Global Roads & Traffic

[22 Apr 22]

Table of Contents

Introduction

Global Roads & Traffic by Virtual Road (VRoad) is a procedural mesh generator and traffic simulation plugin for Unity. It generates a fully-functioning network for vehicle traffic of roads, junctions, bridges, tunnels and traffic lights, and a network for pedestrians of side walks, road crossings and footpaths. The road and walking networks can be populated with moving traffic and pedestrians which then bring the Unity scene to life. The plugin uses data from OpenStreetMap, which has global coverage – all you need to specify is a centre point of (latitude, longitude) and the size of the area to build.

The plugin creates meshes as the basis for the infrastructure. Some basic road surface materials are supplied, but you replace these materials with ones that suit the style of your target application. Similarly, you need to supply vehicle prefabs suitable for the style of your application. For each of your vehicle prefabs, you can select an engine type that the simulation algorithm will use to calculate movement, such as maximum acceleration and deceleration.

Variants

The plugin is available in two variants: Lite and Pro.

Feature	Lite	Pro
Maximum Map Area At Aspect 1:1 At Aspect 16:9 Typical City Blocks	100 Ha = 1 km x 1 km = 1.33 km x 750 m ~ 50	1600 Ha = 4 km x 4 km = 5.33 km x 3 km ~ 800
Taxis and Buses	No	Yes
Source for Example Game	No	Yes

Installation

The Global Roads & Traffic Plugin runs on Unity LTS (Long-term-Support) versions 2020.3 and 2021.2. The Plugin may run without issue on other versions, but we recommend you use one of these versions for new projects.

Step 1: Install Required Package Dependencies

From the Package Manager first check that you already have the required packages, and if not, install them:

[Unity Registry] Input System (may prompt a restart: skip it, see Step 3)
[Unity Registry] Unity UI
[Asset Store/My Assets] Unity Starter Assets - Third Person Character Controller

- This is a free package but you must "buy" it in the asset store
- Required parts: **`InputSystem`** & **`ThirdPersonController`**
- Other parts of this package are optional

Step 2: Import the "VRoad" package into your project

Assets > Import Package > Custom Package... (select All) > Import

Step 3: Enable new Input System

If you skipped the restart at Step 1, now is the time to make sure you have the new Input System activated. To check, go to:

Edit > Project Settings > Player > Active Input Handling

and confirm that it is set to [Input System Handling (New)] or [Both]

Step 4: (Optional): Upgrade Materials for Universal/HD Render Pipeline

The materials in the VRoad package were created for the built-in pipeline. After importing to URP or HDRP, they be shown in the "invalid" hot-pink colour

URP: To fix materials, select:

Edit > Render Pipeline > Universal Render Pipeline >
Upgrade Project Materials to Universal RP Materials

HDRP: To fix materials, select:

Edit > Render Pipeline > HD Render Pipeline >
Upgrade from Built-in Pipeline >
Upgrade Project Materials to High Definition Materials

Step 5: Confirm Successful Installation

On successful installation, there will be a button on the tools menu
Tools > Global Roads & Traffic

Quick Start

In Unity, open the plugin window from Tools > Global Roads & Traffic

Open the Options tab, select Auto-Open Scene for Tab

Open the Build tab, select Locate map with browser then Launch Browser

Zoom to your selected area in the web browser. Outline is red initially, it must be black or green to proceed.

On the Build tab, click Play Scene BuildMap to play this scene in the Editor. You should see a progress bar on the Scene and Game views while it is building.

On completion, you can move around in the Game view using the mouse.

Now switch to the Traffic tab. This will stop the Editor playing and open the RunTraffic scene. Click Play Scene RunTraffic

Once the scene loads, you will see traffic and pedestrians moving. If you do not see pedestrians it is likely that you have not imported the Unity pedestrian package [Third Person Character Controller] – see Installation, Step 1.

Navigation in Game Panel

Left Mouse Drag – Pan
Middle Mouse Drag – Change Camera Angle
Middle Mouse Scroll – Zoom
Right Mouse Drag – Spin

To make the camera follow a vehicle, using the Scene Hierarchy:

- Click on a vehicle game object,
  - e.g. RunTraffic Scene/ VRoadTraffic/ Cars/ DT12345
- In the Game Panel, zoom in to the vehicle using mouse scroll

To make the camera follow a vehicle, using the Scene View Panel:

- Zoom in to the scene view
- Optionally, pause the Editor Player, to make selection easier
- Select a vehicle. This will select the child game object in Hierarchy
- In the Hierarchy panel, select the parent game object
- Resume the Editor Player
- In the Game Panel, zoom in to the vehicle using mouse scroll

The same technique can be used to follow a pedestrian.

Build Tab

The Build Tab is used to specify the area of map to build. This tab is used in conjunction with the BuildMap scene.

The Launch Browser button should open a new browser tab, at the URL http://vroad.uk/sm/ If your system is not set up to allow Unity to open browser pages, then you can manually open the page in a browser.

If the Locate map with browser checkbox is selected, this tab looks at the system clipboard for a (latitude, longitude) location. It uses that location if the size of the area is below the maximum threshold, so you must first zoom in until the selection box changes from red to black or green. If the VRoad map server is not available, you can use any web map that copies to clipboard, such as right-click on http://maps.google.com .

In the browser, you can zoom the map with the mouse scroll wheel or the {+/-} buttons at the top left corner. You can pan (move the map) by dragging any mouse button or with the arrow keys on the keyboard. The fastest way to select an area is to hold down the shift key and use the left mouse button to draw a 'marquee' box to select the area of interest.

When the size of the selected area is less than or equal to the threshold, the colour of the selection box outline will change from red to black or green. If required, you can move the corner points to change the aspect ratio of the selection area. By default, the selection area is set up to have a 16:9 aspect ratio, so that the map generated fits well in a typical screen size.

When the selection box outline is black or green, the Map Location fields in the Global Roads & Traffic window will change accordingly.

When the selection box outline is black, this means that the currently selected area is OK for the Pro variant, but too large for the Lite variant.

Once you have a (latitude, longitude) value in the Build Tab, you can switch off the toggle and enter a specific area and map size in the fields below.

The Play button at the bottom of the tab will be activated when a valid map area is selected, and the BuildMap scene is open.

Rebuild Tab

This tab is used to rebuild the VRoad map from the raw OpenStreetMap JSON data file and the cached terrain data. This option is a bit faster than using the Build tab to re-download the data from the map server, particularly if it is busy. This tab is used in conjunction with the BuildMap scene.

The browse button [...] allows you to select a JSON file to rebuild into a VRoad map file. The Play button at the bottom of the tab will be activated when a valid JSON file is selected, and the BuildMap scene is open.

Click Save as Prefab to save meshes for all of the objects to a prefab that you can use later. The prefab will be saved to Assets/VRoad/Prefabs/Maps/.
To examine the prefab, create a new basic scene (with camera and light) then drag the newly-created map prefab into that new scene. By default, each layer in the scene is a single object, but if you want to delete or edit individual roads or buildings, try building the map again, but this time, go to the Options tab and select Create Multiple Meshes. This will create a separate mesh in its own game object for each road, each junction, each building, etc. Where a road or building has been named in OpenStreetMap it will use that name for the game object.

[There is a map-editing feature, currently in beta-test, to add edits to the JSON file to 'post-process' the raw data from the map server. This feature allows changes such as moving nodes, excluding roads or walkways which are not required, changing the alignment geometry of lanes or junctions, changing terrain elevation, etc. More information on the map-editing feature will be forthcoming when it is released.]

Traffic Tab

This tab is used to open a previously saved VRoad file, create road and walkway surface meshes from it and then run a traffic and pedestrian simulation on those surfaces. This tab is used in conjunction with the RunTraffic scene.

The browse button [...] allows you to select a VRoad file to load. Once selected, the file will be loaded when you play the scene. Loading is handled by the UMapLocation script attached to the VRoadMap game object.

The vehicle and pedestrian models included with the package are intended as examples only, not to be used in your released application.

To replace the vehicle models with your own:

- create a prefab with a structure that is the same as the examples:
  - A parent object with a component Type Spec{Car,Bus,Trailer,Truck} script. The transform of the parent object should be reset to default values, as it will be used to position the vehicle in the simulation.
  - A child object defining the shape (and texture) of the vehicle. The transform of this object can be used to orientate the vehicle.
- Set up the Type Spec values Wheel Base and Engine Type appropriate for your vehicle model and set the Abundance value according to the relative number of each model you want to see in the simulation. For example, if you had four car models and you wanted 2 of them to be common and the other 2 to be relatively rare, you might assign Abundance values of 45, 45, 5, 5. A useful convention to follow is to make the abundance values sum to a round number such as 100 or 1000, but the sum can be any value, it is only the relative values that matter. To change the relative proportion of vehicle classes (cars, coaches, trucks), see the field in the option tab.
- Drag the vehicle prefab to one of the arrays on the UBotHandlerExample script: Prefab Cars, Prefab Coaches, etc.

To replace the pedestrian models with your own, follow the same process as for vehicles, this time adding your new prefab to the Prefab Peds array.

Options Tab

This tab is used to set up some options for building VRoad maps.

Create Multiple Meshes: create a game object and mesh for each lane, junction, building, etc. See the section on the Rebuild Tab.

Create Unity Terrain: this creates a Unity Terrain object as well as the VRoad terrain layer. The Unity Terrain object can be edited with Unity terrain tools. The Unity Terrain object does not have holes for tunnels, you will need to create those yourself, if you have any tunnels.

Car, Coach, Truck %: The split of vehicle classes which is "baked" into the VRoad file. Enter three values in this field to change the split from the default, which is 90,5,5. For example, if you want no coaches and four times more trucks than the the default, you would enter 80, 0, 20.

Mapbox Token: Paste your own token into this field, to continue downloading terrain tiles after your initial free allocation has been used. It is free to register with Mapbox, and as of [22 Apr 22] the free tier includes 750K terrain tiles. From the Mapbox sign-in page, go to Tokens, then press the clipboard icon to copy your token, then paste it here.

Auto-Open Scene for Tab: Select this to automatically switch scenes when you switch tabs on the Global Roads and Traffic panel. Note that the switching process will stop the editor from playing the current scene, so you may not want to enable this option all the time. This option is disabled by default.

Variant Tab [Lite] / [Pro]

This tab indicates which variant is in use, and the features of that variant.

BuildMap Scene

This scene is used by the Build and Rebuild tabs on the Global Roads & Traffic panel. It contains these Game Objects:

- Camera / Light: as for basic new scene
- Logging: redirects messages from the map builder and the simulation modules to the console
- Canvas: a simple UI canvas, showing progress bars for the map builder and simulation file loader, and a simple menu system for play/pause control of the simulation in the game panel.
- VRoadMap: the parent object for the mesh that will be generated. This object also has a number of scripts attached:
  - UBuildMap: a controller for the map building process
  - UStateHandler: handles the state machine for the simulation app
  - UMouseExample: mouse handling for the game panel
  - UExitHandler: shuts down all simulation threads
  - UMapMeshExample: the main script for building meshes from the data in the VRoad file

RunTraffic Scene

This scene is used by the Traffic tab on the Global Roads & Traffic panel. It contains the same (or very similar) objects to those in the BuildMap scene, plus:

- VRoadTraffic: the parent object for all the vehicles and pedestrians that are spawned by the simulation. This object also has a number of scripts attached:
  - UPlaySim: a script that controls the simulation play/pause state
  - UBotHandler: the main handler for the “Bots” (Vehicles and Pedestrians) in the simulation. This is the place to drop your own vehicle and pedestrian models into the scene.

Configuration

Configuration files are stored in a location relative to Unity's path variable `Application.persistentDatapath`

On Windows this is

```
%userprofile%\AppData\LocalLow\<companyname>\<productname>
```

Configuration files for this package are stored on Windows in:

```
%userprofile%\AppData\LocalLow\VRoad\
```

vroad-config.bin: This file contains the URL for terrain tiles and a fallback URL for OSM Overpass data. This file is binary, downloaded from the VRoad server on each start-up. If download fails, any existing local file will be used. If there is no local file, a new file containing default values will be created.

vroad-config-inst.json: This file contains the main URL for OSM Overpass data, and also for OSM Nominatim, which is used only as a last resort if no place names can be discovered from the OSM data. This is a text configuration file, downloaded from the VRoad server on each start-up. This file should not be edited manually, instead see the next file, vroad-config-user.json.

vroad-config-user.json: This file is optional. If it exists, its values override those in vroad-config-inst.json. Lines can be copied manually from the inst file, then edited to suit, but it must be in a valid JSON format. We recommend you use a validating text editor to edit the JSON file, such as Notepad++. JSON errors will be highlighted in the Unity editor console. A new file will be created by the Global Roads & Traffic panel if you paste a Mapbox Token into the options tab.

