Logbook

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Contents

1 LP3

1.1 Week 1

Problems

During the first week no major problems were encountered.

Proposed Solutions

Reflections

The team feels that they have sufficient guidance in which tool to investigate for the product development. Each and everyone also feels satisfied with being assigned a static role throughout the whole project.

Meetings

An introduction meeting was held the first day of the course, as well as a secondary meeting to do some general planning and work-assignment. The first meeting with our supervisor was held.

Interim Goals

Everyone should familiarize themselves with the relevant tool we are using and the protocols and tools related to their specific role within the project.

Description of Individual Performance

- **Martin Blom**
  I spent my time mostly looking at tutorials and getting to know Unity. I also worked on fixing templates for documentation since i have the role of Secretary.

- **Felix Jönsson**
  Brushed up on my Scrum knowledge since I was assigned as the team's Scrum Master. Also installed necessary tools and did some "Hello World" projects of varying difficulty in Unity.

- **Hannes Kaulio**
  This week I mainly watched unity tutorials.

- **Arvid Nyberg**

- **Marcus Schagerberg**
  I focused on administrative tasks such as preparing the time report and setting up a CI/CD for autocompilation of LaTeX documents. In addition to that I setup a document structure in Overleaf.

- **Jakob Windt**

  This past week I spent my time mostly on getting to know Unity. For example, I made a simple program where the user can move around on a flat surface, as well as jump. Furthermore, I spent some time in Overleaf, creating a template for the weekly logbook.

1.2   Week 2

Problems

We have not encountered any problems yet, however our supervisor noted that we might get a lot of merge conflicts in the future since we are working in the same Unity project.

Proposed Solutions

Our supervisor recommended that we create one scene in Unity for each developer and that all developers work solely in their own scene to avoid merge conflicts. We setup the Unity project like this with an additional main scene where we will put the result itself.

Reflections

The team feel more confident in being able to use Road Architect as a tool for drawing our maps, which led to the whole team investing more time in understanding how it works.

Meetings

We had a supervisor meeting and a planning and setup meeting.

Interim Goals

We set our first product development sprint goal, "Enable one car to follow lanes in two simple road maps". We also set a goal to be able to send in the first draft of our project plan to our supervisor early this week for feedback.

Description of Individual Performance

- **Martin Blom**
  This week I spent my time mainly on writing in the project report, collecting relevant data from sources and exploring Unity further.

- **Felix Jönsson**
  This week I wrote on the Problem and Method section of our project plan, read a lot of papers regarding relevant topics for our product. Familiarised myself with the Unity asset Road Architect and set up my development environment for Unity (VC, IDE integration, etc).

- **Hannes Kaulio**
  This week i mainly wrote on the project plan, specifically the problem section. I also started getting familiar with the road architecture source code and coded a little bit.

- **Arvid Nyberg**
  This week I was quite busy with other things so I haven't been able to put

down the work I intended. I acquainted myself with the course a little bit more and started working on societal and ethical aspects in the project plan. On Friday I participated in the meeting.

- **Marcus Schagerberg**
  I continued with some administration and setup of our documentation, but spent most of my time looking into the Road Architect asset. We have looked into this asset briefly since it allows us to create road systems easily. It is also very powerful with support for creating intersections and bridges for example as well as modify the terrain.

  I looked into the development possibilities for the asset since we need additional features such as creating lines for each lane that we need to use for our vehicles as a guide line that they should follow while driving. I was able to add that feature to the asset and figured out more of how it works so I now feel confident that we can use Road Architect in our project.

- **Jakob Windt**
  I spent my time about 50/50 between writing the project planning report and doing research about Unity. During the research I found out about tools like Unity's UI Toolkit and Unity's New Input system.

  To test these features I created a 2 simple Unity projects. The first project allows the user to move around as a rolling cube, which I made to test the input system. The second project was a very simple UI using the toolkit.

  For the project planning report, it was decided that I should write the purpose and limitation sections, which I completed.

1.3 Week 3

Problems

Main problems this week took the form of making our modified third-party assets handle intersections, and setting up a Unity to organization to allow future asset purchases to be available for the whole group.

Proposed Solutions

The proposed solution for solving the Unity Asset situation is for one group member to do proper research to find the most efficient way for group asset managing. To solve the intersection problems, it was decided to have every group member test the lane creation on their own computer since the results seem to wary between group members.

Reflections

Overall a good first development week, still some hick-ups regarding different set up of varying tools. Since we started working early on the project plan we've had to receive feedback from the supervisor two times already.

Meetings

Supervisor meeting and numerous remote in-official developer meetings throughout the week

Interim Goals

We sent in our draft of the project plan to our supervisor and received feedback as planned. The goals for this week's sprint were mostly met, however the features were developed in separate branches so they will need to be merged together in order to create a working version that includes all the new features.

The goals for next week are based around our goal for the first iteration, which is to have working autonomous vehicles. Next week we will for example implement algorithms for lane switching so that the vehicles can transfer between different lanes and also roads through intersections.

Description of Individual Performance

- **Martin Blom**
  I have done a lot of exploration of assets and testing their compatibility with the current version of unity (and sharing them). I was also meant to do the road networks for testing but ran into problems/bugs with road architect. Road architect now needs further evaluation of functionality before work can precede. Lastly I polished my sections in the planning report and did my usual duties as the secretary.

- **Felix Jönsson**
  Did some further modifications of the scrum board. Had a lot of issues with git and different development set up but should be mostly fixed now. Implemented a player controlled car that the player control via keyboard. Reviewed feedback and added new text to Problem, Method and Ethical Considerations in the project plan.

- **Hannes Kaulio**
  I have mainly worked on graph generation this week. I added a weighted graph representation from a road architect road system. I developed a graphical debug view for the graph that clearly shows how all roads are connected. I also wrote an A* implementation that can find the shortest path to a node.

- **Arvid Nyberg**

- **Marcus Schagerberg**
  I have worked on improving the lane generation by making it support intersections as well as looped roads. Furthermore I have supported in the development of creating a road network graph to allow the vehicles to navigate. Finally, I implemented two algorithms for making the vehicles follow lines. One that works using physics and vector arithmetic to steer towards the line, and a more performance optimised version that simply moves the vehicle between the points on the line.

- **Jakob Windt**
  My main focus this week was to implement a camera switching system. The system I created allows the user to map cameras to key binds, as well as UI overlay buttons that will change the users POV. This UI is also the basis we'll use to implement a future development UI. After finishing this, I started looking into Blender, which I thought was a good tool to use to create road signs etc for the project. However, after creating some road signs, we found an asset that included all European road signs, as well as an editor for them which we decided to use instead. Lastly, I also spent some time cleaning up my sections in the planning report.

1.4   Week 4

Problems

This week Arvid Nyberg dropped out of the project.

Road Architect was identified as being unstable for some use cases, and bugs were found when trying to construct road networks of certain types.

Proposed Solutions

The team split the work of Arvid among the members and planned ahead, keeping in mind the reduction in capacity. As he was responsible for the project report, it was decided to share that responsibility among all members.

In order to combat the instability of Road Architect it was decided to develop a road generator in-house. This will also improve the performance of the simulation as it will be possible to implement more efficient code for the parts that are needed within the project scope.

Reflections

The team has made good progress in creating an MVP, with simple road generation, a functioning car (with "realistic" physics), and four-way intersections.

Meetings

Weekly supervisor meeting on Monday, and then an additional meeting on Wednesday for the team to discuss how to move away from the Road Architect asset.

Interim Goals

The goals for next week will be similar to those of last week for some tasks, as we now need to redo the work in our own road generator. Other than that, we will aim to start working on the communication between vehicles and other entities, such as traffic lights.

Description of Individual Performance

- **Martin Blom**
  This week I mostly tested the stability of Road Architect and concluded it was not at a functioning level. This put a stop to most tasks I had assigned myself, so instead I focused on getting our assets bought.

- **Felix Jönsson**
  Fixed documentation after receiving feedback from supervisor and added text to the sections Problem, Method, and Societal and Ethical aspects.

Implemented a camera system, different cameras, and input manager in our application.

- **Hannes Kaulio**
  This week i started out rewriting the physics of the car to use the new asset, Edy's car physics. Then i spent the rest of the time on trying to implement intersection creation.

- **Marcus Schagerberg**
  I was focusing on creating a new road generator to use instead of Road Architect. I focused on a simple UI where you can create new road systems and roads, and creating the road meshes with support for multiple lanes.

- **Jakob Windt**
  During this week, I spent most of my time implementing traffic lights. I created a controller that would pair up traffics light to determine what type of intersection they're in. From this information, each individual traffic light would switch it's lighting to match what was asked from the controller. I wanted to implement a way for a car to trigger the traffics light to change colors, but decided to wait until this week, since we're unsure on how to implement.

1.5 Week 5

Problems

There are still some minor bugs that need to be fixed with RoadGenerator.

The newly implemented Snoks currently calculate the distance to a node using the birds path. This needs to be changed to the distance between the nodes.

Proposed Solutions

There are no specific proposed solutions other than testing the code, and from there fix the bugs.

Reflections

The team successfully created a first version of RoadGenerator, our own custom substitute asset for RoadArchitect. With this the team should start to be able to implement parts of the project that are reliant on the roads.

Meetings

There was only the scheduled Monday meeting with our supervisor.

Interim Goals

The goals for next week is to implement a basic version of the cars navigation system. Furthermore, because the first draft of the final report needs to be sent to the other group by Friday, there will have to be some writing done during the week.

Description of Individual Performance

- **Martin Blom**
  This week I worked a lot on the driving behaviour of the car. Specifically I implemented a braking distance calculation to always make the car stop at the right distance. I also made the steer target dynamic to make the car take corners better. Lastly i did some general tuning of the driving behaviour and implemented a simple fuel consumption model.

- **Felix Jönsson**
  Added shader and incorporated it into the code. Refactored a lot of how the camera code works and implemented additional camera features. Worked further on GameObject toggle logic.

- **Hannes Kaulio**
  This week I mainly worked on intersection creation.

- **Marcus Schagerberg**
  This week I almost exclusively worked on RoadGenerator. I finished the required features to be able to switch from RoadArchitect to RoadGenerator this week. I also reworked the intersection generation and implemented an improved algorithm called Bezier clipping for finding intersecting points between Bezier paths.

- **Jakob Windt**
  This week I spent my time on many smaller parts of the project. First, I designed and created a mock up UI in a program called Balsamiq Wireframes. Furthermore, I rigged a new high quality vehicle model with Edy's Physics which we would use as the vehicle for a user to control. Lastly, I started working on a Terrain editor. I was both able to use scripts to modify the 3D terrain, and also made it so you can import data from OpenStreetMaps to blender, and then from there import it as an asset to Unity. This allows us to take real life 3D map data and display it in Unity.

1.6 Week 6

Problems

Proposed Solutions

Reflections

Meetings

There was only the scheduled Monday meeting with our supervisor.

Interim Goals

Description of Individual Performance

- **Martin Blom**
  This week I did not have much time due to moving living location. But I managed to at least do some PR reviews and switched the distance calculation logic for the car. As well as some report writing and a small start to the node occupation model.

- **Felix Jönsson**
  Researched related work, read up on papers regarding these. Compared them to each other and wrote about them in the project plan report. Did some further coding on input handling and cameras.

- **Hannes Kaulio**
  This week i wrote on the final report on the theory and method. I also implemented the navigational system for the cars. Now the cars can travel to a given position.

- **Marcus Schagerberg**
  My main focus this week was finishing intersection creation. I added support for 3-way intersections, and switched all intersection generation to procedural mesh generation, meaning they are dynamically created and create a good transition between roads allowing intersections to be created for different road angles.

- **Jakob Windt**
  I spent my time working on two things this week. To begin, I wrote some sections on the first draft of the final report. Specifically, I wrote the tools section in the methods chapter. Programming wise, I implemented a car spawner object that spawns the cars when the program is started. The user can change in the settings how many cars should be spawned, and the script will divide them between the roads by the length ratio of the road. Or, you can spawn an amount of cars based on the roads max capacity of cars. Each car is automatically offset an equal amount between each other so no collisions take place. With the car spawner, I was also able to some limit testing on how many cars we would be able to have running at the same time.

1.7 Week 7

Problems

When reworking the node generation the rotation of the lane nodes got lost, which meant that the cars spawned incorrectly.

Proposed Solutions

We readded the rotation on the road nodes instead, and then created a conditional logic for the lane nodes so they use their road node's rotation, but flipped if the lane is in the opposite direction to the road.

Reflections

Meetings

There was only the scheduled Monday meeting with our supervisor.

Interim Goals

Description of Individual Performance

- **Martin Blom**
  This week I worked on making the cars respond to each other by checking whether a car is already occupying a node or not. I also worked on the midterm presentation as well as a lot of small bugs in the AutoDrive script.

- **Felix Jönsson**
  Mostly prepared for the half time presentation as well as wrote on the theory and introduction section of the project report.

- **Hannes Kaulio**
  This week I finished the navigation code and also created the start menu, settings UI. I also started working on connecting the traffic logic to the road nodes and making the cars respond to the traffic lights.

- **Marcus Schagerberg**
  This week I worked on road and lane node generation. I decoupled them from the vertex points to allow them to be generated correctly for intersections, and allow us to control how often we create the nodes. I also worked on giving feedback during the opposition and switched the intersection algorithm to use Bezier Clipping instead.

- **Jakob Windt**
  This week I worked on improving the traffic lights. I made it so when you create an intersection, traffic lights would immediately spawn in their correct locations. This works both for 3-way and 4-way intersections. When an intersection is created, a flow container is spawned. This flow

container will keep track of all the intersections signs, traffic lights, and other models. In the flow container, either a traffic light controller or stop sign controller will get spawned. These are used to control their respective models.

1.8 Week 8

Problems

Proposed Solutions

Reflections

The midterm presentation was held during this week. From the presentation we got some input from the audience about certain aspects of the project. The main point that was brought up, was that since we declared that our simulator will be user-friendly, we need to complete the necessary testing to prove this claim.

Meetings

There was only the scheduled Monday meeting with our supervisor.

Interim Goals

Hopefully complete a first stable build release of the project that can be used to demo.

Description of Individual Performance

- **Martin Blom**
  This week I mainly focused on the half time presentation but also did some work (Bug fix and rework some logic) on performance mode in AutoDrive and some finishing touches on the node occupancy system.

- **Felix Jönsson**
  Apart from the half time presentation, I havent contributed to the project this week due to exam and hand ins in two other courses. For some reason, IT student take 2.5 courses LP3 and 1.5 in LP4!

- **Hannes Kaulio**
  This week i created speed sign spawning, disabled u turns, traffic light stop logic and road spawning using OSM data.

- **Marcus Schagerberg**
  I worked a lot with turning in intersections this week, as it is a more difficult task than it seems. There was a lot of work trying to create the different paths the vehicle can take depending on which road it enters in and should exit at in an intersection. The paths need to be separated so the vehicles do not affect each other, except for the occupation feature where it is important that they share the data so they are aware of other vehicles travelling in the intersections.

  I also created a debug utility that allows us to draw lines, and place spheres at positions to visualize where points are in space to help with debugging.

- **Jakob Windt**
  Because of personal reason, I haven't spent that much time on the project this week. But even so, I managed to implement and connect a UI overlay for the simulator. The functionality of the UI works, but the buttons need to be connected to their functions. The UI overlay has a very simple design, since the style sheet for the simulator has been decided.

1.9   Exam week

Problems

Proposed Solutions

Reflections

Meetings

There was only the scheduled Monday meeting with our supervisor.

Interim Goals

Description of Individual Performance

- **Martin Blom**
  This week I mainly focused on reworking more of the performance system as a whole. This took more time/did not make much improvements than anticipated because there were other unrelated bugs messing with the code.

- **Felix Jönsson**
  Did not contribute to the project this week due to exam week in optional course and the course that runs parallel for IT-students.

- **Hannes Kaulio**
  This week I mainly worked on connecting roads to each other. I also finished the visual navigation path and did some traffic light work.

- **Marcus Schagerberg**
  This week I mostly worked on bug fixes and multi lane navigation support. I also added support for multiple independent road systems as well as finished intersection navigation. I also created a demo scene in preparation of the demonstration for our supervisor at our weekly meeting.

- **Jakob Windt**
  I started this week working on fixing some bugs. An example, was that the intersection flow containers that take care if an intersections road signs, would overflow spawn them, resulting in duplicate game objects. Additionally, I implemented a script that handles in game time, as well as a basic schedule for events. The schedule is built using a calendar queue, that prioritizes the events by their respective time stamps.

2 LP4

2.1 Week 1

Problems

Proposed Solutions

Reflections

Meetings

There was the scheduled Monday meeting with our supervisor, as well as the Chalmers Library meeting where we got information about finding information and looking for references.

Interim Goals

Description of Individual Performance

- **Martin Blom**
  This week I worked on reworking a lot of performance logic and fixing bugs that had to do with the driving itself.

- **Felix Jönsson**
  Been working on programming features that allows the user to interact with objects in the simulation.

- **Hannes Kaulio**
  This week I fixed a lot of bugs, finished implementing the traffic stopping logic and continued working on connecting roads.

- **Marcus Schagerberg**
  This week I worked on fixing several bugs, mainly related to how the car drives and navigates. Then I started working on refactoring the AutoDrive script that controls the cars, making it modular and much easier to add new features to and modify the current behaviour. I also attended the meeting at the library, discussing how we can find references and noted the resources we were shown.

- **Jakob Windt**
  As was decided during the weeks sprint planning meeting, the main focus was bug/error fixing. While solving bugs I created a custom editor for our AutoDrive script, which allows the user to update settings live while the simulation is running. This solved a bug which revolved around switching the navigation path/target on/off while the simulation was running. Another bug I started working on was our CarSpawner script which needed to be updated since I wrote it a couple weeks ago. This is because of our additional features of the simulator, that did not exist when I wrote it originally.

2.2 Week 2

Problems

Proposed Solutions

Reflections

Meetings

Interim Goals

Description of Individual Performance

- **Martin Blom**

- **Felix Jönsson**
  Mainly bug fixes, refactoring and integrating my code with other code.

- **Hannes Kaulio**
  This week I mainly refactored code, fixed bugs and worked on adding lamp posts.

- **Marcus Schagerberg**
  I mainly worked on yielding in intersections to avoid collisions. The traffic lights help, but collisions can still occur as cars will cross each others paths when turning, so even with traffic lights we need yielding for the cars to behave properly.

- **Jakob Windt**
  Most of my time this week was spent on reworking the car spawner. Because of the new features, mainly intersections, that have been added since I wrote the original car spawner, it needed to be fixed. So I rewrote the code and logic, to exclude spawning cars in intersections etc. I also wrote some code to allow cars to be controlled by time events by the time manager, which can later be used to develop busses and other scheduled vehicles.