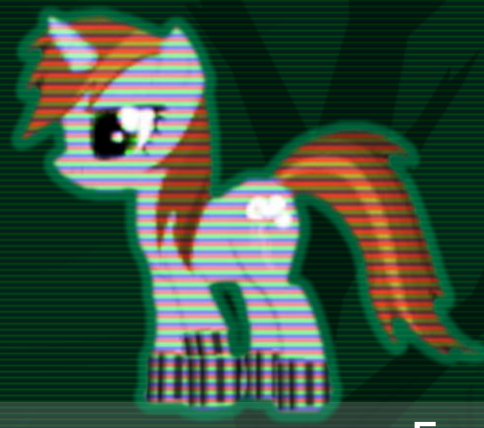


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GROUP 19

SYSTEM DESIGN DOCUMENT FOR FALLOUT EQUESTRIA

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This version overrides all previous versions.

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1 Introduction

1.1 Design goals

The project should be loosely connected in order to make anything possible.

1.2 Definitions, acronyms and abbreviations

- Archetype - A blue print for entities.
- Assets - Things that are loaded from hard drive, e.g. sound, textures, maps etc.
- Behavior - Defines how an entity behaves.
- Client - A computer connected to a host.
- Component - A class defining a property of an entity.
- Entity - A public key to a database containing components.
- Game world - A world containing entity systems, an entity database and entities.
- GPU - Graphics Processing Unit
- GUI, graphical user interface
- Host - The computer, to which the other computers are connected. Acts as a server. The place where logic is done, and the game is run.
- Java, programming language
- Look and feel - A XML-file and a large texture containing all the normal backgrounds, highlights, etc. that make up the GUI.
- LWJGL - A graphics library for java enabling access to Open GL.
- RGBA - A color format
- Screen - A layer on the display.

2 System design

2.1 Overview

The application uses a mix and match of different programming patterns and philosophies. The following headings will cover the most important of them.

2.2 Screen systems

It is a layered system able to show several screens at once on top of each other. It uses different screens for **GUI** and **game worlds**. These screens transition between each other according to player input. This system is based on a C#-project, see reference. The important classes here are:

- The ScreenManager class, which is the container of the screens, managing the rendering and updating as well as making it possible to transition between screens.
- The GameScreen class, which is the base of all screens. It contains update and rendering logic.
- The GUIScreen class, which is the base of all screens containing GUI.
- The EntityScreen class, which is the base of all screens containing entity worlds.

2.3 Graphics system

All the graphics are done through **LWJGL**. The main classes are:

- The `SpriteBatch` class, which batches sprites in order to draw them together instead of drawing them one by one. This increases performance significantly.
- The `RenderTarget2D` class, which makes it possible to use a `SpriteBatch` to render to a texture. This is done by using one of the specialized `SpriteBatch` begin method overloads. The texture can then be used again by using the `RenderTarget2D.getTexture()` method.
- The `ShaderEffect` class, which makes it possible to add shader effects to the drawing of the `SpriteBatch`. This is done by specifying the shader in a `SpriteBatch` begin method call.
- The `Texture2D` class, which is a class representing images on the **GPU**.
- The `Color` class, which defines a **RGBA**-color in the float format.

2.4 Entity Framework

The Entity Framework is core of everything dynamic in the application. This framework is inspired by the Artemis framework. It contains a number of classes, out of which the most important are:

- The `IEntity` class, which defines an **entity**. This class has a direct connection to an entity database and can only be created through a `IEntityFactory`. This class is used throughout the entity systems in order to gain access to its label, groups and components. Furthermore, the network uses the ID of this class to synchronize the databases of the different players.
- The `IComponent` class, which is the base for all **components**. To understand what a component is, examples are the best way to go:
 - `PhysicsComp`, adding this component to an entity gives it properties of mass, velocity etc. and makes it susceptible to gravity.
 - `AnimationComp`, adding this component makes it possible to animate and render the entity.
 - `HealthComp`, adding this component makes it possible to get injured and die.
- The `IEntityDatabase` class, which is implemented as a relational database. See figure below.

EntityID	IComponent A	IComponent B	IComponent C	...
0x000000	Null	B	C	
0x000001	A	B	Null	
0x000002	Null	Null	C	
0x000003	A	B	C	
...	

- The `ComponentMapper`, which maps a component type through the `ComponentTypeManager` to an index for fast retrieving of components from the database.
- The `ComponentTypeManager`, which maps a component to the specific index that is represented by the column in the `IEntityDatabase`. For instance the `IComponent A` in the example figure above is mapped to the column index 0.
- The `EntityArchetype` class, which is a class that the `IEntityFactory` can use to create an entity containing specific components. It is basically a runtime blueprint of an entity type.

- The `EntityFactory` class, which is the place where the entities are born, as well as the place they go to when they die. In other words, it is a factory for creating and recycling entities.
- The `EntityGroupManager` class, which enables entities to be placed in different groups, identified by a string group name. An example of usage of this is the `CameraControlSystem`, in which the camera is affected by all entities contained in the group “Camera targets”.
- The `EntityLabelManager` class, which is similar to the `EntityGroupManager`, but this class enables entities to be identified by one unique string label.
- The `EntityManager` class, which provides a simple interface for interacting with all the other features of the entity framework; e.g. `EntityFactory`, `IEntityLabelManager` etc.
- The `EntitySystem` class, which is the base of all entity systems. To run the game entity systems are required. For example, the following classes are entity systems:
 - `AnimationSystem` – This handles the animation components.
 - `HealthRegenerationSystem` – This handles the health components, and thereby regenerates health.
 - `DeathSystem` – Kills entities when they have zero health or less.
- The `EntitySystemManager` class, which manages entity systems, making them update and process as they should.
- The `EntityWorld` class, which contains an `IEntityManager`, `IEntityDatabase` and `IEntitySystems`. This class makes it easier to use the entity framework, by providing an easy interface to interact with.

These entity classes all implements respective interfaces, so that anything can have other custom implementation and still work. An example of this is the `NetworkedEntityFactory` that extends `EntityFactory` and thereby replacing it as the used `IEntityFactory`.

2.5 GUI

The GUI is based on the class `GUIControl`, as well as `LookAndFeel`, `GUIRenderingContext` and `GUIRenderer<T>`.

- The `GUIControl` is the base class of all GUI controls. It is responsible for the things common for all controls; like resizing, colorization, and event management.
- The `LookAndFeel` makes it possible to implement a wide range of different looks to the GUI in an easy way. The `LookAndFeels` can be loaded through the `ContentManager`.
- The `GUIRenderingContext` is what makes the GUI render. This by using the GUI render-targets and rendering thing in the correct order. The rendering is done by `GUIRenderers`.
- `GUIRenderer<T>` Makes it able to render the GUI control of the type `T`. Controls that needs to be rendered in a significantly different way uses different renderers.

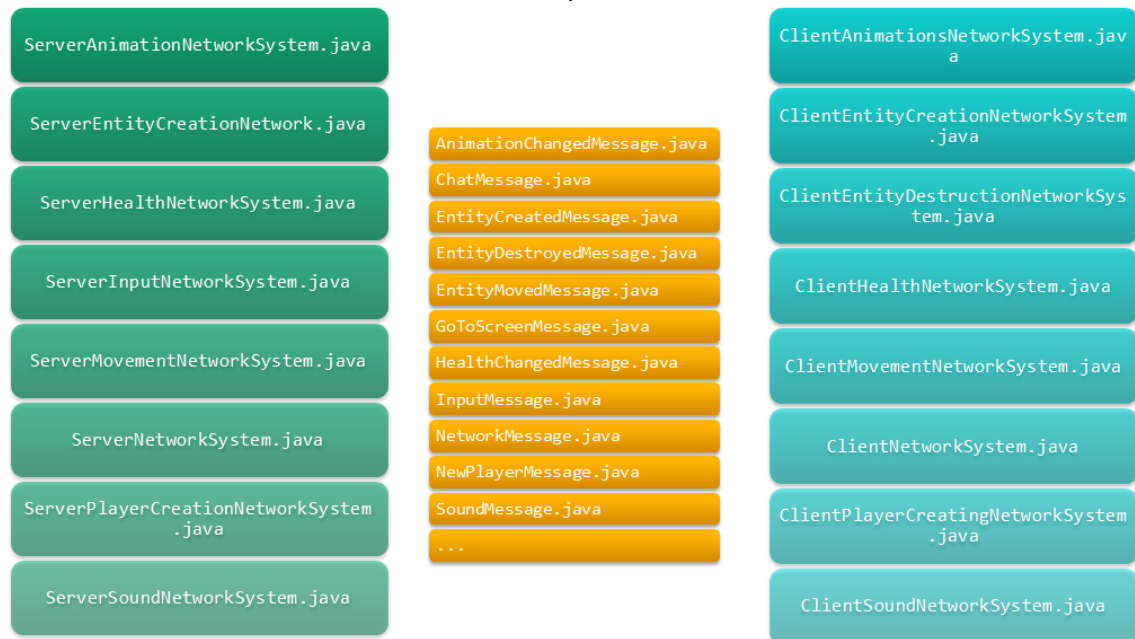
2.6 Network

The network uses the `KryoNet` library in order to send objects of the type `NetworkMessage` between the server and the clients. Both the server and

the clients have network systems handling the incoming messages and sending new messages.

The architecture used is *Authoritative Server*, i.e. all the logic is done on the server side and then sent to the client side for rendering. The clients only send their input and the server does the rest.

To enable networking, use `NetworkSystemBuilder` and specify the world and other arguments needed by the the networked entity systems. Examples of functioning parts of the system is `ServerMovementNetworkSystem` (SMNS), `ClientMovementNetworkSystem` (CMNS), `EntityMovedMessage` (EMM). Each update, the server sends the position of all entities through an EMM. The client then receives the EMM and uses it to update its entities.



2.7 Content

The framework is currently able to load files of the following formats:

- .anim (Format for animation)
- .animset (Format for a set of animations)
- .archetype (Format for entity archetypes)
- .effect (Format for vertex and fragment shaders)
- .font (Format for character information on the font texture)
- .ogg (Format for sound effects and music)
- .pchar (Format for player characteristics)
- .png (Format for textures)
- .scene (Format for the scenes in the game)
- .tdict (Format for look and feel, as well as body part information on animation textures)
- .XML (Format for things we didn't come up with a good format name for)

Each format has one or more loaders derived from `IContentLoader<T>`, which converts the content into the type `T`. For XML-based content, `JDom` and `XStream` are used for the conversion. For loading of content, `contentManager.Load(String path, Class<T> classToLoad)` is used. For example:

```
Texture2D texture = contentManager.Load("foo",Texture2D.class);
```

2.8 Behaviors

The behaviors are inspired by the `MonoBehavior` class in Unity¹. They are used to define very specialized behaviours, differing from the larger events handled by the `IEntitySystems`. For example; AI, input response, etc. are handle in these classes

2.9 Animation

This system makes it possible to animate. The animations are bone based and the `animationsystem` is based on a port from a C#-project named Demina. The Demina animation editor is used to make the animations.

2.10 Scene

Scenes are made through a tile editor previously implemented by Lukas Kurtyan in a hobby project which has been customized to fit this project as well as possible.

2.11 Utils

The package `Utils` contains various useful classes such `Camera2D`, `Clock`, `Timer`

2.12 Software decomposition

2.12.1 General

Package diagram. For each package an UML class diagram in appendix

2.12.2 Layering

2.12.3 Dependency analysis

2.13 Concurrency issues

2.14 Persistent data management

2.15 Access control and security

2.16 Boundary conditions

3 References

APPENDIX

¹ <http://unity3d.com/>

