

Heat Mapping Unity Plugin

Game Engines E2013
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1 Introduction

This report is the result of a project in the Game Engines E2013 (MGAE-E2013) course on the Games line at the IT-University of Copenhagen autumn 2013.

For the project, I have worked with Jakob Melnyk (jmel) to create a plugin for Unity that allows the user to gather data for their games and create heat maps based on this data.

Throughout this report I will be referring to two games, in which we have tested the plugin: AngryBots which is a demo project for Unity and Hiaerth which is a game we have created for the Game Design course¹.

2 The Project

When it comes to video games, there is a lot of data available from when people are playing and all of it can be tracked. Data that involves the positions of objects, where entities died (and what they died to), where certain events were performed, etc. can also be very interesting for the developers. It can be used for statistics, influencing balance, finding bottlenecks and figure out what is interesting for the players.

While the data is important, displaying it in an easy-to-understand manner is at least as important. Using an FPS² game as an example, showing what weapons the players prefer to use overall, their accuracy with weapons, which enemies are killed with which weapon, etc. can be visualized properly with a table. It works because the data is numbers and the numbers are not necessarily related to where in the world the event takes place.

When it comes to positioning of any kind in a game, a table is not a good choice. A table is useful for saying how many times an event happened, but it is not very helpful when it comes to stating *where* the event happened. "Event e has happened at location x, y, z so and so many times" gives some information, but where in the game is x, y, z?

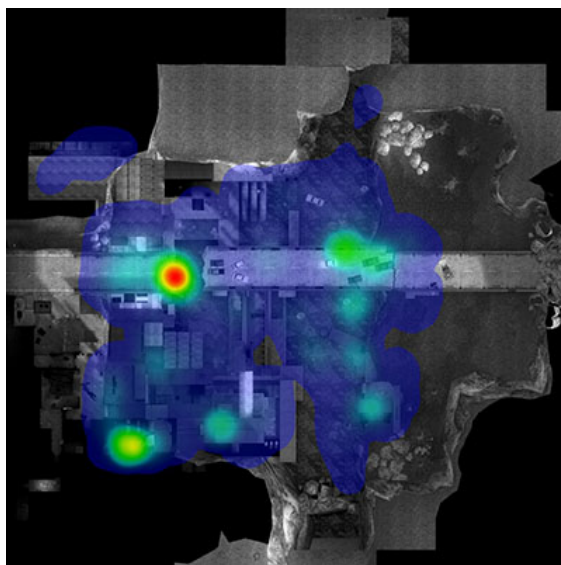


Figure 1: A heat map representing deaths in a level in *Half-Life 2*

¹The entire Unity project can be found at <https://github.com/esfdk/DarkForest>

²First Person Shooter

This is where heat maps have their place. Using colors, they can show where - and how many times - an event has happened in the game. Heat maps are maps of the different places of the game with colored spots on. The colors of the spots range from an icy blue to a dark red. The darker the color is, the more times a certain event has happened there.

Looking at **figure 1** on page 1, one place is bright red, which means that players have died a lot at that position. This can either indicate that the place is too hard, that the players have missed something that can heighten their survival, or that the place is working as an intended difficult area. Either way, the heat map gives the developers useful information, which is easy to understand and work with.

2.1 Goal of the Project

As both Jakob and I are rather interested in game balance and mechanics, we decided we wanted to make a tool that could assist in generating heat maps. After talking it through, we decided to create the tool for Unity, for a couple of reasons.

Unity works on a set of rules. Every object in the game world has a position and every object has access to methods that are the same for all objects (such as the `Update()` method, which is called every frame on every object). This means we can assume that every object can do certain things, and base our tool on that.

Another nice thing is that plugins in Unity are actually just collections of scripts and prefabricated objects. As such, it is easy to export and import in another game. Copy the necessary scripts and objects, and you have a working heat map tool for another game.

Unity is also fairly easy to work with, when it comes to creating new tools for it. The API used in Unity is solid, and gives access to basically anything one will need. The documentation and support for Unity is also extensive, making it easy to figure out what one can do and how to do it.

2.2 Features

Track events on all kinds of objects.

Gather data in XML files and combine to one file.

Chose a set of data (object/event) to display.

Work offline.

Ease of use. (Finding a tool that seems to cover all your needs, just to figure out that it takes ages to set up properly is never fun. In fact, it can turn people away from using the tool, even if may be what they are looking for. Therefore, one of our goals was to make the plugin easy to set up and easy to use.)

3 Overview of the Plugin

The plugin Jakob and I have created allows for basic tracking of objects and events in a game created in Unity. The gathered data is stored in an XML file and can be used inside Unity to create a basic heat map for the game.

The events that gets tracked are grouped by what object they belong to, which makes it easy to generate a heat map for a certain type of event on a single object (such as the player dying, jumping, firing a bullet, enemies spawning, etc.) or a combination the individual events. It is also possible to access all events for a given object, a given event for all objects or all events for all objects.

The plugin can, by default, track some default Unity events such as the position of an object. Furthermore, one can track custom events, allowing the developers to gather virtually any kind of data they want. The heat map generation will take the custom events into account, and allow generation of heat maps of the custom events.

As seen in **figure 2**, the heat map overlay generated by the plugin is of a decent quality, and certainly good enough to learn something about the players' behaviour from. As one can see, the player just walked around until they got to something interesting, at which point they stayed for a little while, investigating it.

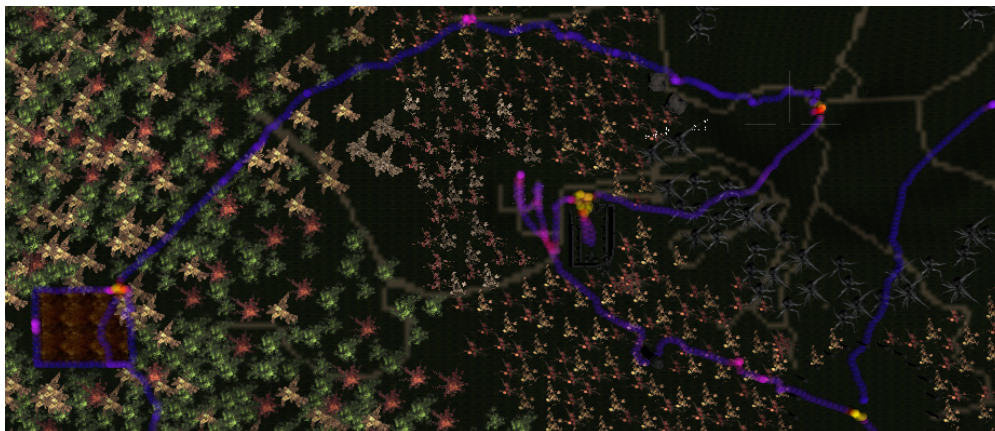


Figure 2: A heat map showing player movement in the game Hiraeth.

3.1 Parts of the Plugin

The plugin consists of four folders, each containing components needed for tracking and visualizing data.

Editor

The **editor** folder contains two scripts, `HM_TrackerEditor` and `HM_GenerateHeatMapEditor`. Both scripts "support" other scripts (`HM_Tracker` and `HM_GenerateHeatMap`), and their primary job is to modify the Unity inspector to make the scripts they support easier to use.

Plugins

The **plugins** folder contain two scripts that are used internally in the heat mapping, `Colorx` and `HSBColor`. These two scripts are used to control the color of the markers that are used to represent the position of events in the game. Both of them have been written by Jonathan Czeck, Graveck Interactive 2006.

Prefabs

The **prefabs** folder contains the two objects that will be used to generate and show the heat map. The `HM_HeatMap` is used to generating the heat map from the gathered data, while the `HM_HeatMarker` shows each position generated from the data.

Scripts

The **scripts** folder contains six scripts that are part of the heat mapping process.

- The `HM_ControlObjectScript` script is put on a dummy object that is generated when the game start. It ensures that only one folder is created for the data gathering session, and it takes care of combining the data for the different objects when the game ends.
- The `HM_Event` script is very basic. It holds the type of event and the position at which it happened and can write this data to an XML file.
- The `HM_EventTypes` script holds the default type of events the plugin can track.
- The `HM_GenerateHeatMap` script takes care of generating the heat map based on the data gathered, and it creates and places the markers in the world. The data is uses is chosen through the Unity inspector options.
- The `HM_HeatMarkerScript` script is placed on the `HM_HeatMarker` objects, and is used to change the color on the marker.
- The `HM_Tracker` script is placed on the object one wants to gather data for. It will track the object's position by default and can be set up to track some other events as well. It will save this data to an XML file for the session that is in progress (determined by the `HM_ControlObjectScript` script).

3.2 ???

4 How To Use

4.1 Tracking objects

4.2 Generating the heat map

5 Performance

5.1 Saving data

5.2 Generating the heat map

6 Conclusion

6.1 Issues

Custom events from javascript is not easy.

The transparent spheres do not work with the new 2D tools in 4.3. Transparent objects appear to be totally invisible.