System design document for Project_D

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This version overrides all
previous versions.

1 Introduction

1.1 Definitions, acronyms and abbreviation

- **Player:** The person(s) holding the controller(s).
- **Supervisors:** The “good” characters in the game, trying to get the factory to function as usual.
- **Saboteur:** The “evil” player, is trying to destroy the factory from the inside.
- **Worker/NPC:** The characters walking around the factory that serves the purpose of being decoy for supervisors/saboteur(s).
- **Character:** Term used to describe both supervisors, saboteurs and workers.
- **Machine:** The target for the saboteur and the things all supervisors need to maintain and secure. The main objective of the saboteur tot destroy.
- **Spotlight:** A spotlight that casts a pillar of light around on the map, when hovering over a sabotaged machine for the first time it will trigger an animation of the machine that is destroyed.
- **Honest interaction:** Either maintaining a machine or entering the spotlight controller.
- **Dishonest interaction:** The saboteur is sabotaging a machine.
- **Catch/capture:** The supervisors has figured out (think that they’ve) who the saboteur is and tries to catch/capture him/her.
- **Blackout:** A saboteur has the ability to make a 5th of the map around him/her go black and this way escape in the darkness, used to give the saboteur another chance if spotted by the supervisors.
- **Strike:** The supervisors have tried to catch 4 workers but none of them were the saboteur they will start to strike and the supervisors lose.
- **LibGDX:** A game framework that we base or game on.
- **Bullet:** A physics library build in libGdx and used for collisions and game physics.

2 System architecture

Project_D is meant to be played on one single computer with multiple controllers. It runs on Windows, Mac and Linux since it is written in java and the JVM (Java Virtual Machine) is supported by each of these OS’s.
The project implements a model, view, controller pattern (MVC) and uses some additional custom packages.

A level editor has been created in Blender which is able to export to our map format which can then be imported into the game. The map editor utilises a python script in blender that renders an xml-file and then LibGdx own file manager to interpret it into java compatible code.

An AI package has also been created that is able to create nodes and assign these values which can then be utilised by entities in the game. First built as a simulation for the AI behaviour but is written in a way that some classes can be reused.

A lot of the functionality for the view will be composed of preexisting functionality included in libGDX.

For handling collisions between player controlled objects. JBullet which is integrated in LibGdx will be used.

The most overall, top level, description of the system. Which (how many) machines are involved? What software on each (which versions). Which responsibility for each software? Dependency analysis. If more machines: How do they communicate? Describe the high level overall flow of some use case. How to start/stop system.

An UML deployment diagram, possibly drawings and other explanations. Possibly UML sequence diagrams for flow. (Persistence and Access control further down) Any general principles in application? Flow, creations, ...

3. Subsystem

3.1 Model

The model consists of two main branches deriving from the GameObject class, the entities and the static objects.

3.1.1 Static objects

The static objects represent all objects in the game that just stand still and may be walls but also machines that the players are able to interact with. These are all represented by a 3D model in the rendered view.

The OOP design structure is simple. Mainly class inheritance and not a lot of design patterns except from a state pattern used for the machines to represent their current state. They can be either active so that they're able to interact with the players or "destroyed" and therefore not able to interact with the players. The usage of the states is when a machine is "destroyed" the it delegates to an empty method.

3.1.2 Entities

The entities represent all objects in the game that can move around still and may be walls but also machines that the players are able to interact with. Some of these are represented by a 3D model in the rendered view.

We've put more time into designing the Entity branch and therefore the structure is more thought through. To reuse as much code as possible we've tried to structure the inheritances in more layers. Sometimes a layer is just used to make another method reusable but nothing more. In PlayerCharacters are designed with the template method pattern for the different behaviours corresponding to supervisors and saboteurs. Each PlayerCharacter has an internal state which is used to determine if a function should be executed or not. This is needed since characters controlled by players can "be caught" and therefore they're out of the game

3.1.3 The state pattern

In the game there are a lot of objects that needs to have multiple behaviour depending on the current game situation. There are a lot of variations of state patterns ranging from the states of player controlled characters to the different game states itself.

In the initial discussion thoughts about a decorator pattern or a strategy pattern occurred, but in the end the state pattern was the winner. The state pattern was declared the winner since it is feels like an extension of the class since it represents an internal state. Depending on the situation it is easy to change state and through dynamical typing run the code that we want to. It also increases the readability and understandability of the code where it is feels more natural when a Worker is in a captured state rather than it implements a strategy that it can not move.

Compared to strategy pattern which would have been the second alternative the state pattern support that the behaviour can be quite different from state to state whereas the strategy pattern is different methods to achieve a similar or the same behaviour. Because of this and the other profits the strategy pattern therefore weighs up the circular dependencies that it creates between the state and the context.

3.2 View

3.2.1 Render manager

As stated before lot of the functionality for the view will be composed of preexisting functionality included in libGDX. The view mainly consists of a rendermanager that as the name implies handles all the rendering by getting passed a collection of objects that map to a specific graphical instance.

The rendermanager also handles rendering everything once from the camera to generate a shadow map that is later used during the normal rendering to create shadows.

3.2.2 Base Shader

The view also includes a basic shader class used to create a basic rendering pipeline with custom shaders.

3.3 Controller module

The controller module consists of the input handler classes and the different game states that currently have support. The controller also handle input from a number of Xbox controllers or a keyboard to enable interaction with the model.

3.3.1 Game States

The game states are the internal state of our game and determine what the player view. It can either be a menu or a part of the game view. Since it represents the internal states of the game eg. when the game has ended there will be an ending state that shows an ending screen.

3.3.1.1 iGameState

Interface which defines the methods which all game states have to implement. These consists of an init, start, stop, update and an exit method.

3.3.1.2 InGameState

This state controls the actual gameplay and what the player see in the game view. Ties the MVC together in a state that runs the game.

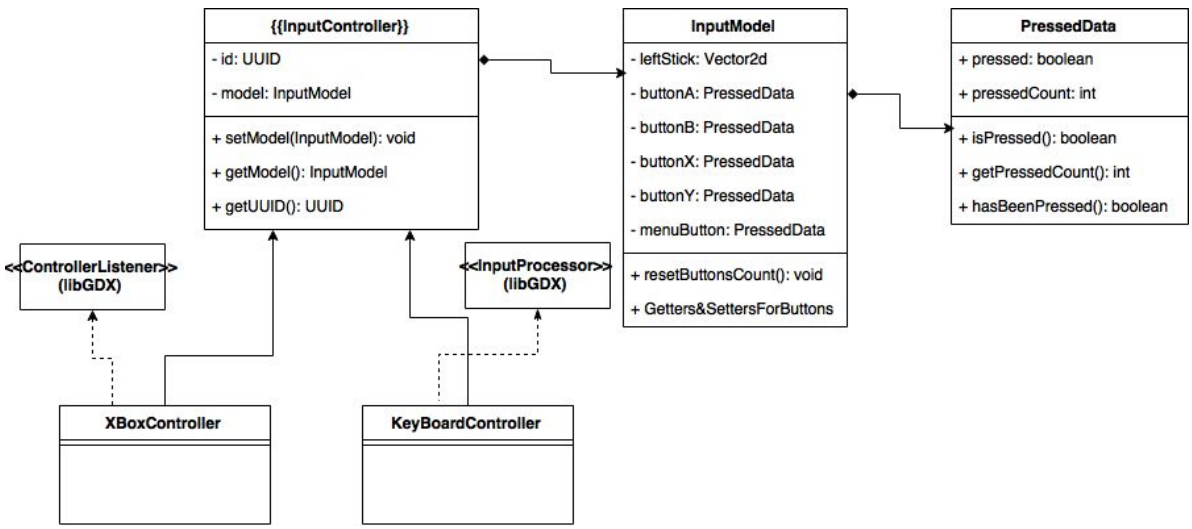
3.3.1.3 MainMenuState

This state displays the main menu (UI) where the player(s) can either start the game or go to the settings state.

3.3.1.4 SettingsState

This state displays the settings (UI) with various parameters and setting for the game, mainly related to the game view.

3.3.2 Input



User inputs are handled by the input controller classes. Each controller contains a InputModel which contains input data, for example which button is pressed. This makes it possible to easily create many different types of controllers.

Inputs are later read in all different game states. This makes it possible to respond to a button differently depending on which game state it is in.

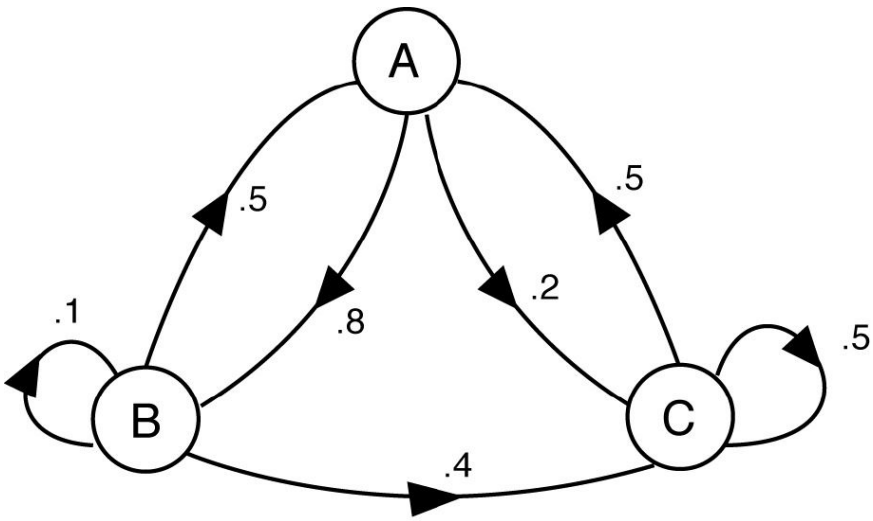
3.3.2.1 InputController
This is an abstract class that is a base for all sorts of inputs. It contains an InputModel instance where all input data will be saved.

3.3.2.2 KeyboardController
This input controller is responsible for handling input from the keyboard and converting it to a format known to the model.

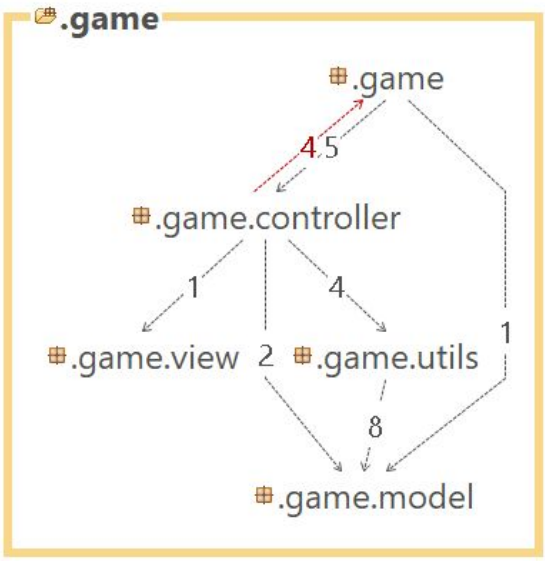
3.3.2.3 XboxController
This input controller is responsible for handling input from the Xbox controller and converting it to a format known to the model.

3.5 AI
The AI package consists of a node class which allows creation of graph that can later be used by entities in the game to move around the map, creating the illusion of intelligent behaviour.

The nodes have a list of connections, and an associated strength with each connection allowing fine tuning of how likely entities will be to choose a certain path.



Visually this could be described by the above graph. A for example has connections to B and C with the strengths 0.8, and the strength 0.2 respectively. In essence, this makes an entity 80% more likely to move to B when positioned at A. Due to the fact that every node contains it own list of connections and strengths this allows as shown in the graph a different likelihood of moving from B to A than from A to B.



3.6 GameObjectContainer

GameObjectContainer is a container class that contains 3 different types of objects that are in a way connected to each other. It contains a GameObject, GraphicObject and PhysicsObject. GameObjectContainer has a EntityContainer which extends it. It is supposed to be used for GameObjects that will be moved. Therefore it has methods which enables it to move and rotate the GameObject around in the world.

3.7 Physics, collision and jbullet

The game uses jbullet for physics. This includes collisions and movement. It uses the btRigidBody provided by jbullet for all physics objects. These physics objects are added to a btDynamicsWorld which then automatically handles all collisions when force is added to the physics objects. When collisions happens a callback will be made to the inner class CollisionListener which extends ContactListener within InGameState. The callback method onContactAdded provides information about which GameObjects a collision happened with. That information can then be sent further for more functionality.

3.8 LibGdx

LibGdx is a game development framework used in this project to facilitate rendering of objects to the screen. This is done by passing the collection to the render manager, along with a list of all the lights in the scene and the camera. The render manager then uses the render objects in this list to draw the objects to the screen and the light objects to accurately light the scene.

3.1 “...First software to describe” ...

Recap: What is this doing (more detailed)? Divide it into top level subsystems. An UML package diagramf

for the top level. Describe responsibilities for each package (subsystem). Describe interface. Describe the flow of some use case inside this software. Try to identify abstraction layers. Dependency analysis
Concurrency issues.
If a standalone application
- -Here you describe how MVC is implemented
- -Here you describe your design model (which should be in one package and build on the domain model)
- -A class diagram for the design model.

else
- -MVC and domain model described at System Architecture

Diagrams
- -Dependencies (STAN or similar)
- -UML sequence diagrams for flow.

Quality
- -List of tests (or description where to find the test)
- -Quality tool reports, like PMD (known issues listed here)

NOTE: Each Java, XML, etc. file should have a header comment: Author, responsibility, used by.., uses ...

3.2 “...next software to describe” ...

As above....

4. Persistent data management

Data is stored in an assets folder. Within the assets folder there are a few subdirectories for storing maps, models and shaders. Data is accessed using classes libGDX provides, for example FileHandle.

4.2 Map format

A map is stored using our own custom XML tags and as can be seen below:

```
<Machine x="-30" y="0" z="120" rotationX="0.0" rotationY="34"
rotationZ="0" scaleX="1" scaleY="1" scaleZ="1"></Machine>
```

The map itself is created by exporting objects from the 3D modeling application Blender using a python script.

Each tag is associated with an object in the model, in the above example a machine, and its associated transformation attributes are parsed and used to instantiate the object in the game.

If a value is missing the parser will create an object with predefined default values, for example in the case of positions if the xyz coordinates are not defined the parser will set these as 0.

Currently, when the new game button is pressed in the main menu the inGameState's init method is run which parses the selected map.
How does the application
store data (handle resources, icons, images, audio, ...). When?
How? URLs, pathe's, ...
data formats... naming..

5. Access control and security

Project_D is a local only game, therefore no communication is involved.

6. References

Where are they????