Game Programming Laboratory 2014

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Game Description

Summary

The game is a physics puzzler based around a fluid simulation in a 2D side view. The goal of the game is to control a stream of water to touch certain items in a specific order.

To do so, the player is able to dig away parts of the terrain to create channels and pathways for the water. In some levels, the player may also be able to place a limited number of objects in the scene. Levels can only be manipulated ahead of time, in a paused view of the level. When the player is finished with their changes to the terrain, they can start the simulation and watch the fluid flow through the scene. No more edits can be made at this point.

If the level goals are met, the player can move on to the next level. If not, the level is reset and the player gets a chance to change the terrain some more.

Detailed description

The player is responsible for a temperamental chunk of ice that quite enjoys being frozen. However, as spring is coming and the weather turns warmer, the ice inadvertently starts to melt, making it considerably unhappy. The task of the player is thus to guide the water and help it bring back winter, so it can enjoy its frozen form again.

Each level starts out in the spring season with one or more blocks of ice placed in the scene. When the level is started, these ice blocks start to melt and continually release water into the scene until they are fully dissolved.

Three different “season changers” are placed throughout the level. These are items that, when touched by the water, change the current season to another. However, the laws of nature must not be broken, and seasons cannot come out of order: The "summer" item must be touched before the "autumn" item and so forth. The level is lost if seasons are activated out of order.

Environment

Each level initially consists of four different materials: Air, ice, dirt and stone. Dirt and stone are obstacles that block the flow of water; water can only freely flow through air. Dirt is diggable, meaning that the player can remove parts of it if they want to. Stone, however, cannot be removed. This both prevents the player from bypassing challenges simply by digging past them, but can also make it easier for the level maker to communicate to the player where water needs to go.

In addition to materials, some levels contain items that react to water in a certain way. In more advanced levels, the player also gets an “inventory” of one or two items he is allowed to place in order to manipulate the flow of water in more complex ways.

The items that will potentially be implemented are listed below.

Items

- **Season changers**: These items always occur in a level and cannot be placed or moved by the player. There must always be at least three different season changers in a level (summer, autumn and winter), which must be activated in order. The level is won when the winter item is activated.

- **Switches and gates**: Gates can block the flow of water as if they were part of the terrain. However, unlike terrain, they can slide open or close when triggered by a switch. If a

switch is touched by water, it triggers and opens or closes all attached gates. Gates and switches are color coded to make the connections clear to the player.

- **Season sensitive gates**: These are gates that cannot be controlled by switches, but open or close depending on the current season. This forces the player to plan ahead, as different paths open or close depending on the timing of the season change.

- **Water pumps**: This block takes in water from an intake and ejects it from an outlet with high pressure. It can eject water upwards as well, which allows for much more interesting gameplay - water doesn't just flow from top to bottom, but can be flung from lower to higher parts of the level, too.

- **Water pipes**: A less extreme version of the pump. Water pipes take in water from one end and transport it to a different part of the level.

- **Acid**: This is a second type of fluid that eats through stone when it comes in touch with it. When controlled with gates and through clever planning, acid can be used to change the level at runtime to open up new paths through which water can flow. Care must be taken, however, since acid and water obliterate each other if they come in touch.

- **Fire and steam**: Fire turns water to steam when it touches it. Steam flows upwards against gravity. After a certain amount of time, steam particles condense and turn back to water particles. This item allows the player to transport water over gaps or reach items in higher parts of the level.

- **Instant freeze**: When touched by water, this item instantly freezes all connecting bodies of water that touch it. Ice created with instant freeze turns back to water after a certain amount of time. Freezing all water in the level with Instant Freeze does not count as winning. However, it can be useful to build temporary bridges: For example, a level could make the player eject water horizontally from a pump onto an instant freeze block, which turns the arching stream of water to ice. Then a second stream of water can flow over the solid ice, allowing it to reach other parts of the level.

Mockups

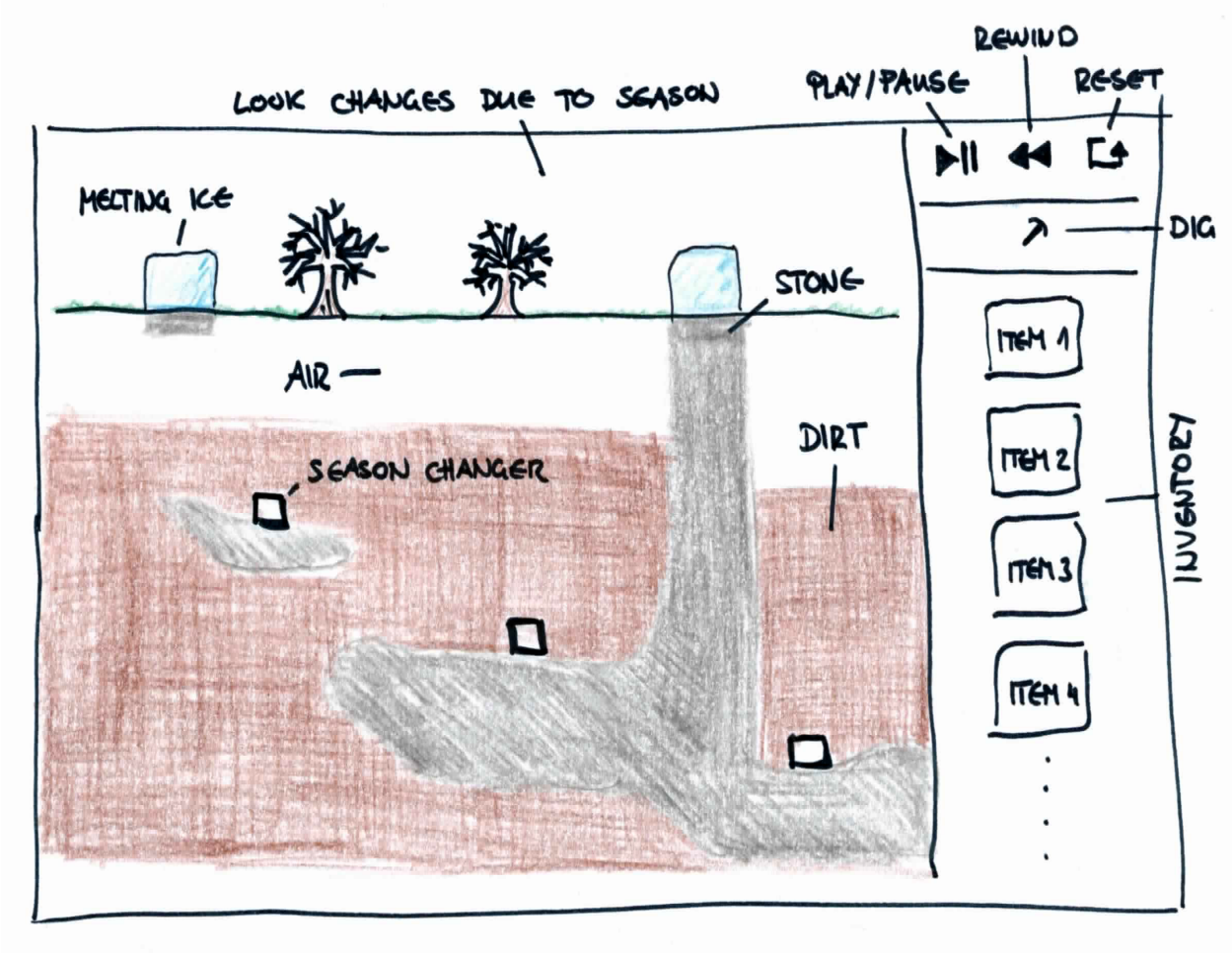


Illustration of the user interface.

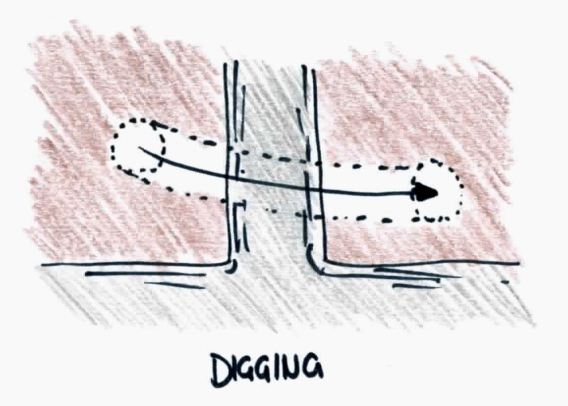
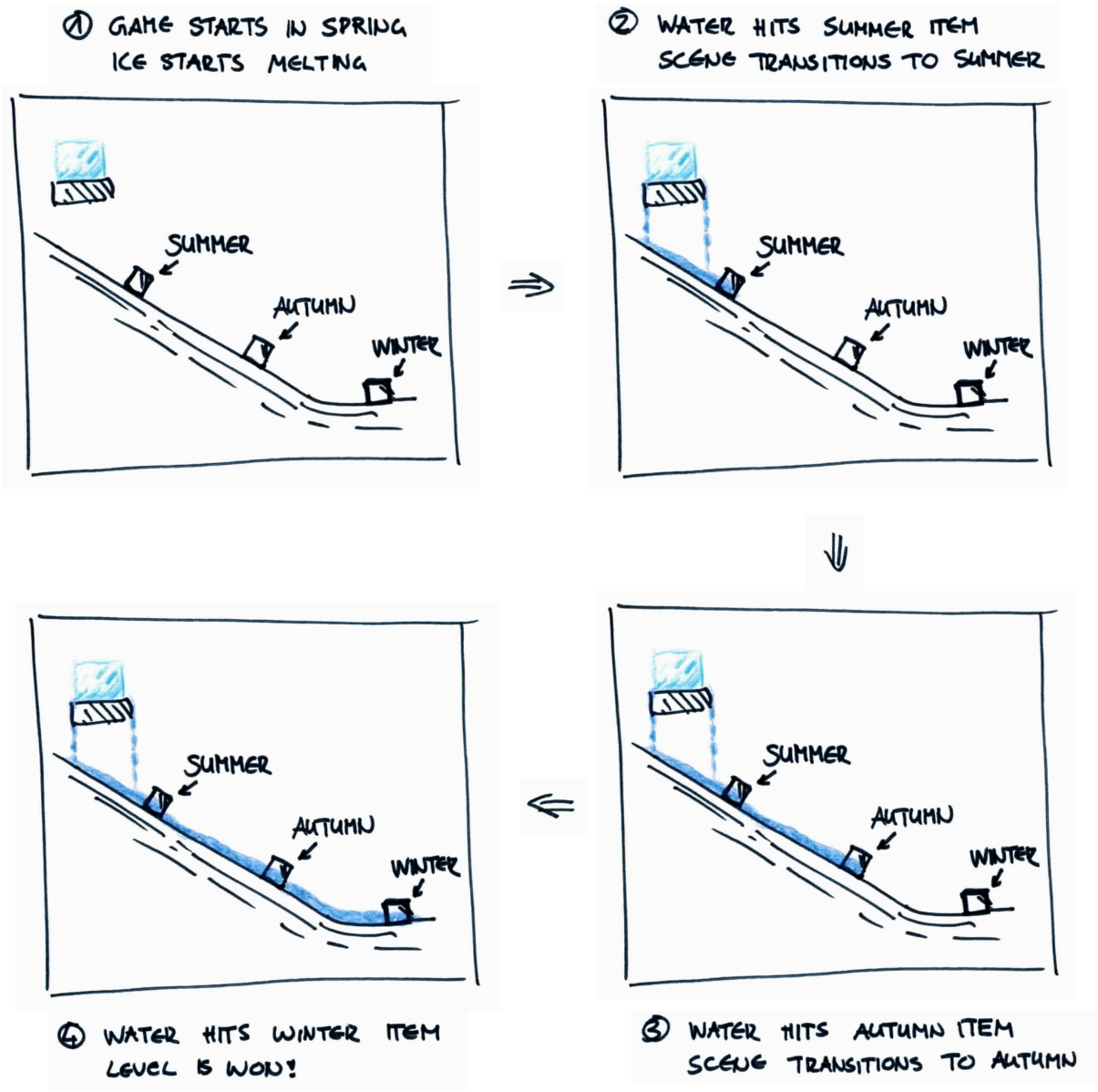


Illustration of digging: Users can dig by dragging the mouse over the map. Note that only dirt can be removed, regions of solid stone are not affected by digging.



A self-solving puzzle, illustrating the main goal of the game: Hitting the 3 season changer items in the correct order.

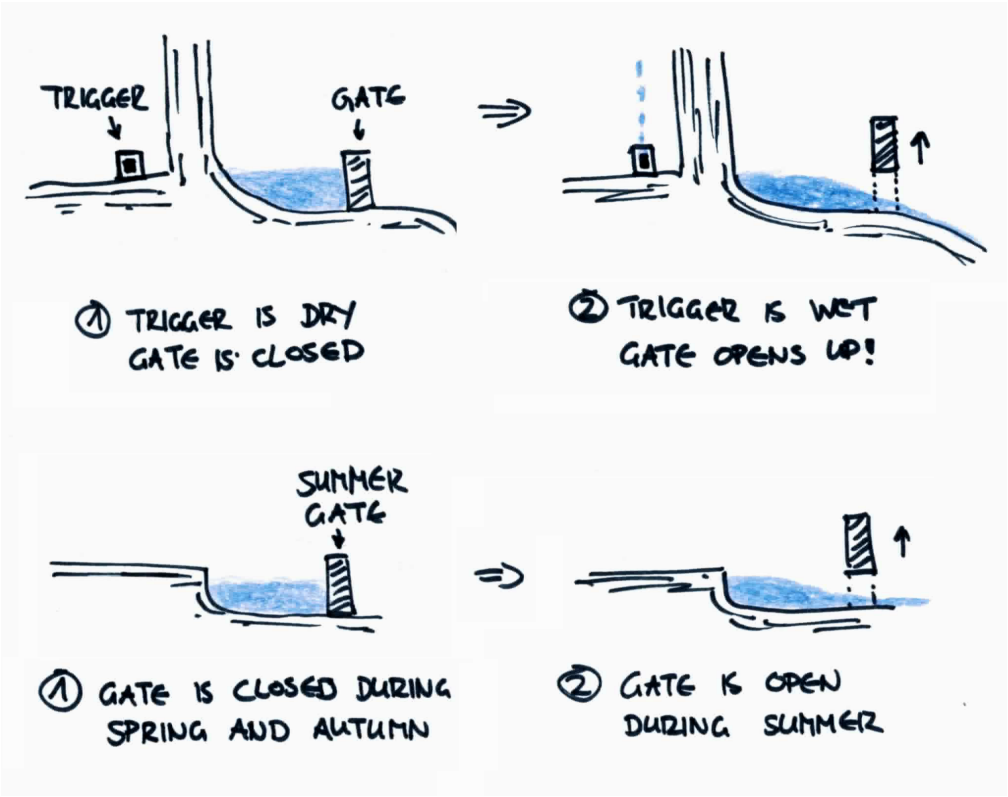


Illustration of different types of gates: Triggered gates (top) block water until a trigger is hit with water, causing the gate to open and allow blocked water to flow. Season sensitive gates (bottom) block water until the respective season is activated, allowing blocked water to flow.

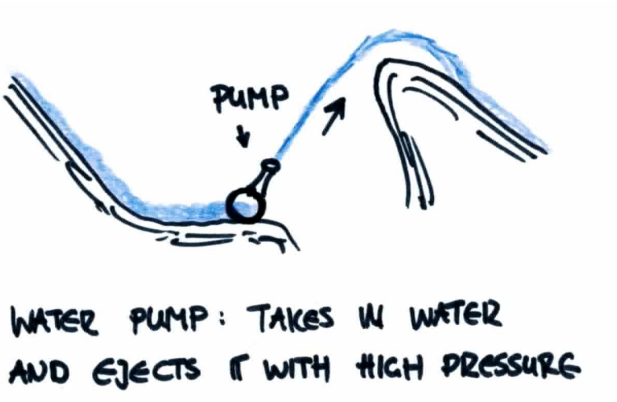


Illustration of water pumps: A water pump (top) takes water in and ejects it with high pressure, allowing water to jump up to higher levels. A rotation gizmo (bottom) is provided to players to allow them to orientate the nozzle of the pump.

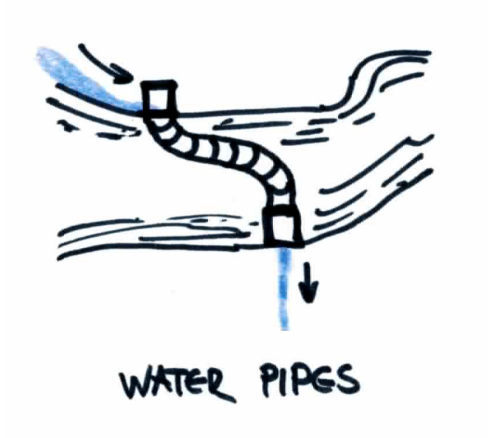


Illustration of water pipes. Pipes take in water on one side and release it on the other. Pipes may also transport water to higher levels.

Illustration of fire and steam. Water is vaporized when it comes in contact with fire, steam rises against gravity and condensates at some later point in time, turning back to water.

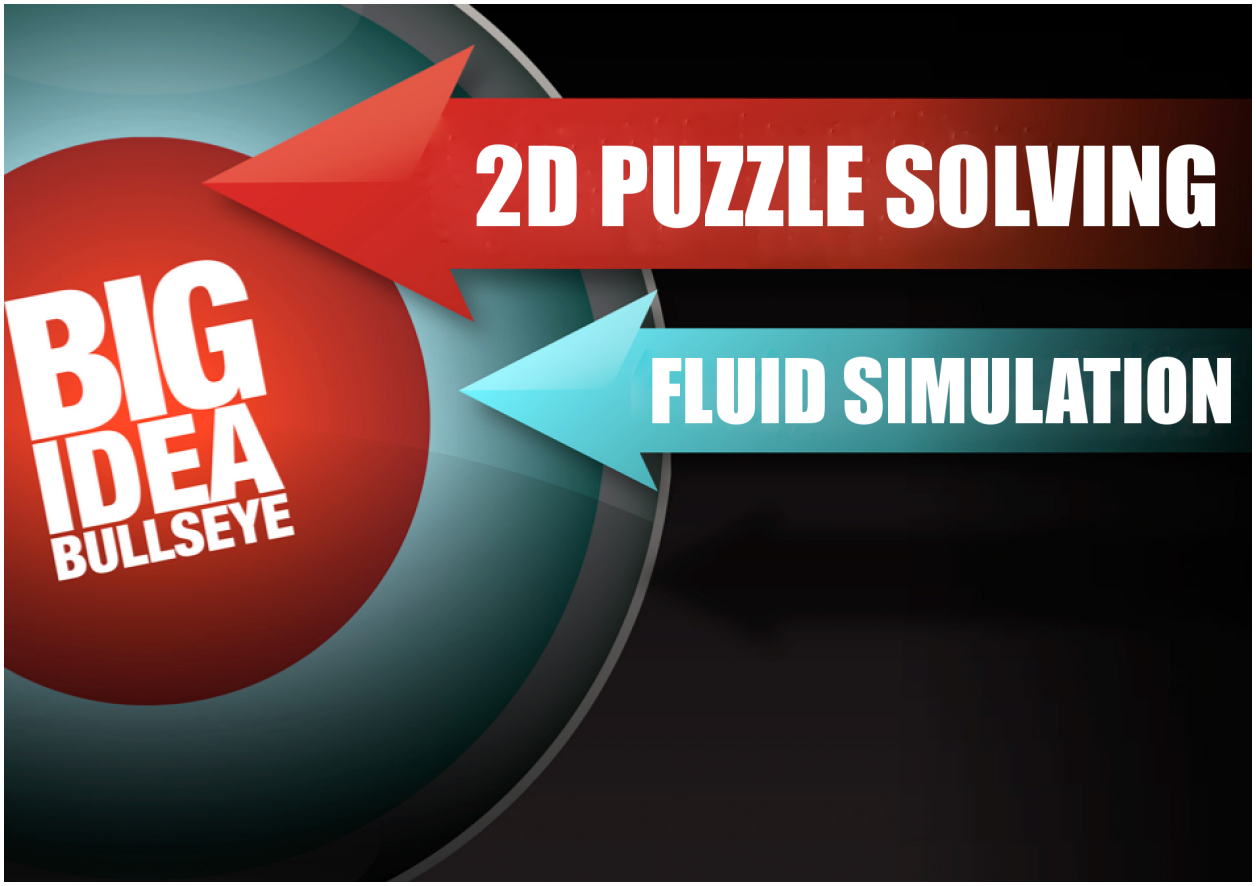
Technical Achievement

The main technical achievement is the implementation of a believable fluid simulation. The focus should be on robustness and easy control, not physical correctness. The game will implement a 2D smoothed particle hydrodynamics (SPH) method, which allows for fast and robust simulation of particle based water. It also allows for straightforward parallelism if required.
The primary effort for the first two weeks will be to implement the method and determine the performance requirements, which will help to scope out how much work will need to be done on the method rather than the game. Experience shows that performance-wise, SPH methods tend to be very well-behaved in 2D, especially for the small amount of particles that we expect for a game like this.

The terrain will be represented as a fairly low-resolution grid, both for easy manipulation from the player as well as fast collision detection with the particles.

For performance reason, the implementation will be written outside Unity in C++.

Big Idea Bullseye



Development Schedule

Functional minimum

- Fluid simulation
- Editable terrain
- Extremely basic, side view rendering
- “Sandbox” style gameplay

Low target

- Season Changers
- Switches and gates
- Season sensitive gates

Desirable target

- Water pumps
- Water pipes
- Textured terrain
- Season dependent graphical effects (snowflakes, rain, etc.)

High target

- Acid
- Fire and Steam
- Instant Freeze
- Music / Audio

Extras

- Post process refraction shader
- Rigid body physics
- Public level editor
- Online community level repository with rating system

Schedule

	Final Proposal	Physical Prototype				Intrim Report			Alpha Release		Playtest	Release
Task	**KW10**	**KW11**	**KW12**	**KW13**	**KW14**	**KW15**	**KW16**	**KW17**	**KW18**	**KW19**	**KW20**	**KW21**
Fluid Sim			BB	BB	BB	BB						
Editable terrain				BB/ SK	BB/ SK							
Basic graphics					SK							
Sandbox					MM							
Season Changers					MM	MM						
Gates					MM	MM						
Pumps & Pipes						MM	MM					
Textured terrain						SK/ BB	SK/ BB					
Seasonal graphics fx						SK/ BB	SK/ BB					
Acid							BB	BB				
Fire & Steam							BB	BB				
Instant Freeze							MM	MM				
Music / audio							SK	SK	SK			
Refraction shader									BB			
Physics									SK/ MM	SK/ MM	SK/ MM	
Editor									SK/ MM	SK/ MM	SK/ MM	?
Balancing										ALL	ALL	
Polishing												ALL

Assessment

The main strength of the game is the fluid simulation. Games with physics, even if the physics are crude, tend to be enjoyable for most people. Fluid simulations in casual games are starting to get more common, but there is still a slight novelty factor to it that might make people interested. If we can make the fluid fast and fun to play with, we've achieved our main goal.

To make it work as a puzzle game, some care needs to be taken in level design: Early levels should be easy enough for the player to breeze through and get a feel for how the game mechanics work. Developers tend to make levels that are more on the frustrating side, since they are already very familiar with the game mechanics and assume the player is, too. While there should be some challenge in later levels to make the player feel rewarded when he completes them, we need to be careful not to go over the top. The playtesting stage near the end will tell us whether we have achieved that goal or whether there need to be last minute adjustments to the levels.
Level design is notoriously difficult, and if we can't get the balancing quite right, then that's okay. If players enjoy at least part of the game, we'll be happy with the result.