Global Roads & Traffic

[6 Nov 23]

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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 can 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 braking.

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
Aerial Photo on Terrain	Low Resolution	High Resolution
Texture-Map Buildings	Partial	Full
Source Map Customizer	No	Yes
Example Driving Application - uses Unity Wheel Colliders - source code included	No	Yes
Example Traffic Signal Editor - edits splits and offsets - source code included	No	Yes

Installation

The Global Roads & Traffic Plugin runs on Unity LTS (Long-Term-Support) versions 2020.3, 2021.3 and 2022.3. The Plugin may run without any issues on other versions, but we recommend you use one of these LTS 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: accept it)
[Unity Registry] Unity UI
[Asset Store/My Assets] Starter Assets – Third Person Character Controller
- This is a free package but you must "buy" it in the asset store
- You may see a dependency error - to fix it, edit Packages/manifest.json to remove the line "com.unity.render-pipelines.universal"...

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

[Asset Store/My Assets] Global Roads & Traffic [Pro / Lite]

Step 3: Confirm new Input System

Go to: Edit > Project Settings > Player > Active Input Handling

Confirm that it is set to **Input System Package (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 may be shown in the "invalid" magenta colour.

URP: To fix materials, select:

[2020] Edit > Render Pipeline > Universal Render Pipeline > Upgrade Project to URP
[2021] Edit > Rendering > Materials > Convert All Built-In Materials to URP
[2021] [Select Material(s)] Edit > Rendering > Materials > Convert Selected...

HDRP: To fix materials, select:

[2020] Edit > Render Pipeline > HDRP > Upgrade .. Built-in > Upgrade Project to HD
[2021] Edit > Rendering > Materials > Convert All Built-In Materials to HDRP

If the terrain material is still magenta, try switching off the option **Layered Terrain** in the Game Object **UMapMeshExample / Parameters**

Step 5: Confirm Successful Installation

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

You may see a message on Burst package de-activation, requiring an Editor restart.

Quick Start

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

Open the Build tab, press Open Scene, then press Launch Browser

Zoom to your selected area in the web browser. In Pro, selection area outline is red initially, it must be green to proceed. In Lite, size and shape is fixed. Click Copy to Unity to copy latitude and longitude of selected area.

On the Build tab, click Play Scene to play this scene in the Editor. You will 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 stop the Editor playing and switch to the Traffic tab. Press Open Scene then press Play Scene

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.

If the pedestrians are shown in invalid magenta materials, navigate in Hierarchy to Prefab VRoadPedArmature/Geometry/Armature_Mesh and on each material select a valid shader, normally "Standard" near the bottom of the list.

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 to the URL shown on the tooltip. 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 green. If the standard 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.

Area Selection [Pro]: When the size of the selected area is less than or equal to the maximum, the selection box outline will change from red to 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. If Auto-Copy is selected, and the selection box outline is green, the Map Location fields in the Global Roads & Traffic window will change as you pan. 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.

Area Selection [Lite]: the selection box outline is gold. Zoom in until the Copy To Unity button is enabled.

The Play button at the bottom of the Build 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 or customized OpenStreetMap JSON data file and optionally, to create a prefab from the built scene. 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.

Single Mesh / Multiple Meshes: By default, each layer in the scene is a single mesh, 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.

[Pro Feature] To edit the map, use the Map Customization editor window.

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 URunTraffic 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 fields in **UBuildMap / Parameters**
- Once you have created a new prefab, drag it 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. The lower part of this tab is enabled only if the Build Map scene is active.

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

Mapbox Token: Paste your own token into this field, to download terrain tiles and aerial image tiles from Mapbox. As of [6 Nov 23] the free tier includes 750K aerial or terrain tiles. From the Mapbox sign-in page, go to Tokens, then press the clipboard icon to copy your token, then paste it here.

Mapbox Aerial Image Zoom Level: Set this to a value from 13-14 for Lite or 13-17 for Pro to download aerial image tiles. Level 13 is low-resolution, level 17 is high resolution. Higher resolution means more tiles: level 17 downloads 256 times as many tiles as Level 13, so the map will take much longer to build.

Mapbox Terrain: Select this option to download terrain tiles. If this is off, the terrain generated will be flat.

Reset To Defaults: There are many options and parameters which can be modified in the U Build Map and U Map Mesh game objects. Thsi button resets all these option to the default values.

Variant Tab [Lite] / [Pro]

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

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.

Scenes

BuildMap

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
  - UMouseExample: mouse handling for the game panel
  - UMapMeshExample: the main script for building meshes from the data in the VRoad file

RunTraffic

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.
  - UStateHandler: handles the state machine for the simulation app
  - UExitHandler: shuts down all simulation threads on exit

SimulationPrefab

This example scene shows how to run the simulation with a prefab saved from the Rebuild tab. It uses objects similar to those in the scenes above. Note that the name of the .vroad file passed to the simulation must match the file that was created when using the Rebuild tab to generate the prefab.

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. 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: 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.