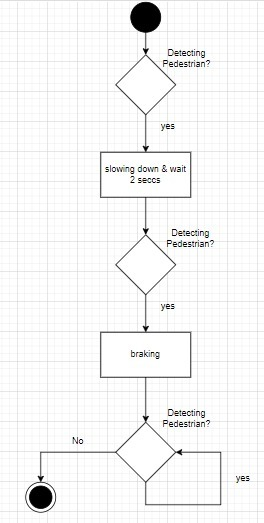


Fig. ?. ???

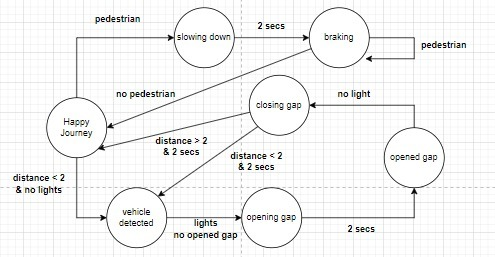


Fig. ?. ???

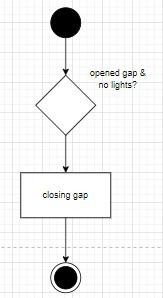


Fig. ?. ???

1. *Parking system*

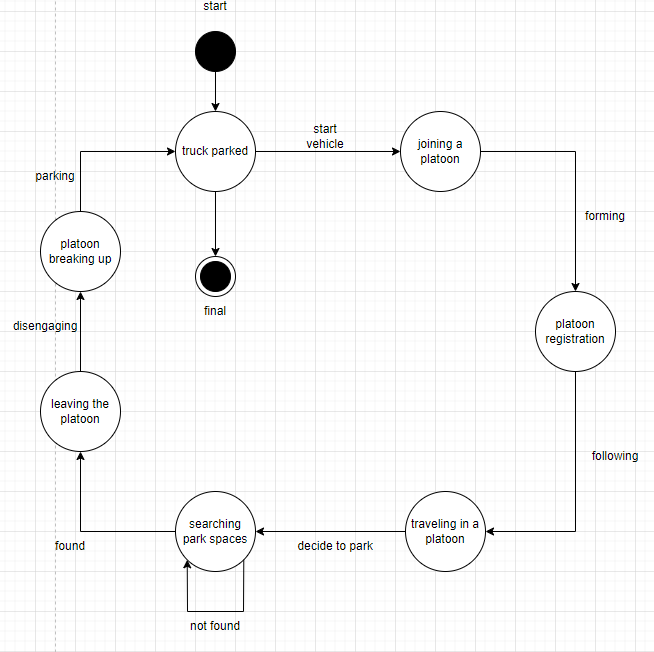


Fig. ?. State machine for parking system.

1. *Implementation for state machine behavior*

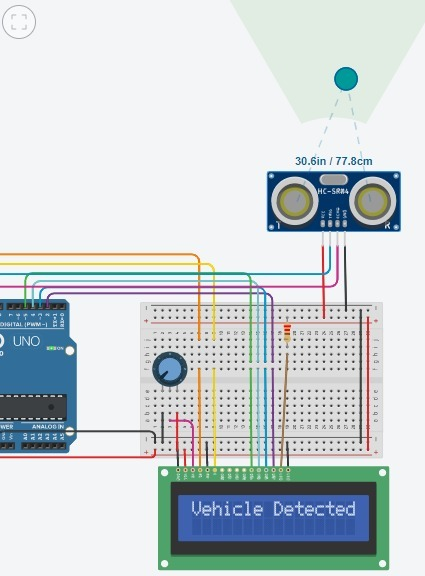


Fig. ?. Simulation on TinkerCAD.(please check)

# *Scheduling*

## Specified requirements to the level of scheduling

1. *Define the computation time of the task of the component we implement*
2. *Specify all scheduling constraints based on the requirements*

## Proof for Implement component is scheduable

# *V&V (Testing)*

1. *Junit testing*

Testing was done to validate the code implemented for the Arduino board using the software Eclipse IDE and Junit. There were created 3 functions: the first function consists in the validation for detection of a pedestrian with 3 different use cases, the second one consists in the validation for detection of a vehicle with 4 different use cases and the last one was used to test the correct display of a message.

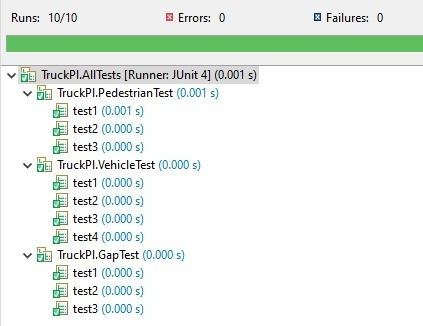


Fig. ?. Unit test result in Junit.

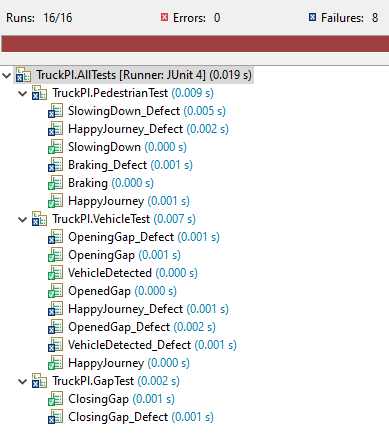
1. *Defect test*

Fig. ?. Defect test result in Junit.

1. *Component / interface testing*
2. *Component / block testing in a test-driven based way*

# Conclusion

with units. In the example, write “Magnetization (A/m)” or “Magnetization {A[m(1)]}”, not just “A/m”. Do not label axes with a ratio of quantities and units. For example, write “Temperature (K)”, not “Temperature/K”.

##### Conclusion

The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression “one of us (R. B. G.) thanks ...”. Instead, try “R. B. G. thanks...”. Put sponsor acknowledgments in the unnumbered footnote on the first page.

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