Ship Movement Analysis

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Current State:

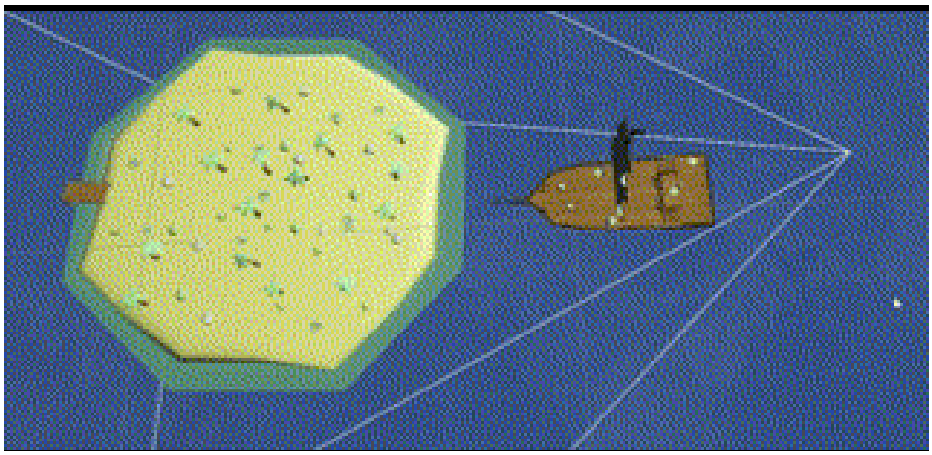
Our current ship movement system relies on a mix of translating and adding force to the boat game object. Although this system works to get the job done in a basic way, it also has many fall backs.

In its current state it's very difficult to make the ship feel like it's moving as a ship, as it's simply moving forward with no external influence or capabilities for said influence to happen. The ship moves instantly which is another issue, and the steering system currently relies on a button to be held which doesn't feel good for a rudder/steering wheel. If the ship hits a rock or an island, it is also unaffected and tries to push forward until it finally gets through. And finally, if we want to add realism such as active water, or boat rocking the current system will fail when that is implemented.

Summary:

This leaves us with multiple issues:

- No external influences (wind, water flow, collision)
- The ship not moving like a ship (Only being pushed forward with a constant, but change-able value)
- The steering wheel functioning in a way that requires constant interaction
- No capability for the boat to rock/sway



Potential Solutions:

Although each of these factors should work together as a contingent system, there are individual factors within each one to consider.

Importance is marked on a 1-5 scale (1 being low, 5 being high, and 0 for not being considered)

External Influences:

External influences are a very important part when thinking about a ship:

If the game includes a wind system where the direction of the wind speed changes, that can heavily influence how the game is played. Wind as an influence allows for specific parts of the map to be a factor (spots where the wind is stronger), or weather-based factors changing the way movement works in a larger area.

- Wind direction and strength (3)
    - On a world scale (3)
    - In smaller pockets (2)
    - Based on weather conditions (1)

If the water is a factor it can influence how the ship moves and swerves alongside the wind. Depending on the current and flow it can result in different ways the ship can be steered, and be an additional (usually minor) aspect for the player to keep an eye on. This can also include factors such as waves which impede the ship, or possibly influence the player's decisions.

- Waters influence (0)
    - Waves (0)
        - Introduces rocking and obstacles.
    - Current (0)
        - Introduces minor inconveniences or benefits.

The last external factor I think it's important to consider is what happens when the ship collides with obstacles (rocks, islands, enemies, etc.), and waves (if included). The ship should be able to rock more and course itself into a position where the player is not impeded, whether that's to the detriment of them taking on damage, loosing speed, or being set off course.

- Collisions (5)

Ship Propulsion:

The way a ship moves is very important, if it just has forward facing velocity and no momentum overtime then it makes it very difficult to feel like it's an actual ship. In real life there are a variety of methods used, but they all include momentum that's gained from an internal or external source.

Sails: (5)

Sails, the method which our group will be using is a method of propulsion that relies heavily on the air currents in a given area. Being able to turn the sails allows you to catch and utilize wind when it's coming in from different directions, and harness it into forward momentum. The ship's shape allows it to cut through the water, and although its rotations is slightly altered by the way the wind is facing, most of the energy is transmitted forward (as long as there is wind, and it's not facing the complete opposite direction).

Water Current: (1)

Water current is an important factor for water vessels, but in most cases on the ocean it matters on a larger scale. When it comes to rivers and lakes, boats are a lot more heavily reliant on natural currents as most of the energy is provided by the water's natural flow. Water current shouldn't be a large consideration for our project given the nature of our environment and the difficulty of fluid simulation (or the faking of it).

Manual/Motor/Propeller: (0)

Although it's not a major factor for us to consider for this project, it's an important aspect to look at when thinking about creating a boat movement system. Most modern boats rely on making their own water currents through the use of a motor and/or propeller. The creation of this means that they don't need to rely on natural water currents (which are less effective to rely on in large bodies of water), and wind which is also quite unpredictable. Manually creating your momentum is another method commonly used in both modern and old timey sea faring, through the use of paddles and/or oars you're able to create momentum through the power of human muscle.

Steering:

When it comes to steering the ship the method of propulsion is a large influence. As sails will be our main (if not only) method of propulsion and influence on the ship, but the main source player agency in steering will also be either a rudder or steering wheel. Each has their own factors but in the end achieve the same result.

Rudder: (2)

If the ship uses a rudder, it will typically need to be held and constantly looked after, being that it has a 1-1 turn ratio (it's quicker if not instant to change directions) through the shaft and rudder.

Wheel: (4)

The second option is a steering wheel which would have a larger ratio of influence over the rudder, meaning it can turn at more precise angles, but take longer to change between said angles. The additional benefit of the steering wheel is it can be set to a specific value, and either not change, or slightly change over time.

Past those two direct methods of steering, there is the potential to have either water current, or wind influence the intensity of a turn, or passively turn the ship over time. Although this shouldn't be a major consideration as it won't majorly affect the game.

Between the two options of Rudder/Shaft and Steering Wheel, the wheel would make more sense as the player won't always need to be actively steering the ship, and could add more chaos to the game as a player could leave the wheel and do another action.

Swaying:

The last factor I think is important to put into consideration is the passive/active swaying of the ship. This factor is heavily influenced by the other points as water, wind, collisions, steering, and propulsion are all potential factors for how a ship sways, but in reality there are two main factors which are momentum, and buoyancy.

Momentum affects the intensity of how a ship shakes, if it's going faster that means it'll be more stable (think bullets), as the momentum will keep it straight and less wabbly, but that also means it's more susceptible to external factors that affect steering, meaning that changes would be more intense when they happen, but them happening is much less frequent.

Buoyancy is the other factor that's important to think about with the swaying of a ship. As our game won't be using a fluid simulation with density and displacement as factors, it's important to think about how this can be simulated in our game. The ship itself won't be floating on top of water, rather sitting in it in world space. In real life it would float on top of water because it's less dense (full of air) and has less mass that the density of water, meaning the ship will rock with the waves.

Both of these factors are too difficult and time consuming for our team to consider, so we need to figure out how to fake it. We can either fully fake it by having the values change, or use an up force. By having the ship constantly falling to either side, and having a force keep it up we can simulate rocking, and possibly vary how much it is by the intensity of waves, wind direction, and ship speed. The other option of faking it would result in a similar end goal, but be harder to accomplish when outside influences might be considered.

Up-force is my intended method to solve this issue, as it will give us more control over the sway and intensity, while having the potential to interact with other systems.

Review:

That was a lot to go over, so I'll now expand my thinking into what is actually actionable, and what will be effective for the project in general. The results of considering these factors have shown a few that stand out above the rest in feasibility, and actual importance.

1. External Forces:
    a. At this stage I think the first factor to be considered here would be a global or local speed variable, or a mix of the two.
        i. Having a global vector that changes slightly over time in intensity and direction would allow for a passive aspect for players to think from moment to moment.
        ii. Having different areas have different intensities whether it's as a boost or detriment will give players something to plan out their actions more and observe their environment.
    b. The second factor that's very important to think about is how the ship will handle collisions and course correction. Having the ship successfully move/bounce away from things it hits will drastically improve the game's feel and result in a more consistent game experience.
2. Propulsion:
    a. The only factor to really consider here is the sails and how they will apply movement to the ship. Using the factors from 1. A., it should be easy to achieve, but the way momentum is kept track needs to be thought out thoroughly, as collisions will need to alter it.
3. Steering:
    a. The steering wheel is the most likely option here as it gives more visualization and the player more control, while also introducing a more important passive

aspect to be considered. This will most likely be reliant only on the ship's propulsion, but wind might be a factor to consider.

4. Swaying:
    a. The ship's buoyancy should be one of the main factors considered, even if it's barely noticeable in the game. It's a passive aspect that can drastically improve a sailing games experience by increasing immersion. Up force is also a factor that will help with collisions, as it will work as a system to influence the ships rotation variables. That does mean it may override the steering direction to ensure proper function.

Expected Timeline/Order

1. **Wind Direction Variable**: 1-2 Hours
2. Up Force Implementation: 1-2 Days
3. **Steering Functionality**: 1-2 Hours
4. **Wind Propulsion**: 4-5 Hours
5. Swaying Functionality: 4-5 Hours
6. **Collision Events**: 4-5 Hours