Team 18

FlowLogic: Traffic Flow Simulator

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Problem Statement:

For urban planners and engineers looking to design new infrastructure or improve existing systems, predicting and visualizing traffic flow can be challenging. Current traffic flow simulation tools (Vissim, SUMO, SimTraffic, etc.) are either inaccessible, overly complex, or lack the flexibility to create fully customized layouts. Our traffic flow simulator addresses these challenges by offering an easy-to-use drag-and-drop interface for creating personalized layouts, along with detailed analyses of how traffic flows through these designs. This solution allows users to efficiently plan, visualize, and optimize traffic systems with ease. Our solution will differ from our competitors by being easy-to-use and flexible.

Background Information:

Audience

Everyday, around the world, roads are being planned and built. This product would help those who plan and build roads ensure that their plans would work in a real world scenario. The main audience for this application would be urban planners, civil engineers, and traffic enthusiasts. It could also be used as a tool in an educational context, so educators and students could be in the audience as well. This tool can be used by both designers -

those who will plan the roads, and viewers - those who view the design (builders, managers, etc.).

Similar Products

There are multiple products providing similar services including PTV Vissim, SUMO, and SimTraffic, but they lack an easy-to-use UI. Some even require knowledge of coding to use. For example, PTV Vissim and SUMO are high-detail traffic simulations that simulate almost anything that can happen within traffic–such as lane-changing, car-following, etc. Despite their power, they come with a steep learning curve and often require extensive coding knowledge in order to create efficient simulations. SimTraffic, on the other hand, offers a more user-friendly experience compared to Vissim and SUMO. However, it still requires a solid understanding of traffic engineering concepts. This makes it less accessible to non-experts. None of these existing solutions provide a truly intuitive interface for quickly creating and testing simple urban layouts, which can be a barrier for some users.

We will address these problems by having an easy-to-use drag and drop UI that allows for effortless designing and simulating urban traffic scenarios. This approach will help users to focus on planning and optimizing traffic systems without needing heavy technical knowledge.

Functional Requirements:

1. As a designer, I would like to have a grid-style canvas that I can build on
2. As a designer, I would like to drag and drop roads onto the grid

3. As a designer, I would like to adjust intersection types so that I can control traffic flow.
4. As a designer, I would like to be able to adjust the amount of people going to each building so that I can simulate a realistic environment.
5. As a designer, I would like to place parking areas with different parking capacities.
6. As a designer, I would like to configure traffic light timings so that I can test different strategies.
7. As a viewer, I would like to adjust the speed of the simulation so that I can run real-time or accelerated scenarios as needed.
8. As both a designer and a viewer, I would like to be able to simulate traffic flow so that I can view how my layout would work in a real world scenario.
9. As a viewer and a designer, I would like to be able to import saved layouts so that I can see other's work.
10. As a designer, I would like to be able to export saved layouts so that I can share my work with others.
11. As both a designer and a viewer, I would like to see statistics from the traffic simulation so that I can perform an analysis of my layout.
12. As a designer, I would like to receive suggestions on my layouts so that I can improve on them.
13. As a designer, I would like to adjust speed limits on roads.
14. As a designer and a viewer, I would like to be presented with a menu when I open the app.
15. As a designer, I would like to be able to adjust the width (# of lanes) on roads.

16. As a designer, I would like to adjust the direction from where traffic flows in the simulation.
17. As a designer, I would like an adjustable-sized map for different size layouts.
18. As a designer and a viewer, I would like to graphically view statistics.
19. As a designer, I would like to be able to edit and remove roads.
20. As a designer, I would like to be able to edit and remove buildings.
21. As a designer, I would like roads to automatically snap together into intersections when they meet.
22. As a designer, I would like to be able to save layouts to my computer.
23. As a designer, I would like to be able to load my saved layouts to the simulation.
24. As a designer and a viewer, I would like to view my saved layouts all in one place
25. As a designer and a viewer, I would like to delete and rename saved layouts.
26. As a designer, I would like to name roads and buildings within a layout, so that I can refer to them more easily.
27. As a designer, I would like to assign different types of vehicles to the simulation.
28. As a designer, I would like to add pedestrian walkways and crosswalks if time allows.
29. As a designer, I would like to be able to add construction zones that impact traffic flow.
30. As a designer, I would like to be able to add one-way streets

31. As a designer, I would like to be able to simulate rush hour periods.
32. As a designer, I would like to be able to compare statistics between two saved layouts if time allows.
33. As a designer, I would like to be able to set accident probabilities if time allows.
34. As a designer, I would like to simulate special events (concerts, games, etc) if time allows.
35. As a designer, I would like to be able to add roundabouts.
36. As a designer, I would like to be able to factor in emergency vehicles if time allows.
37. As a designer, I would like to be able to add public transportation if time allows.
38. As a designer, I would like an undo button.

Non-Functional Requirements:

Architecture and Performance

Our product will use an object-oriented design in Java, allowing for easy scalability and maintainability. Our system will have 3 parts: The Simulation Engine which handles vehicle and traffic logic; User Interface (UI) that provides a drag-and-drop layout editor with a visual representation of traffic flow, implemented in JavaFX; and Storage which stores road layouts and traffic simulation results for later analysis. We will use threading to handle vehicle movement and traffic signals for good performance on large layouts. We will implement optimized data structures for good performance as well. The optimized system should be able to support 20,000 cars in a simulation that lasts only 5 minutes.

Security

Since our program isn't online, security won't be too much of a concern. Files can only be sent by an individual via other services (email, text, etc.), so the user controls who sees their layouts. Additionally all the files are stored locally so there should be no concern with data breaches or similar issues.

Usability & Accessibility

The main goal of our program is for it to be very usable. For this to happen, roads that are placed will snap IMMEDIATELY to the nearest spot on the grid, so that there is no need to line things up exactly. Additionally, the program will be built in Java making it runnable on machines with any of the major operating systems (MacOS, Windows, Linux), making it accessible to all users.