UPS Visual Analytics for Large-Scale Dynamic Flow Networks
Technical User Guide

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Contents

1 General Information

1.1 Overview

A visualisation system presenting Origin Destination Flow Maps in Virtual Reality

- A software system based on Unity [1], SteamVR [2] and VRTK(Virtual Reality Toolkit) [3]

- Pre-made prefab to create new maps

- Python [4] scripts to process data

- System Name: UPS In Virtual Reality

- System Category: Visualisation Tool

- Operational Status: Developing

This software has only been tested on Unity 2018 v3.2.f1 using HTC Vive and SteamVR. This software should extend to other Virtual Reality Technologies which VRTK [3] supports.

This guide does not document the code base, only how to set up the software to work with your system. For code documentation, please refer to "annotated.html", in the Docs Folder.
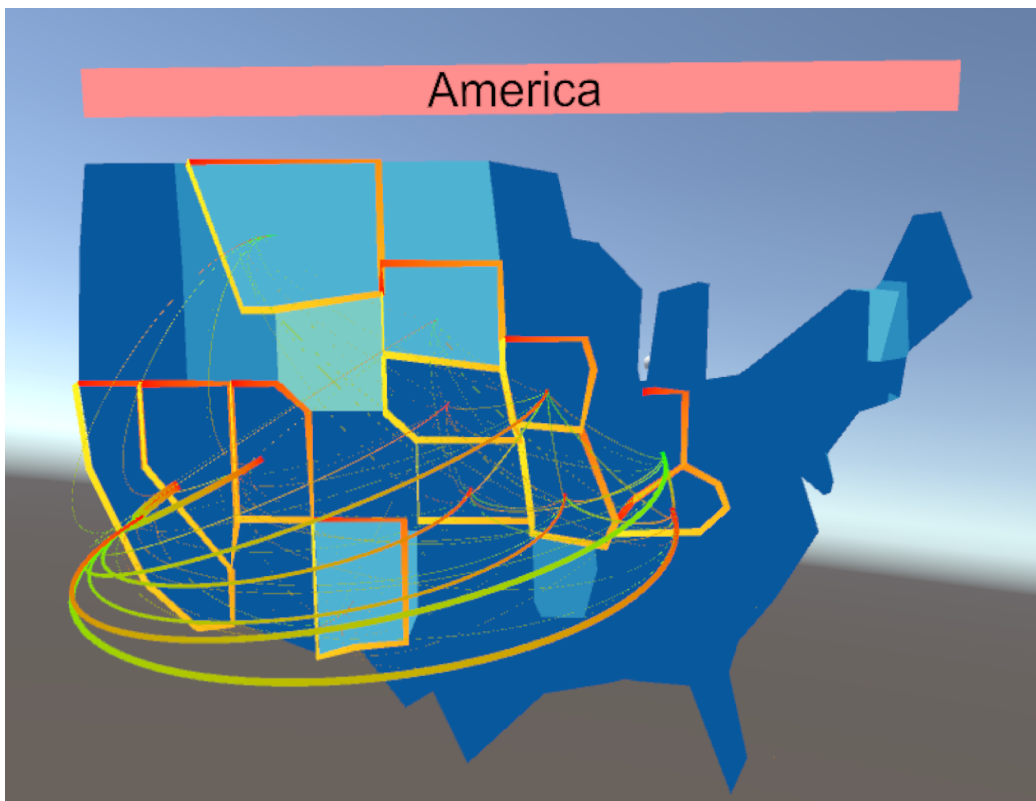

Figure 1: Example map created in the software

1.2 Points of contact

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1.3 Acronyms

VRTK : Virtual Reality Toolkit
VR : Virtual Reality
UPS : United Postal Service

1.4 Precautions

These precautions have been adapted from [5] to fit this project. We highly recommend reading the health and safety guide related to your specific virtual reality technology.

1.4.1 Safety Precautions

- The headset produces an immersive virtual reality experience that distracts users from and completely blocks the view of their actual surroundings. Always be aware of surroundings when using the headset.

- Take special care to ensure that you are not near other people, objects, stairs, balconies, windows, furniture, or other items that you can bump into or knock down when using—or immediately after using—the headset.

- Do not handle sharp or otherwise dangerous objects while using the headset. Never wear the headset in situations that require attention, such as walking, bicycling or driving.

- Do not wear glasses when using the headset. Doing so may cause facial injuries. If you need corrective lenses, it is recommended that you wear contact lenses when using the headset.

1.4.2 Health Precautions

- This product should not be used by children under the age of 13, as this is a critical period in visual development.

- Prolonged usage should be avoided, as this could negatively impact hand-eye coordination, balance and multi-tasking ability.

- Immediately discontinue the use of the headset if you experience any of the following symptoms: seizures, loss of awareness, eye strain, eye or muscle twitching, involuntary movements, altered, blurred, or double vision or other visual abnormalities, dizziness, disorientation, impaired balance, impaired hand-eye coordination, excessive sweating, increased salivation, nausea, lightheadedness, discomfort or pain in the head or eyes, drowsiness, fatigue, or any symptoms similar to motion sickness.

2 Getting Stared

2.1 Hardware Requirements

We recommend the following minimum hardware. These specifications were proposed by the Vive [6]. These requirements ensure a high frame such that the user will not experience motion sickness. You will need a basic network connection to ensure you can install necessary software. The data processing also requires an internet connection.

- CPU: Intel i5-4590 or AMD FX 8350 equivalent

- GPU: Nvidia GeForce GTX 970 or AMD Radeon R9 290

- RAM: 4GB DDR4

- CPU Cooler: Stock/Deepcool Gammaxx 400

- Video Output: HDMI 1.4, DisplayPort 1.2 or newer

- USB Port: 1x USB 2.0 or better port

- 250GB HDD(To Store necessary programs and data)

- Basic Network Connection

2.2 Software Dependencies

This software has a series of software dependencies. These will need to be installed on your system if you want to customise this project. Furthermore, you need to ensure that all dependencies of the listed software are installed.

- Operating System: Windows 7, Windows 8.1 or Windows 10

- Unity [1]: Tested on 2018 v3.2.f1

– Steam [7]

– SteamVR [2]

– Doxygen [2]

– Python ($\geq$ v2.7) [4]

– Microsoft Visual Studio: Tested on Visual Studio 2017 [8]

2.3   Running for the first time

Once you have all software dependencies installed, open up Unity and press the play button as shown in Figure 2. This will then render your first map, which you can interact with.
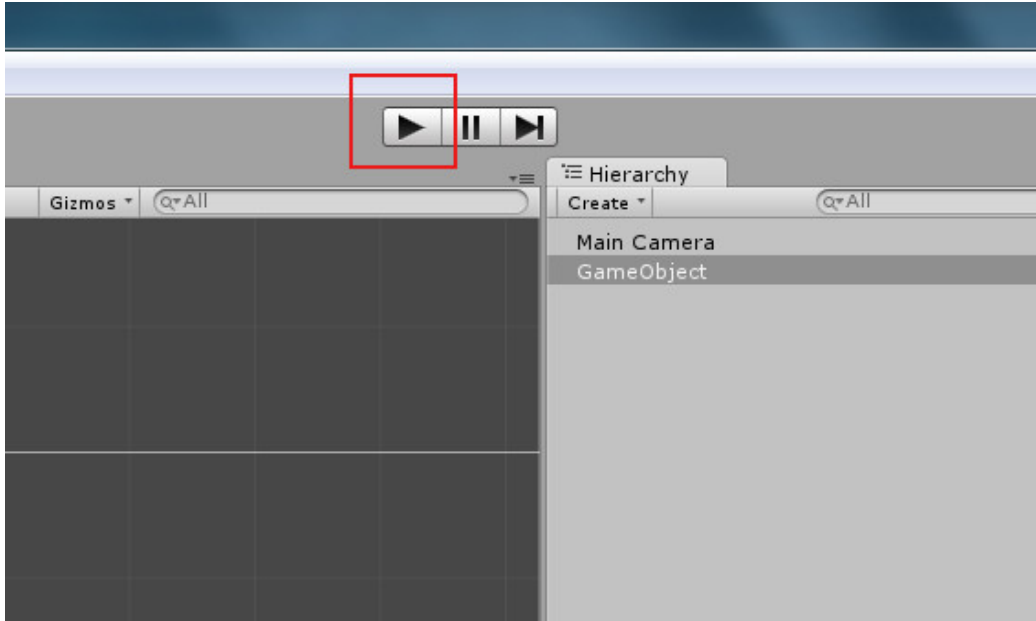

Figure 2: Starting the Unity Program

3   Creating New Maps

Maps are created by adding a Map Prefab, which is located in the MapPrefab folder. You will need to specify properties on these maps to generate them. These properties will specify the details about this map and all of the children. Some example properties are shown in Figure 7. Once you have specified the following properties, press play and the map will be generated at run time.

- Main Map:
    - Path to a geoJSON file containing the information for the Main Map for this set. For example the main map for the default set is mainland America.
- Path To States
    - This should be the path to a folder containing a series of files, one for each state. The file name should be the name of the state.
- Path To Data
    - This should be the folder containing the output from the data processing script.
- Choropleth Legend
    - You need to specify a legend for the choropleth maps. Section 4 will specify more detail about the Legend.
- State Stack

– You need to specify a horizontal stack for the states to appear on. Section 5 will specify more detail about the stack.

- County Stack

    – You need to specify a vertical stack for the states to appear on. Section 5 will specify more detail about the stack.

- Have Tooltip

    – You can specify if you would like the main map to have a label on top.

- Map Scale

    – You can specify the size of the maps and all of the children. This will default to (1,1,1), which is the reccomended size.
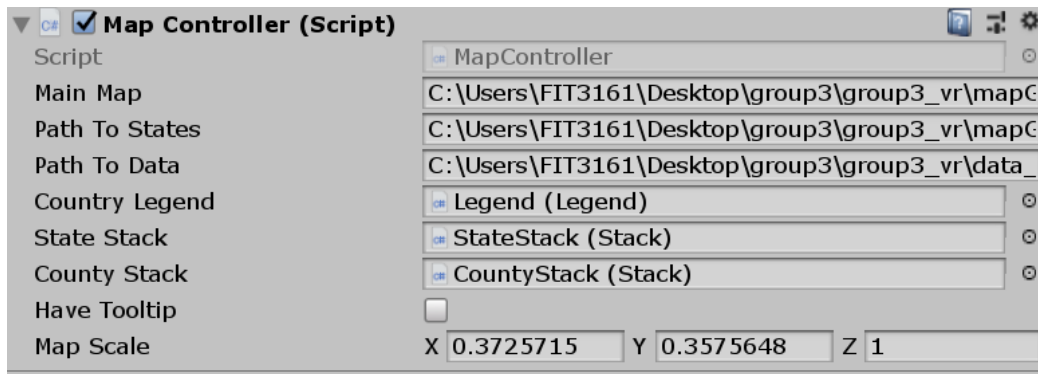

Figure 3: Creating a map instance

3.1 Known Issues

3.1.1 Simple Map Shapes

Unity meshes are limited to only handle shapes with simple geometry. Therefore the maps will need to be prepossessed to simplify the geometry. We recommend the following tool to help with this process [9].

3.1.2 Missing States

If you are missing states in the folder for data, an error will appear in the console specifying the missing state. You can either choose to add this state (recommended) or ignore it.

4 Legends

The legend prefab draws an interactable legend to the screen. One legend can be connected to multiple maps. The legends have a series of predefined colour schemes, which are from d3 [10]. Colour schemes can be viewed at [11]. Similar to maps (Section 3), you would need to define a series of properties.

- Legend Colour

    – Colour scheme from d3.

- Class Separator 1-6

    – Separation between classes in the legend. The generated maps will reference these properties.
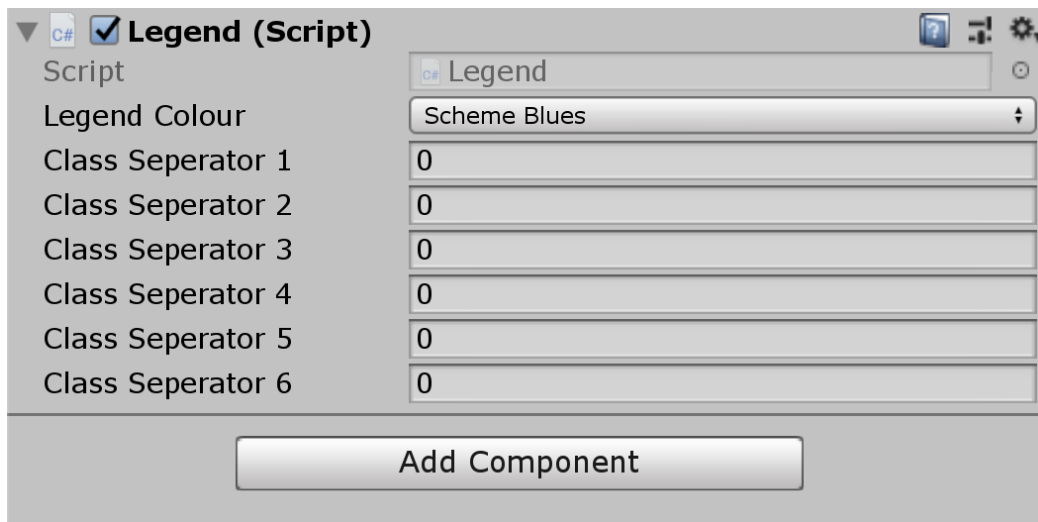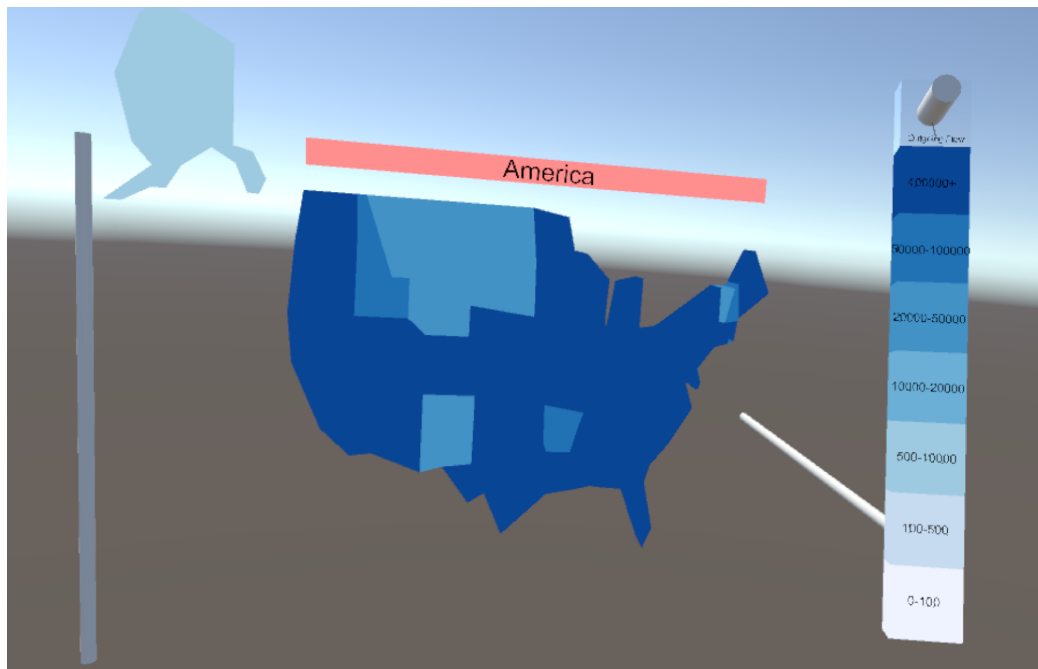
Figure 4: Creating a Legend

Figure 5: Components on the screen including a legend on the right

5   Stack

The stacks are the generation points of the map objects. There are two forms of stacks, horizontal and vertical. You can also specify the distance between generated maps. One stack can be connected to multiple maps allowing you to reuse the stacks or have a separate one for each map.
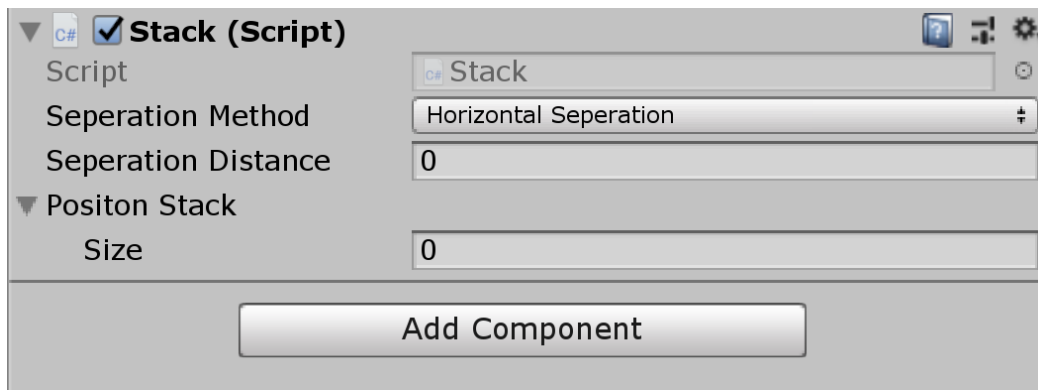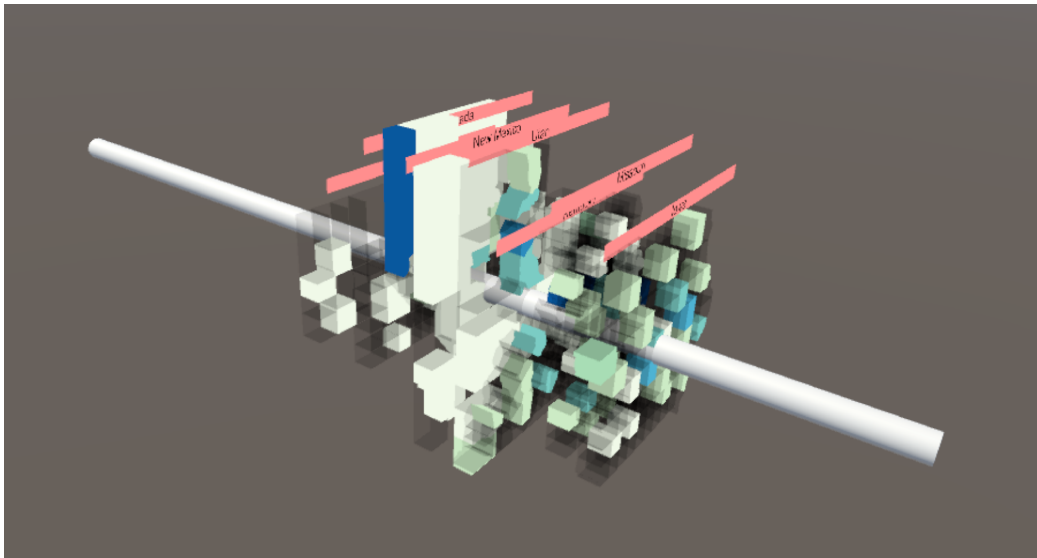
Figure 6: Creating a Stack

Figure 7: Stack being used for states.

6   Data Processing

To process the data, the *main.py* python file will need to be run. This file accepts a series of inputs, which will be the original data files. The script will then clean, parse and format the data such that it can be read by the visualisation software.

To look up the state and county of each facility, an API call is made, therefore internet is needed to clean the data.

7   References

References

[1] Unity Technologies. Unity - unity, 2019. URL `https://unity.com/`.

[2] 2019. URL `https://store.steampowered.com/app/250820/SteamVR/`.

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[4] Guido Van Rossum and Fred L Drake Jr. *Python tutorial*. Centrum voor Wiskunde en Informatica Amsterdam, The Netherlands, 1995.

[5] 2019.   URL `https://www.samsung.com/au/support/mobile-devices/gear-vr-safety-and-health-precautions/`.

[6] 2019. URL https://www.vive.com/au/support/vive/category_howto/what-are-the-system-requirements.html.

[7] 2019. URL https://store.steampowered.com/.

[8] 2019. URL https://visualstudio.microsoft.com/.

[9] 2019. URL https://github.com/mbloch/mapshaper.

[10] Michael Bostock, Vadim Ogievetsky, and Jeffrey Heer. D3 data-driven documents. *IEEE Transactions on Visualization and Computer Graphics*, 17(12):2301–2309, December 2011. ISSN 1077-2626. URL https://doi.org/10.1109/TVCG.2011.185.

[11] 2019. URL https://github.com/d3/d3-scale-chromatic.