Alpha Release Report:

Aquario Kart: Double Splash!!

January 2021

Team Markedly Minified Olives (MMO)
Mark Pilgram
Min-Shan Luong
Oliver Jung

Changes & Additions since the Interim Demo

Vehicle changes

Some minor changes were made to the vehicle's handling, for example it will now start sliding to the side if you try to drive along steep terrain. There's also a new respawn system that is activated if the vehicle leaves the race track or detects that it is stuck upside down. After respawning, vehicles receive a temporary invincibility period where they can not be affected by offensive items from other players and can pass through other vehicles.

Vehicles now also have randomized color and material properties, allowing the player to distinguish between their opponents. These color choices are made using a random algorithm from this article for each vehicle.

Item Boxes & Items

As is typical for the genre, items in our game can now be obtained from item boxes that are spawned in lines at regular intervals across the track. Our item distribution system offers several customization options and works as follows:

Items can define a maximum number of active instances, a minimum time between the item being granted to a player, a minimum race time to have passed before the item becomes available and a relative pickup chance based on the distance of the vehicle passing through an item box from the vehicle in first place. This is to say that the position of the player picking up an item is irrelevant, only their distance from first place matters. Using an animation curve, the item chance can be precisely adjusted for any distance. So when a vehicle drives through an item box, each available item checks if its current instance count exceeds its maximum, if the item has recently been given to a player and must wait to be given again and whether the race has gone on for long enough for the item to be available. Items that meet the availability criteria are added to a list of possible items. The racer then receives an item from this list based on weighted randomness.

Each item has a primary and secondary function and also defines a water cost for its use and water gain on discard. Discarding items causes the vehicle discarding the item to leave a short puddle trail behind in addition to giving it back some water. The current set of items is as follows.

1. **Water Jets**
   Primary use: Improves the user's acceleration and handling properties for a few seconds.
   Alternate use: Allows the vehicle to jump over obstacles.

2. **Water Bomb**
   Primary Use: Throws a bomb forward that explodes on impact. Nearby opponents are blasted away.
   Alternate use: Drops the bomb behind the user's vehicle. The Bomb will then explode if an opponent enters close proximity or the bomb's 5 second timer expires.

3. **Ice Storm**
   Primary & Alternative Use: Summons an ice storm that follows the leading vehicle.

4. **Shield / Ice Block**
   Primary Use: Activates a shield that protects the user from obstacles/bombs and slippery ground.
   **Alternate Use:** Spawns a solid ice block behind the user.

5. **Wave**
   Primary Use: Sends a wave forward that drags vehicles roughly matching its direction with it.
   Alternate use: Sens a wave backwards that launches vehicles opposing its direction into the air

Water System updates

Puddles can now easily be spawned on-demand. They can either be spawned one at a time, or automatically and seamlessly trailing a specified transform for a certain duration. We opted for an object-pool system to handle the "spawning" of these puddles, as the constant instantiations from trails could negatively impact performance. Rather than constantly Instantiating and destroying puddle objects during the race, a puddle manager object creates a pool of (currently around 250) puddles at the start, that can be enabled and disabled when needed. The system will still instantiate new puddles over time if the pool is about to run dry due to high demand, but try to spread these instantiations out over multiple frames.
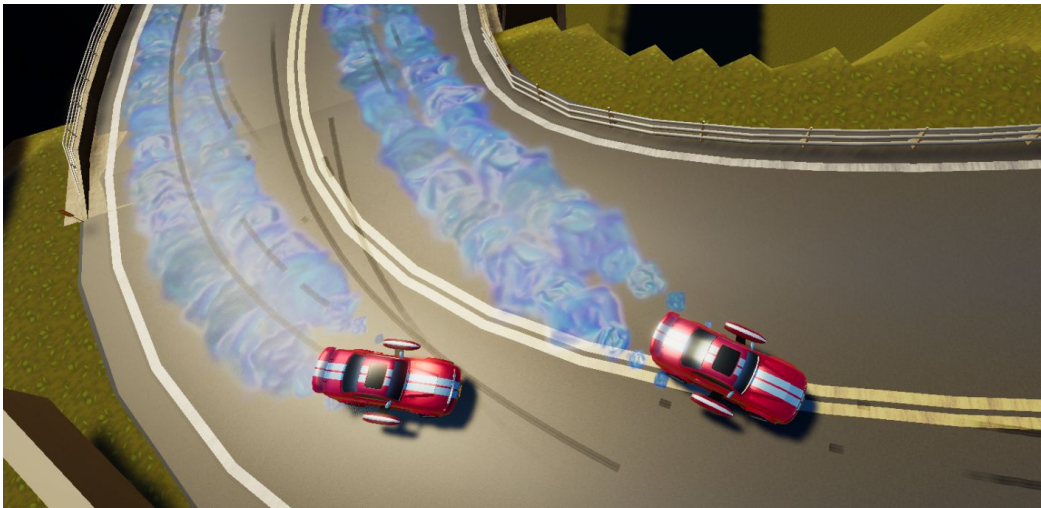
Another mechanic added for one of our items are ice puddles. They're like regular puddles, except without the benefits: The influence handling, but don't give vehicles water.

Race Stages

Races now have a proper start and end. Upon loading into a race, we start off by showing the map intro showing various parts of the level, as well as the level name. This is followed by the race countdown stage, which smoothly transitions into the race itself. Once the player - or more specifically the vehicle being viewed by the camera - passes the finish line, the race is over, and this vehicle's position and race time are displayed. If the spectated vehicle was controlled by the player during the race, control is transferred over to the AI, so that the vehicle can continue driving on in the background of the post-race menu.

Parameters for the race such as opponent count, lap count, available items or the existence of a human-controlled vehicle can all be adjusted with just a few clicks, though this can currently only be done in the Unity Editor. We may add the option to create custom races to the main menu later on.

User Interface

Our game now has a fully featured user Interface. One of the original goals was to not just create a functional UI, but an attractive one as well. Though there are still some inconsistencies as the style of our menus developed over time, I think it's fair to say that we have achieved what we had planned for this goal. All menus feature a unique slanted look and are fully animated, while still being highly responsive. Additionally all menus feature seamless Mouse, Keyboard and Gamepad navigation and are designed to be easy to navigate with any of these input devices.

Main Menu

The main menu is arguably the most complex part of the game's UI. It offers a help section with information about the game's controls and various mechanics, as well as a settings section to change various graphics options. Here users can adjust the game's render resolution scale (only affecting the resolution of 3D elements, not the UI), shadow draw distance and volumetric cloud resolution.

Pause Menu & Post-Race Menu

From the pause & post-race menu players have the option to either return to the main menu or restart the race. The post-race menu also displays the player's finishing position and race time.

Game HUD

The game's UI is split into a bottom left and bottom right section. On the left the player can see the spectated vehicle's lap progress, position and a minimap, while the right displays the currently possessed item (if available) and water tank state. The water section is split into two bars: A small one showing the current water usage/gain rate in red or green depending on the context and a larger one displaying the current water level and water cost/gain of an item (if available). The minimap is created at runtime based on the positions of checkpoints in the Checkpoint Network using our own UI Line Renderer.

AI Improvements

We improved the AI's track-following capabilities by allowing it to target arbitrarily distant points on the track rather than just the next checkpoint. With the previous system the AI didn't really have any information to base its decisions around when it got close to a checkpoint, as it effectively couldn't see beyond that point.

To further improve the AI's ability to follow the track, most objects were excluded from the dynamic obstacle avoidance system to the point where it hardly ever is active, as this system ended up being more detrimental to the AI's driving style than beneficial in its current form.

Furthermore the AI can now manually initiate drifts when it detects a sharp corner ahead. Previously the only time the AI would drift was when it landed sideways after a jump, in which case the vehicle's handling model automatically triggers a drift entry.

The final addition is the ability for the AI to use items. Essentially each item defines a function that guides the AI on whether it should use said item. For example the bomb item would check for opponents directly ahead or behind of the vehicle and recommend a primary, alternate or no item use depending on the situation. Generally items will prioritize negatively influencing opponents ahead of the vehicle and preserving the vehicle's own position over punishing opponents further back. If the AI is unable to use the item for a certain period of time and can gain a relevant amount of water from discarding the item, it will finally choose the discard option.

Checkpoint updates

In order to improve the AI the checkpoint system now offers extended access to the data of the checkpoints. This enables the AI to take the next few checkpoints into account when making decisions. Furthermore, the checkpoints now provide custom respawn positions for the vehicles in order to ensure spawning at more helpful locations. In the previous version the vehicles always respawned at the position of the last checkpoint, but that caused trouble if the last checkpoint was located near an obstacle or something similar.

Moreover, we added support for connecting checkpoints to create custom loops inside the racing track. This is necessary for closing the track in case of multi-lap racing courses and implementing optional paths later on. For the first case we also implemented the logic for detecting if a vehicle has finished its current lap. In this case the checkpoint system informs the vehicle automatically.

Track Updates

The track has been smoothed out in places to create a more enjoyable driving experience. These changes give the player and the AI more control at some parts of the track and make them able to drive faster without risking flying off the track.

To make the track more interesting and add some variance to the scenery the environment now contains vegetation like bushes or trees and also structures like villages, boulders, rivers or waterfalls. Additionally, we placed obstacles along the track which serve to guide the player towards the finish line.

Water Effects

To improve the visual feedback about changing ground conditions, we created some effects like water splashes which appear at the sides of the vehicle when driving through puddles or other water sources. Other effects inform the player about the usage of items. The water bomb for example destroys itself with a watery explosion effect. For the wave and shield item we just made some fancy custom shaders. Also frozen puddles now use a different shader than normal puddles. Furthermore, we improved our shaders for lakes, rivers and waterfalls to make the water look more realistic.