USER REQUIREMENTS SPECIFICATIONS

Hyena Crossing

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Version 1.5

VERSION HISTORY

February 23, 2020: Created the document.
March 04,2020: Added functional and non-functional requirements, UI sketches and use-cases for iteration 1.
March 15,2020: Updated the use cases.
April 05, 2020: Added iteration 2 use cases.
May 25, 2020: Updated the use cases.
June 16, 2020: Added Iteration 3 use cases.

INTRODUCTION

This document is going to cover all the required features that the client has requested from our application.

We are going to represent those requirements in a form of use cases.

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NON-FUNCTIONAL REQUIREMENTS

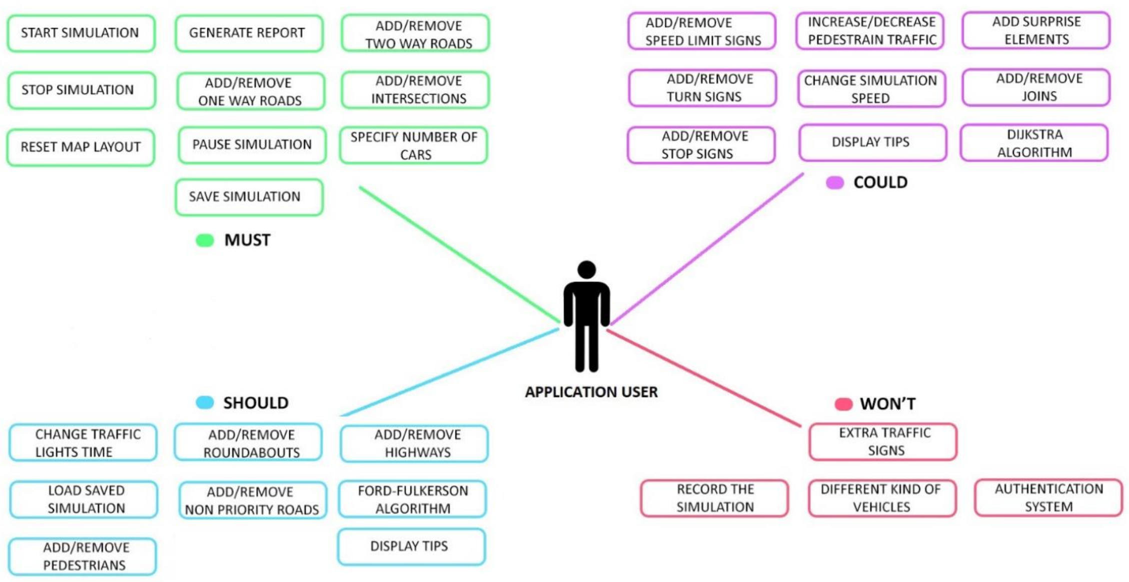
- **Robustness** - the application has to work without errors when executed.
- **Efficiency** - the application has to work smoothly with small response time
- **Usability** - the application needs to have user-friendly ui
- **Readability** - the code of the application has to be structured and the solutions justified
- **Testability** - the application has to be tested with test cases
- **Accessibility** - the application has to work on Windows

FUNCTIONAL REQUIREMENTS

The functional requirements for our application are shown in this use case diagram.

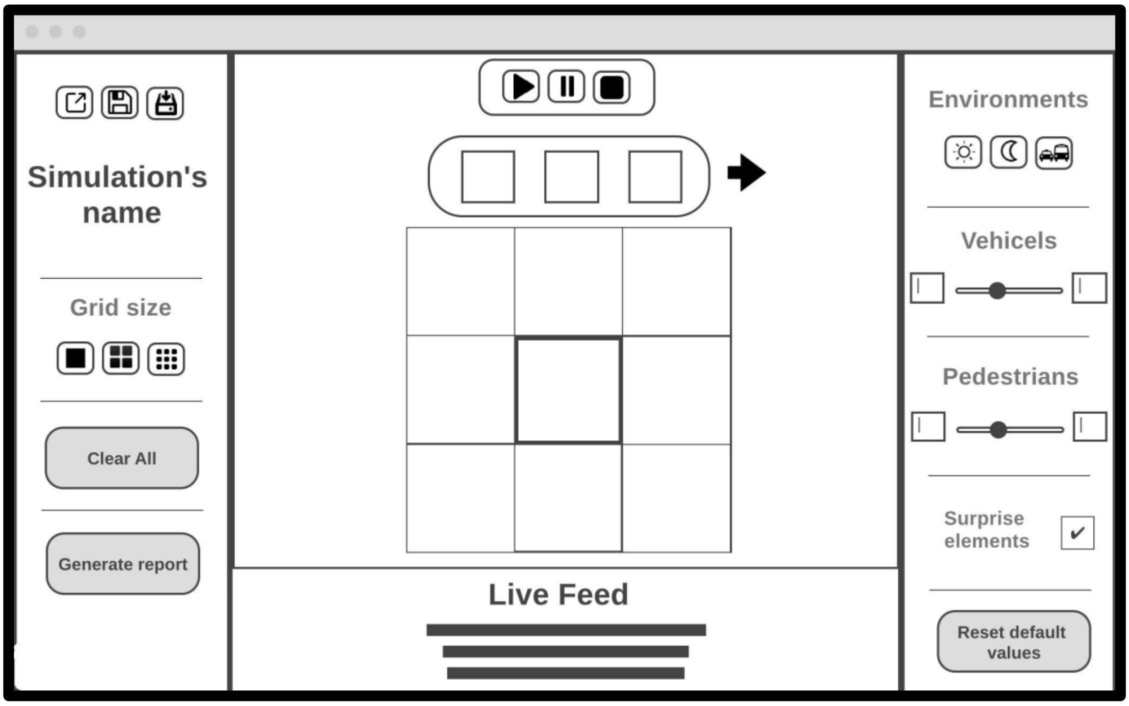
The must features will be explored further in the use cases section.

USE CASE DIAGRAM



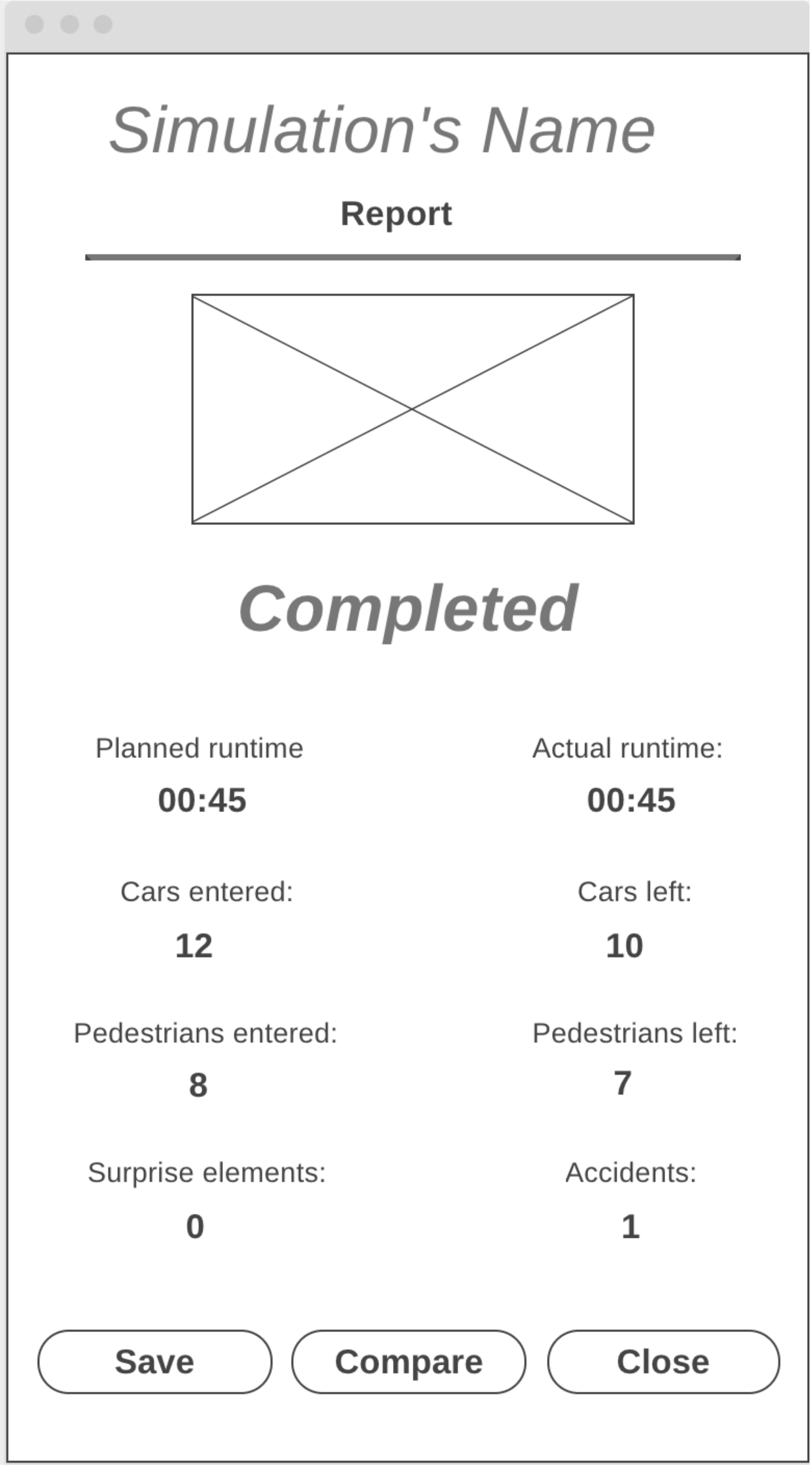
USER INTERFACE SKETCHES

Our application will have the following layout for the main screen:



This window has 4 panels:

1- File & Grid options (Left panel): From top towards bottom you can see the file options (Open - Save - Save as). Underneath that you can find the simulation's name that the user can edit. Followed by grid size options (Small - Medium - Large). Next you can see a "Clear All" button which removes all elements from the grid. After that you can see the "Generate report" button which displays a report about the simulation that just took place, here's an example of such window:



Simulation's Name

Report

Completed

Planned runtime
00:45

Actual runtime:
00:45

Cars entered:
12

Cars left:
10

Pedestrians entered:
8

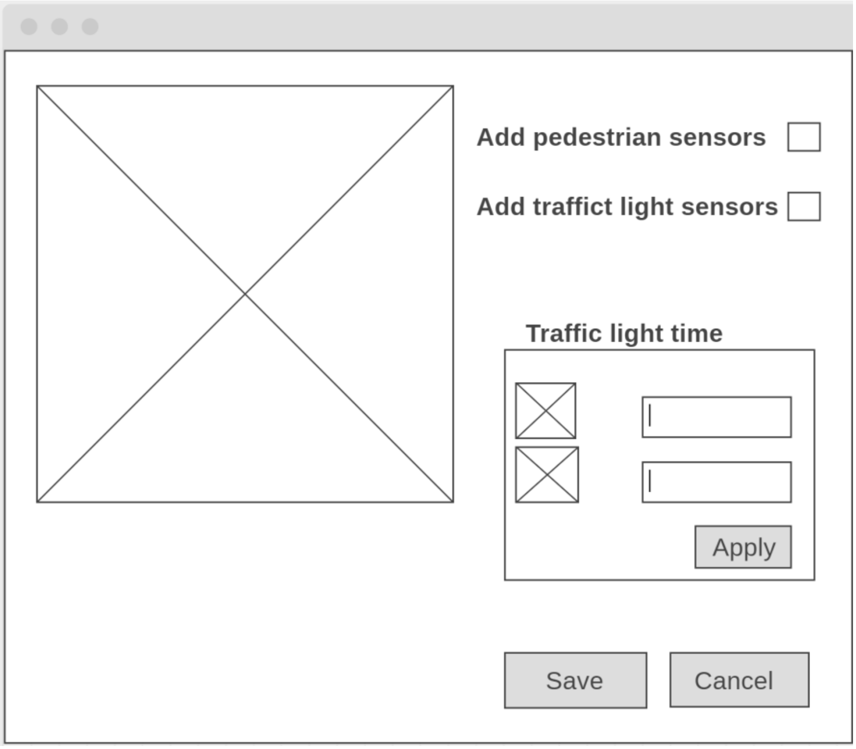
Pedestrians left:
7

Surprise elements:
0

Accidents:
1

2- Simulation’s main screen (Top-center panel): This is the screen where the actual simulation is going to take place, on top you have “Play - Pause - Stop” buttons. Underneath you have the pieces list window, this window is visible whenever a user clicks on an empty piece of the grid. After that you have the grid on which the user can have the pieces on.

By double clicking on a specific piece, a window form for modifying the settings of the selected piece will be shown on the screen.



The user will be able to set the green and the red light time per traffic light and add / remove sensors. To change the green or the red time of a traffic light, the user will select the traffic light by clicking on it and inserting in the text boxes the desired amount of seconds for each traffic color.The settings are saved per traffic light by clicking the “Apply” button.

The user can also choose to add pedestrian or traffic light sensors.To save the changes,the user can click the “Save button” on the bottom of the form.The user will be informed if the changes have been successfully applied.

3- Live feed (Bottom-center panel): This window will provide updates/live feed about the simulation while it’s taking place.

4- Dynamic elements (Right panel): This panel is for adding/removing/modifying live elements (pedestrians - vehicles - emergency vehicles) to the simulation. On top you can find Pre-set environments with 3 pre-defined environments (Normal day traffic - Normal night traffic - Rush hour), in which the user can click on one and it would modify the parameters to emulate that environment. Afterwards you have the pedestrians and vehicles sliders, which the user can use to specify how many cars/people this simulation is going to have. Next you have the "Surprise elements" checkbox, which adds a percentage of random events taking place on the map to simulate real-life traffic (e.g. An accident happening & ambulance/police cars showing up). Lastly we have the "Reset default values" button, which restores the default parameters of this panel. This panel is also unaccessible while the simulation is taking place.

USE CASES

In this section we're going to list all the required use cases that our application is going to have:

ITERATION 1

Start Simulation

ID: 1

Name: Start Simulation

Goal: Start the simulation

Actors: User

Description: The user clicks a button that starts the flow of cars hence the simulation

Pre-conditions: The user has constructed a road system by placing roads on the map

Trigger: Click of the button "Start Simulation"

Main Success Scenario:

1. User click button "Start Simulation"
2. System starts the simulation

Post-condition:

1. User can stop the simulation or exit
2. User can pause the simulation

Extensions:

2A: ***User restarts the program:***

- Use case ends

Stop Simulation

ID: 2

Name: Stop Simulation

Goal: Stop the simulation

Actors: User

Description: The user clicks a button that stops the simulation and clears the currently build road system

Pre-conditions: The simulation is running

Trigger: Clicking the button “Stop Simulation”

Main Success Scenario:

1. User clicks button “Stop Simulation”
2. System stops the simulation
3. System resets the road map

Post-condition:

1. The simulation is resetted.

Extensions:

-3A: ***User restarts the program:***

- Use case ends.

Pause Simulation

ID: 3

Name: Pause Simulation

Goal: Stop the simulation for a while/pause the simulation

Actors: User

Description: The user clicks a button that stops the simulation but does not end it

Pre-conditions: The simulation is running

Trigger: Clicking the button “Pause Simulation”

Main Success Scenario:

1. User clicks button “Pause Simulation”
2. System pauses the simulation without resetting the map

Post-condition:

1. User can continue the simulation or stop it

Extensions:

-2A: ***User restarts the program***:

- Use case ends.

Generate a report

ID: 4

Name: Generate a report

Goal: Generate a report for the user of a simulation that already took place.

Actors: User

Description: The user is indicating to display a report that contains the stats of the simulation that just took place. The system displays the result.

Pre-condition:

1. A simulation has just taken place.

2. The simulation is stopped
3. The simulation had at least one dynamic element.

Trigger: Simulation has just ended, and the user indicates to display a report.

Main success scenario:

1. User indicates to display a report for the simulation.
2. System displays the report.

Post-condition:

- The report is shown, and the user can choose to continue.

Extensions:

-1A: ***The simulation had no dynamic elements (cars, pedestrians):***

- System displays an error message.
- The use case is over.

Reset Road Map Layout

ID: 5

Name: Reset road map layout

Goal: Remove all the elements off the grid.

Actors: User

Description: A user can choose to reset a layout displayed on the screen.

Pre-condition:

1. A map is already loaded on the grid.
2. The simulation is stopped.

Trigger: User wants to remove all elements off the grid.

Main success scenario:

1- User clicks on “Reset map”

2- System displays a verification message

3- User chooses to proceed.

4- All elements are removed off the grid.

Postcondition:

- Map grid is now empty.

Extensions:

-3A: ***User chooses to cancel:***

- Use case ends.

Add intersection without zebra crossings

ID: 10

Name: Add intersection

Goal: Add an intersection to the map on the grid.

Actor: User

Description: A user can choose to place an intersection on an empty space on the grid.

Pre-condition: The software is running.

Trigger: User wants to add an intersection to the grid.

Main success scenario:

1. System shows the available intersections.
2. User chooses one and clicks on it.

3. User clicks on the grid where he wants to put the intersection.
4. System draws the intersection on the grid.

Post-condition: an intersection is placed on a grid.

Extensions:

-3A: ***The place on the map is already taken by another object:***

- the system triggers an error sound.

- Nothing changes on the map.

- Back to step 1.

Remove intersection without zebra crossings

ID: 11

Name: Remove intersection

Goal: Remove an intersection from the current map.

Actor: User

Pre-condition: The software should be running

Trigger: User wants to remove an intersection from the current map

Main success scenario:

1. User clicks on the intersections that he wants to remove
2. User chooses from the menu the remove option
3. System removes the selected intersection

Post-condition: Intersection is removed from the screen.

Extensions: *None*

Add intersections with zebra crossing

ID: 11

Name: Add road with a traffic light & zebra crossing

Actor: User

Goal: To add a road with a traffic light to the current map.

Pre-condition: The Software should be running

Trigger: User wants to add a road with a traffic light & zebra crossing to the map

Main success scenario:

1. System shows the available roads with traffic lights & zebra crossings
2. Actor chooses one and clicks on it
3. Actor click on the map where he wants to put the road with traffic lights & zebra crossings
4. System draws the road with traffic lights & zebra crossings on the map

Post-condition: Road with traffic lights & zebra crossings is drawn on screen.

Extensions:

-3A: ***If the place on the map is already taken by another object****:*

- the system triggers an error sound

- Map stays unchanged..

- Back to step 1.

Remove intersections with zebra crossing

ID: 12

Name: Remove road with traffic light & zebra crossing

Actor: User

Goal: To remove a road which has a traffic light & zebra crossing

Pre-condition: The Software should be running

Trigger: User wants to remove a road with a traffic light & zebra crossing

Main success scenario:

1. Actor clicks on the road with traffic lights & zebra crossings that he wants to remove
2. Actor chooses from the menu the remove option
3. System removes the selected road with traffic lights & zebra crossings

   Post-condition: Road with traffic lights & zebra crossings is removed from the screen.

   Extensions: *None*

Save a file

ID : 13

Name: Save a file

Goal: Save the contents of the currently open application

Actor: User

Trigger: User chooses option “Save”

Main Success Scenario:

1. The application saves the contents using the current name and location of the file.
2. The system displays the time and date of the last save in a message.

Post-condition: The content of the application is stored in a file.

Extensions:

-1A: ***Current application has not been given a name and location***

1. System goes to “Save As” use case

Save as a file

ID: 14

Name: Save As file

Goal: Saving contents of currently open file

Actor: User

Trigger:

- User chooses option “Save As”

- User tried to perform “Save a file” use case but did not specify location nor name for the file.

Main Success Scenario:

1. Application asks for name and location of file to be saved
2. Actor provides name and location of file
3. Actor confirms by clicking the ”Save” button
4. Application saves contents using given name and location of file

Extensions:

-2A: ***Actor presses “Cancel” button:***

1. Use case ends

-3A: ***There is already a traffic file with the same name and path:***

1. The system displays appropriate messages and offers choices to replace existing files.

2. If yes, the use case continues.
3. If not, the actor is returned to step 4.

Specify number of cars generated

ID: 15

Name: Specify number of cars generated

Goal: Specify the number of cars that will take part in the traffic flow

Actor: User

Trigger: User signals to change the default value of cars generated

Main Success Scenario:

1. User types in text box the desired number of cars to be shown

Extensions:

-1A: ***The value entered is not a number type/ exceeds the maximum value allowed/ is not a positive value:***

- The system shows an appropriate message.

- Return to step 1 of MSS.

ITERATION 2

Add roundabouts

ID: 16

Name: Add road with a roundabout

Actor: User

Goal: To add a road with a roundabout to the current map.

Pre-condition: The Software should be running

Trigger: User wants to add a road with a roundabout to the map

Main success scenario:

5. System shows the available roads with traffic lights & zebra crossings
6. Actor chooses one and clicks on it
7. Actor click on the map where he wants to put the road with a roundabout
8. System draws the road with a roundabout on the map

Post-condition: Road with a roundabout is drawn on screen.

Extensions:

-3A: ***If the place on the map is already taken by another object**:*

- the system triggers an error sound
- Map stays unchanged..
- Back to step 1.

Remove intersections with roundabout

ID: 17

Name: Remove road with roundabout

Actor: User

Goal: To remove a road which has a roundabout

Pre-condition: The Software should be running

Trigger: User wants to remove a road with a roundabout

Main success scenario:

1. Actor clicks on the road with roundabout that he wants to remove
2. Actor chooses from the menu the remove option
4. System removes the selected road with roundabout

Post-condition: Road with roundabout is removed from the screen.

Extensions: *None*

Change simulation speed

ID: 18

Name: Change simulation speed

Actor: User

Goal: To increase or decrease the speed of the simulation

Pre-condition: The Software should be running

Trigger: User wants to increase or decrease the speed of the simulation

Main success scenario:

1. Actor clicks the button for changing the speed of the simulation
2. Actor chooses how much to increase or decrease the speed of the simulation
5. System changes the speed of the simulation

Post-condition: The speed of the simulation is changed.

Extensions: *None*

Simulation timer

ID: 19

Name: Add timer for the simulation

Goal: Simulation stops when time runs out

Actor: User

Description: A user can choose a number of seconds for the duration of the simulation

Pre-condition: The software is running

Trigger: User wants to specify the duration of the simulation.

Main success scenario:

1. System shows the main screen of the application.

2. User enters number of seconds.

3. User chooses other options

4. User starts simulation.

5. System runs simulation.

6. System stops simulation after the time has passed.

Post-condition:

- The main screen of the application is shown.

Extensions:

2A: The user doesn't specify the number of seconds

- system shows a message

- Back to step 1.

Simulation speed

ID: 20

Name: Add slider for the speed of the simulation

Goal: Simulation runs faster or slower depending on the user's choice

Actor: User

Description: A user can choose a speed for the simulation

Pre-condition: The software is running, a grid has not yet been chosen

Trigger: User wants to specify the speed of the simulation.

Main success scenario:

1. System shows the main screen of the application.

2. User adjusts the slider.

3. User chooses other options

4. User starts simulation.

5. System runs simulation with correct speed.

Post-condition:

- The simulation's speed has increased or decreased

Extensions:

2A: The user chooses a grid before adjusting slider

- system shows a message

- Back to step 1.

Add Surprise Elements

ID: 21

Name: Enable Surprise elements.

Goal: Allowing random car crashes to take place within the simulation.

Actor: User

Description: The user can choose to enable random car crashes within the simulation (to have more of realism).

Pre-condition:

1. The simulation is not running.
2. There is at least one road placed on the grid, and at least 1 car to be generated.

Trigger: User Clicks on "Surprise Elements" checkbox.

Main success scenario:

1. 1.User checks the "Surprise Elements" checkbox.
2. User runs the simulation.

Post-condition:

1. Cars will have a random chance to crash into each other during the simulation.

Extensions:

1A. "Surprise Elements" checkbox is already checked:

1. Continue with Step 2.

2A. User unchecks the "Surprise Elements" checkbox

1. Use case ends.

2. Back to step 1.

3B. User stops/pauses the simulation:

1. Use case ends.
2. Back to step 1.

Enable Special (Emergency) Vehicles

ID: 22

Name: Add Special Emergency Vehicles

Goal: Generate Emergency vehicle to pick up crashed cars

Actor: User

Description: User enables emergency vehicles that pick up crashed cars, these vehicles follow the shortest-path-possible algorithm.

Pre-condition:

1. Simulation is not running.
2. There is at least one road placed on the map, and at least 2 car to be generated.

Trigger: User checks the "Emergency vehicles" checkbox.

Main success scenario:

1. User checks the "Emergency Vehicles" checkbox.
2. System asks the user to choose the start road of the vehicles.
3. User chooses a road piece.
4. System asks the user to choose the destination road of the vehicles.
5. User chooses another road piece.
6. User runs the simulation.

Post-condition:

1. Whenever two cars crash into each other during the simulation, an emergency vehicle will spawn from the starting road and will follow the shortest path to the destination road piece.

Extensions:

1A. “Emergency Vehicles” is already checked:

1. Proceed to step 2.

3A, 5A. User chooses “Cancel” instead

1. Use case ends.
2. Back to step 1.

6A. User resets the simulation.

1. Use case ends.
2. Back to step 1.

Disable Special (Emergency) Vehicles

ID: 23

Name: Remove Special Emergency Vehicles

Goal: Disable emergency vehicles from spawning during the next simulation.

Actor: User

Description: User disables previously enabled emergency vehicles from spawning during the simulation runtime.

Pre-condition:

1. Simulation is not running.
2. “Emergency Vehicles” checkbox is enabled.

Trigger: User unchecks the “Emergency vehicles” checkbox.

Main success scenario:

1. User unchecks the “Emergency Vehicles” checkbox.
2. User runs the simulation.

Post-condition:

1. Whenever two cars crash into each other during the simulation, no emergency vehicles will spawn.

Extensions:

1A. “Emergency Vehicles” is already unchecked:

1. Proceed to step 2.

2A. User resets the simulation.

1. Use case ends.
2. Back to step 1.

Current Flow

Name: Calculate current flow of cars

Goal: System shows the current number of cars on the road network

Actor: User

Description: User can see the number of cars in the simulation

Pre-condition: The software is running

Trigger: User wants to see the number of cars in the simulation.

Main success scenario:

1. System shows the main screen of the application.

2. User starts simulation

3. User clicks the “Current flow” button.

4. System calculates the number

5. System shows the number

Post-condition:

- The simulation has shown the current number of vehicles in the simulation

Extensions:

2A User resets the simulation

1. Use case ends
2. Back to step 1

Adjust Number of Pedestrians

Id: 26

Name: Adjusting Number of Pedestrians

Goal: Increasing and Decreasing numbers of pedestrians

Actor: User

Description: User can add pedestrians to map

Pre-condition: The software is running

Main success scenario:

1. User adjust number of pedestrian using trackbar
2. System shows the number of pedestrians user can add

Enable Road Sensors

Id: 27

Name: Enabling Road Sensors

Goal: Pedestrian can walk in zebra cross

Actor: User

Description: User can make pedestrian walk in zebra cross by activating enable road sensors

Pre-condition: The software is running

Main success scenario:

1. User clicks the checkbox “Enable Road Sensors”

2. System informs user

Extensions:

1A**.** There are no pedestrians:

1. System informs user
2. Proceed to use case “Add Pedestrians

Disable Road Sensors

Id: 28

Name: Disabling Road Sensors

Goal: Pedestrian walks on the sidewalk

Actor: User

Description: User can make pedestrian walks only in sidewalk

Pre-condition: The software is running

Main success scenario:

1. User unchecks the checkbox “Enable Road Sensors”

2. System informs user

ITERATION 3

Load Graph View About Statistics

ID: 29

Name: Load Graph View About Statistics

Goal: The Statistics View is loaded

Actor: User

Trigger: User signals to load the statistics view

Main Success Scenario:

1.User clicks on a button and statistics view is loaded

Choose “Shortest-path” algorithm

ID: 30

Name: Choose shortest path algorithm

Goal: Choose an algorithm to find the shortest path between crash point and two other points (Start and end).

Actor: User

Description: User chooses a shortest path algorithm from two available options: A* and Dijkstra.
After the simulation runs, and when a crash happens: emergency vehicles will follow that path from a start point, toward the crash, then finally to the end point.

Pre-condition:

1. Simulation is not running.
2. “Emergency Vehicles” checkbox is checked.

Trigger: User

Main success scenario:

1. User selects “Dijkstra” from the “Algorithm” tab
2. User clicks on the “Start” button.
3. System displays “Please select a start point on the map”.
4. User selects a start point.
5. User clicks on the “End” button.
6. System displays “Please select an endpoint on the map”.
7. User selects an endpoint.

Post-condition:

1. A crash occurs during the simulation, otherwise the shortest path value will be null.

Extensions:

1A. User selects “A*”

1. The shortest path will be generated based on A* algorithm.
2. continue with step 2.

4A, 7A. User clicks on a point outside the grid.

1. System displays “Please select a point inside the grid”.
2. Back to the previous step.

Show Overall Insights and Statistics

ID: 31

Name: Overall Insights

Goal: Show graphs and statistics about the simulations

Actors: User

Description: The user clicks a button and the application show graphs and statistics about the simulations

Pre-conditions: The application is started

Trigger: Clicking the button “Overall Insights”

Main Success Scenario:

1. User clicks button “Overall Insights”
2. System shows the graphs and statistics

Export to PDF

ID: 32

Name: Export to PDF

Goal: Save the graph as pdf

Actors: User

Description: The user clicks a button and the application saves the graph as pdf

Pre-conditions: The graphs is loaded

Main Success Scenario:

1. Actor clicks button export to pdf
2. System shows dialogue box with saving path and file name
3. Actor clicks save