

Game Design Three

Save Fukushima



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Overview / Design Pitch

Save Fukushima is an “educational” game that tells the story of the technogenic catastrophe that took place in 2011 (and still is) at the ill fated Fukushima Daiichi (Japan) nuclear power plant through a series of mini games. Following the chain of events, the players first tackle cooling the reactors by connecting the correct pipes in order and on time. Thereafter the players attempt to seal the reactors. Lastly the players deal with the long term procedure of decommissioning the plant by removing and securing the spent fuel rods.

Vision

- **Game Summary** - On friday 1st of March 2011 at 2:45 the a severe earthquake of the coast of Japan. Twenty minutes minutes later, a 50-foot series of tsunami waves. Devastating the coastal area and overwhelming the sea defences at the Fukushima nuclear power plant. The initial tremors triggered an automated systems which inserted the control rods into the fuel cores of all active reactors and halted the reactions and power generation. However, the core still continues to generate heat, something known as residual heat. This can be analogous to letting to go of the gas pedal in a car only to have the engine idling. Reactors continued to emit heat and needed to be actively cooled in order to prevent meltdown. This needed power and there was none, the backup generators were all flooded and out of commission.

Connect The Pipes:

At reactor 2, once the cooling systems stops, the water levels inside the reactors GE light water boiling water reactors (BWRs) drops and water injection needs to take place. As an emergency measure, fire trucks are brought on site and begin to inject water into the reactor through the intricate series of pipes. This is the first minigame tasks the player with connecting pipes by rotating pieces into the correct orientation for the water to flow through. Additionally the player has to avoid drainage points where the water can be diverted from the main path. After successfully completing a few levels, the player gets presented with the real account of events where 70% of the water never ended up making it to the reactor because non functioning pump. Lack of cooling would result in complete meltdown at reactor two as core temperature reaches thousands of degrees.

Seal The Reactor:

Over the following few days, a similar fate would befall the other reactors and complete core melt took place in reactor 1 and 3. As the Uranium Oxide fuel rods melt, the reactions with the rod casings produce hydrogen gas. Not long after, hydrogen explosion rocked the stricken plant as the tops of the reactor buildings are blown off. The second minigame tasks the player with a tetris-like experience of sealing the gaps in the containment vessels. Variously shaped pieces fall from the top of the screen and the objective is to form a solid block of three consecutive layers without any gaps as the nuclear fuel melts the bottom. After the game is complete, the player learns that breaches in the containment vessels are still present and efforts to seal the reactors still continue as radioactive water leaks into the soil and makes it out to sea. The



levels of radioactive isotopes in fish (especially top predators like tuna) are severe and marine life in the north pacific ocean is eradicated with the ocean floor sterile.

Grab the Rod:

Once expended, a fuel rod contains more toxic elements than while it's new. Elements such as Plutonium, which is present in the earth's crust in such minute quantities that life has no adaptation to it and is often confused for Potassium, and Cesium 137 are some of the more toxic isotopes present in those rods. For containment, the spent rods are loaded and unloaded from reactor under water and stored above the containment vessel in storage pools many stories above the ground. It is the player's responsibility to decommission the rods. The player controls a robotic hook from side to side and at a carefully chosen moment, releases it in order to "hook"/grab the rod and dispose of it. After the game completion, the player learns that the removal of the fuel rods is a multi-year effort that will continue for many years to come. Having sustained damage in the quake, the pool structures (although reinforced) remain vulnerable to earthquakes which continue to shake the region.

- **Theme/Mood** - Alert, aggressive. Dark, Greens and Yellows.
- **Game Pace** - All puzzles are time based.
- **Game Setting** - Fukushima Daiichi nuclear power plant.

Genre and Rating

Educational Puzzle Game, ESRB EVERYONE 10+

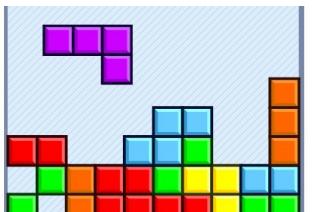
Camera and FOV

2D with 3D graphical elements, static camera.

Ideal audience

15 - 25 Years old, those that enjoy puzzle games, care and wish to know about the event.

Comparable Products

		
<p>Pipe Pang</p> <p>This game represents the first game's puzzle closely, with the exceptions that it lacks multiple paths.</p>	<p>Tetris</p> <p>Represents the rotation and mechanics of <i>Seal the Reactor</i> closely.</p>	<p>Teddy Bear Machine Prize Claw</p> <p>Models the <i>Grab the Rod</i>, similar movement concept of the claw.</p>



Player Core Experience

- **Game Goal** - The primary goal of the game is to roughly parallel the various taken action on site in a series of minigames. The player solves the puzzles and after the solution gets presented with the real accounts of events and the harsh reality. It exercises critical thinking (puzzle solving) skills along with a strong message and awareness. The goal of the game is to communicate the message: The largest extinction event of recorded history is taking place right under our noses. The scale and long term repercussions of the events unfolding will be felt for generations to come. This game is targeted at the younger generation whose children will still be dealing with the repercussions.
- **Core Actions** - the game flows from one consecutive mini game to another.

Connect The Pipes:

The player rotates a series of joints in the correct alignment for the water to flow through to the reactor by clicking or tapping the segments. As the game begins, the water starts moving through the first segment and the objective of the player is not to let the water reach a segment which is not properly aligned (matching end to end). The water can take multiple paths and paths can merge. If the player correctly assembles the pipes, the stage will be cleared. There are three consecutive puzzles to be solved (one for each reactor)

Seal The Reactor:

The player rotates falling pieces into solid lines. Once an unbroken block of number of lines is formed (increases with difficulty), the leaks are said to be contained. From the bottom, the level of the water is rising and if the player leaves a gap, it gets filled. After a short time, entire level shifts downwards as the bottom tiles get dissolved. Any tiles adjacent to the “melt” get dissolved including ones that fill the “cracks”/gaps left by the player. Every tile has a certain “lifetime” during which it can be in contact with the molten rising fuel. If the player allows gaps between the blocks, blocks higher up are exposed to the heat longer and melt away sooner, thus extending the gap.

Grab the Rod:

This game puts the player in the position of the crane operator. The player controls a moving platform carrying a pulley and a grabbing hook. Underneath the hook, fuel rods are stored. The player lines up the hook and chooses the right moment to release. The hook descends automatically and hopefully grabs the rod correctly and on target, without tipping it or other rods over. The game obeys inertial physics and if the player is not gentle with the controls, the rod can slip out. Additionally, due to the damage sustained in earthquake some fragments from ceiling have fallen into the storage tank/ damaged and covered some rods.

- **Characters**

Riku is a character that features in between the games and serves the role of the instructor/objective giver that connects the player to the human element of the tragedy.

There is no back story, merely a voice.

- **LocalScale/Setting**

Game unit scaled to Unity 1 GU = 1m scale.



- 
- **Feedback**
On Screen text narrative, Countdown timers.
 - **Control Scheme**
Touch / Mouse.

Release Platform
iOS and Android.

Proposed Development Technology
Unity, Illustrator.

Game Mechanics

Foundational Breakdown

- **Rules -**

Connect The Pipes:

The water begins flowing immediately as the game commences. Splits in the pipe would create two concurrent paths, with each having half the prior split velocity.

Seal The Reactor:

The player rotates falling pieces into solid lines. Once an unbroken block of number of lines is formed (increases with difficulty), the leaks are said to be contained. From the bottom, the level of the water is rising and is the player leaves a gap, it gets filled. After a short time, entire level shifts downwards as the bottom tiles get dissolve. Any tiles adjacent to the “melt” get dissolved including ones that fill the “cracks”/gaps left by the player.

Grab the Rod:

The player can not drop a rod, in addition, if bumped too severely or aggressively the player fails. Gravity exists, in addition the hook and the rods have enertia. Of the player movers the rod too quickly, it will slip out.

- **Actions -** The player taps on screen buttons and the objects on screen depending on the game.
- **Space -** 2D space, billboarded environmental.
- **Core Mechanics -**

Control:

On screen controls, UI Buttons, mouse point and click if inside the browser.

Feedback:

If the player fails a level, a “level failed” option appears and the player has to restart.

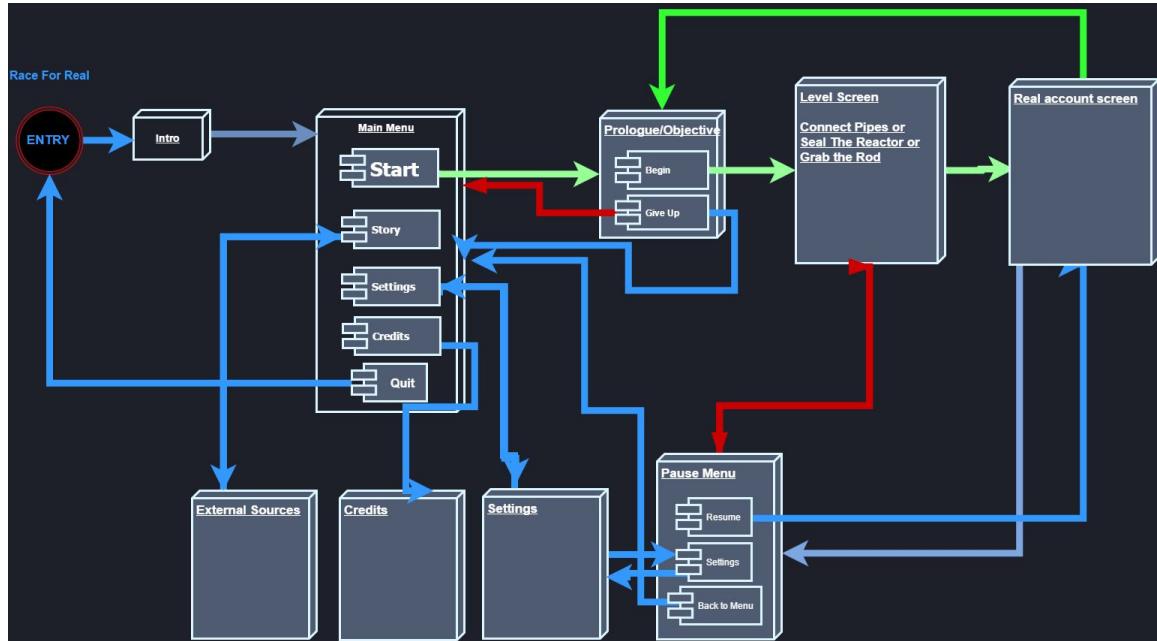
Skill

The player has to use common sense to solve prebuilt puzzles.

Chance

Connect the pipes will randomize the alignment of the pipes, creating an element of unpredictability. The blocks in fill the reactor game are randomly generated. Grab is the rod is skill based.

UI Front End

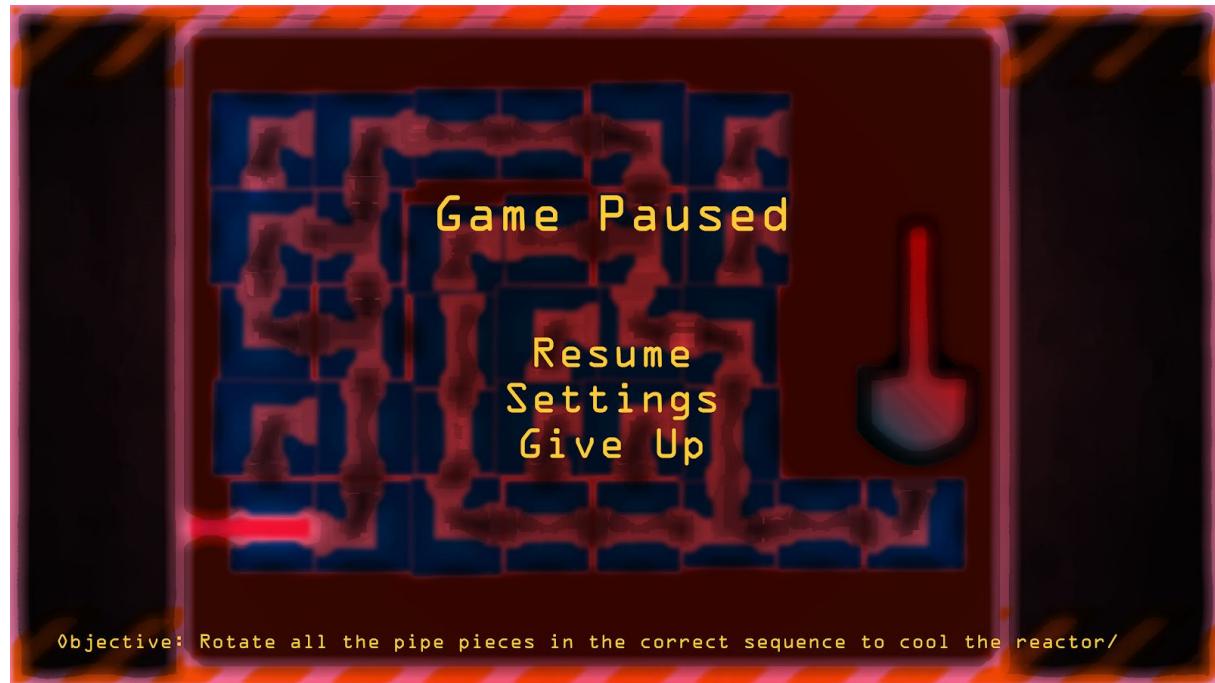


Studio logo and graphics, the player enters the main menu has the option to proceed. No transition timing or loading screens.

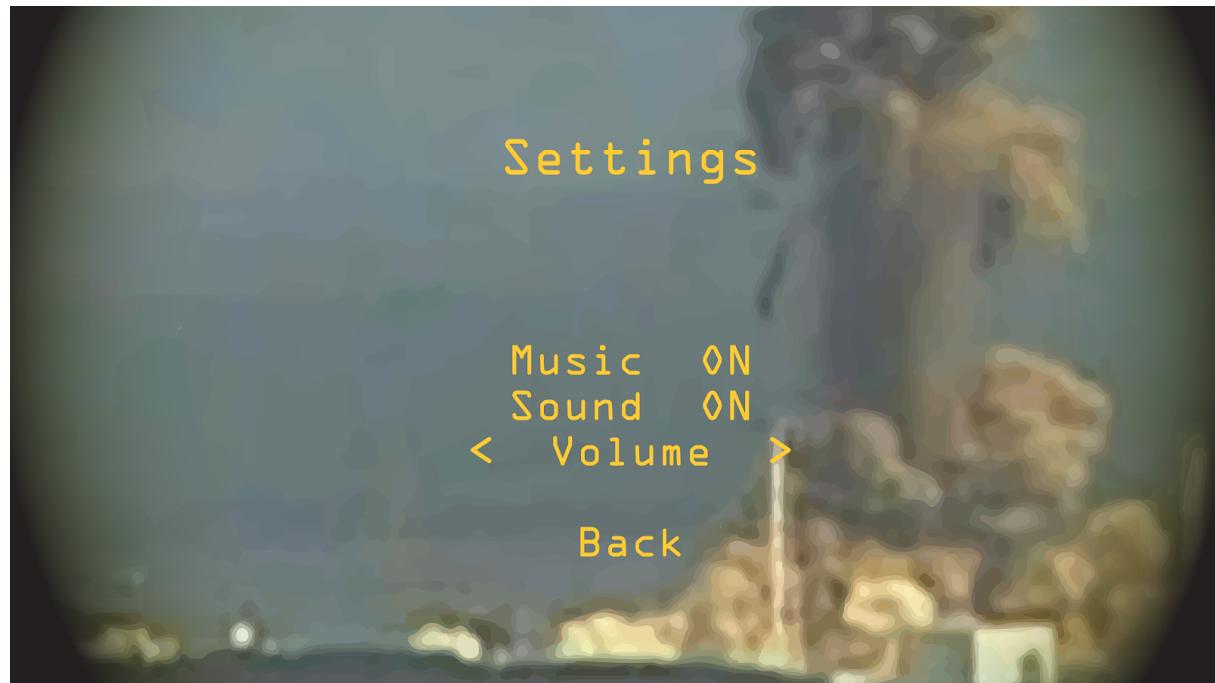
Main Menu



Pause Menu



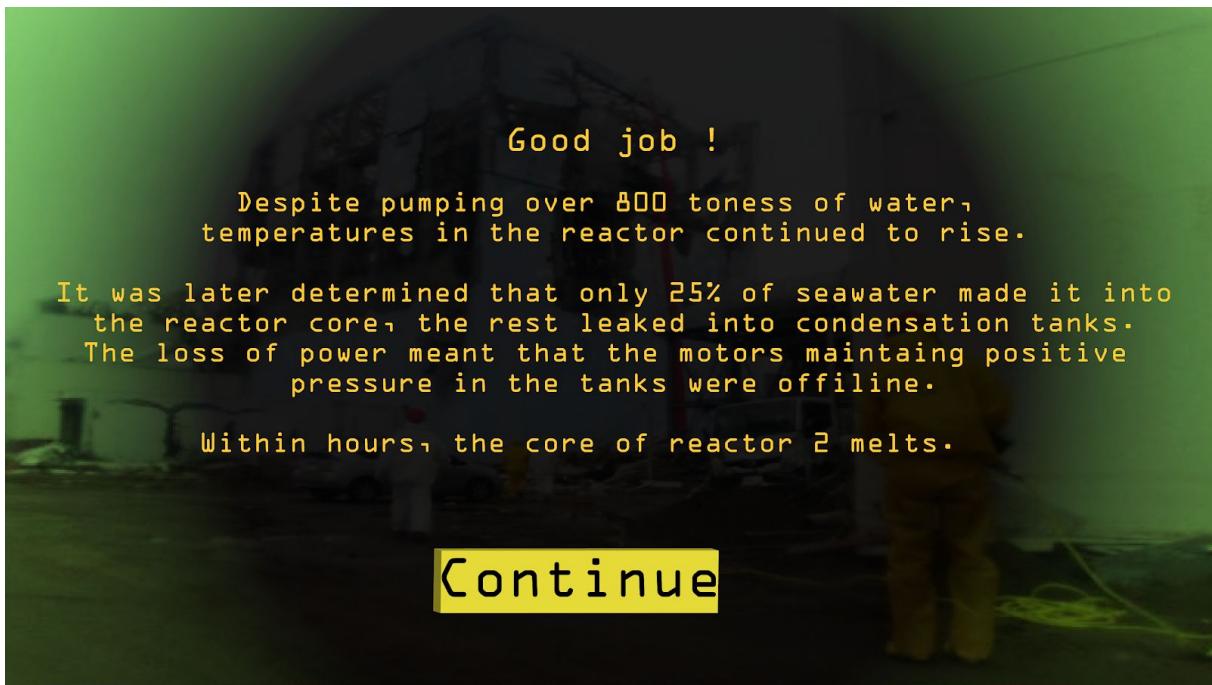
Settings



Prologue objective Screen

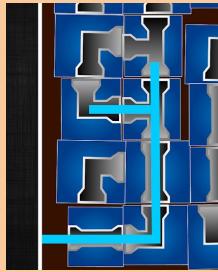


Win/Level End Screen



Object Breakdown

Name And Role Description	States	Attributes	Key assets
<p>Straight Segment</p>  <p>Used for moving the water through a segment. Can be rotated at 90 degree increments.</p>	Rotates, Water Flowing,	Orientation	2D asset
<p>Bend Segment</p>  <p>Used for moving the water through a segment. Can be rotated at 90 degree turns.</p>	Rotates, Water Flowing	Orientation	2D asset
<p>T-Segment</p>  <p>Used for moving the water through a segment. When water encounters this segment, it splits. The flow rate is then half the previous rate. If this segment is merging the streams the new rate of flow will be double.</p>	Rotates, Water Flowing	Orientation	2D asset
Water	Flowing, leaking	Flow rate	2D asset



Entering from the side, the water follows the aligned paths. If the segment is misaligned the the water will spill.

Standard makeup block.



Standard:

Melting:

All shapes are constructed of these single pieces. An individual block has life which starts to diminish once in contact with the molten fluid. Once life is depleted, the black vanishes and the cavity is filled thus exposing the adjacent blocks.

Rotating,
falling,
Glowing

Fall speed
Life (applies to all blocks in the shapes individually), Brightness (indicated how close it is to melting.) The brighter, the closer to melting.

2D asset,
vanish
animation

line piece

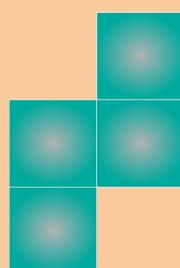


Rotates at 90 degree increments, slowly falls from the top of the screen

Rotating,
falling,

Fall speed.

Squigly.

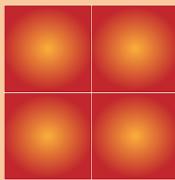
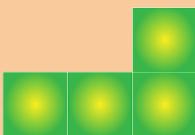


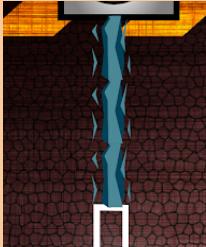
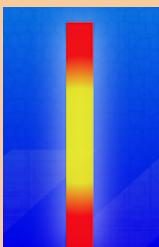
Rotates at 90 degree increments, slowly falls from the top of the screen.
A mirror version of this piece is the reverse squigly.

Rotating,
falling,

Fall speed.

2D asset

Square  Rotates at 90 degree increments, slowly falls from the top of the screen.	Falling	Fall speed.	2D asset
L-Block  Rotates at 90 degree increments, slowly falls from the top of the screen. Reverse piece also exists.	Rotating, falling,	Fall Speed.	
Molten material  This is the natural hazard found on the level. Once the bottom pieces life has been depleted, all top pieces shift by one down into the molten material. Will rise an additional single block in every gap left.	Idle, rising	Damage to tiles, flow rise rate.	2D asset. Glowinm
The hook  Used by the player to grab the rods and move the rocks aside. Has mass and inertia. Can damage rods if the player is too aggressive. In addition, rods slowly slip out of the grasp if too aggressive and the hook is swinging too much.	Idle, moving, Swinging ,	Inertia	2D asset, grabbing animation and mechanics

<p>The Cable</p>  <p>The cable that attaches to the hook is an item the player will have to understand. It has elasticity and behaves like a rope.</p>	idle , swinging, extending, contracting	Elasticity,	2D Model, Physics, sprite elastic physics.
<p>Fuel Rod</p>  <p>The objective of the player is to carefully grab those with the hook and move to the safety vessel. Delicate, a hard collision with another object can make it explode.</p>	Idle, Damaged, Safe/Disposed	Fragility (Lateral Acceleration thresholds),	2D Model, Animation, rigidbody physics
<p>The Rock</p>  <p>Debris that fell from the top of the storage pool, the player will have to move them out of the way in order to get to the rods.</p>	idle	Mass, enertia	2D model, rigidbody physics
<p>The Pulley</p>  <p>The Pulley is controlled by the player. The player moves it from left to right only.</p>	idle , moving	Movement speed,	2d model, input system.



Sound

- Main theme music, example found [here](#).
- Sound effects: water flowing
- Sound effects: mechanical noises.
- Sound effects: Crane Noises
- Sound effects: Explosion Sound

Environment breakdown

World Analysis

- **History** - March 11, 2011 massive damage is caused to the Fukushima Daiichi nuclear power plant causes multiple crisis. th
- **Geography/maps** - The geographical environments consists of the various areas found within a nuclear power plant. Connect the pipes games is set against a backdrop of the underground. Other pipes and switches (cosmetic) are visible in the background in order to set the mood. Seal the reactors takes place in the containment vessel itself, thousands of degrees of heat and awash in deadly radiation. Grab the rod is is set in the storage pool, half the mep is the pool itself and the other half is air.
- **Ecological systems** - All environmental interactions are carefully controlled. Connect the pipes features water which flows in from a source, without player input the game is lost. Seal the reactors features a rising level of molten core which is an environmental hazard and is allowed to reach to the top can cause the player to lose the game. Grab the rod game features rocks, that according to lore, fell from the roof and now rest at the bottom of the pool. The rocks can damage the rods and cause the player to lose.
- **Identification of the narrative moment** - The narrative presents itself as soon as the game begins and is not introduced by other means. The player is informed that he/she will assuming the role of the crisis manager and must fulfill tasks in order to prevent the reactors from melting. At that stage, the tsunami has hit and the plant has been out of power for hours.
- **Cultural norms** - It is of the utmost importance that a thermonuclear explosion does not take place.
- **Religious/mythological systems** - The political climate is tense, if the situation is not contained, the country of Japan will have to be evacuated.
- **Legal/political systems** - Tremendous political pressure, as the person responsible for containing the situation you answer directly to the prime minister.
- **Language systems** - Standard english
- **Notable architecture** - Close mimicry of the Fukushima plants boiling water reactors (BWRs).

Name/Number

Connect the pipes:

Three (for the three reactors) levels, pre built, consecutive, discrete. This space will simulate the real events that took place. The confusing labyrinth of pipes, the initial game screen is intended to confuse the player at first and start the water flowing immediately such that the player has no time to think and plan ahead, but instead to react. Cluttered colorful environment.

Seal the reactor

Three Levels, randomly generated. Progressively less time to complete the build. Although stylized and bright, the idea behind the level is to present the player with a

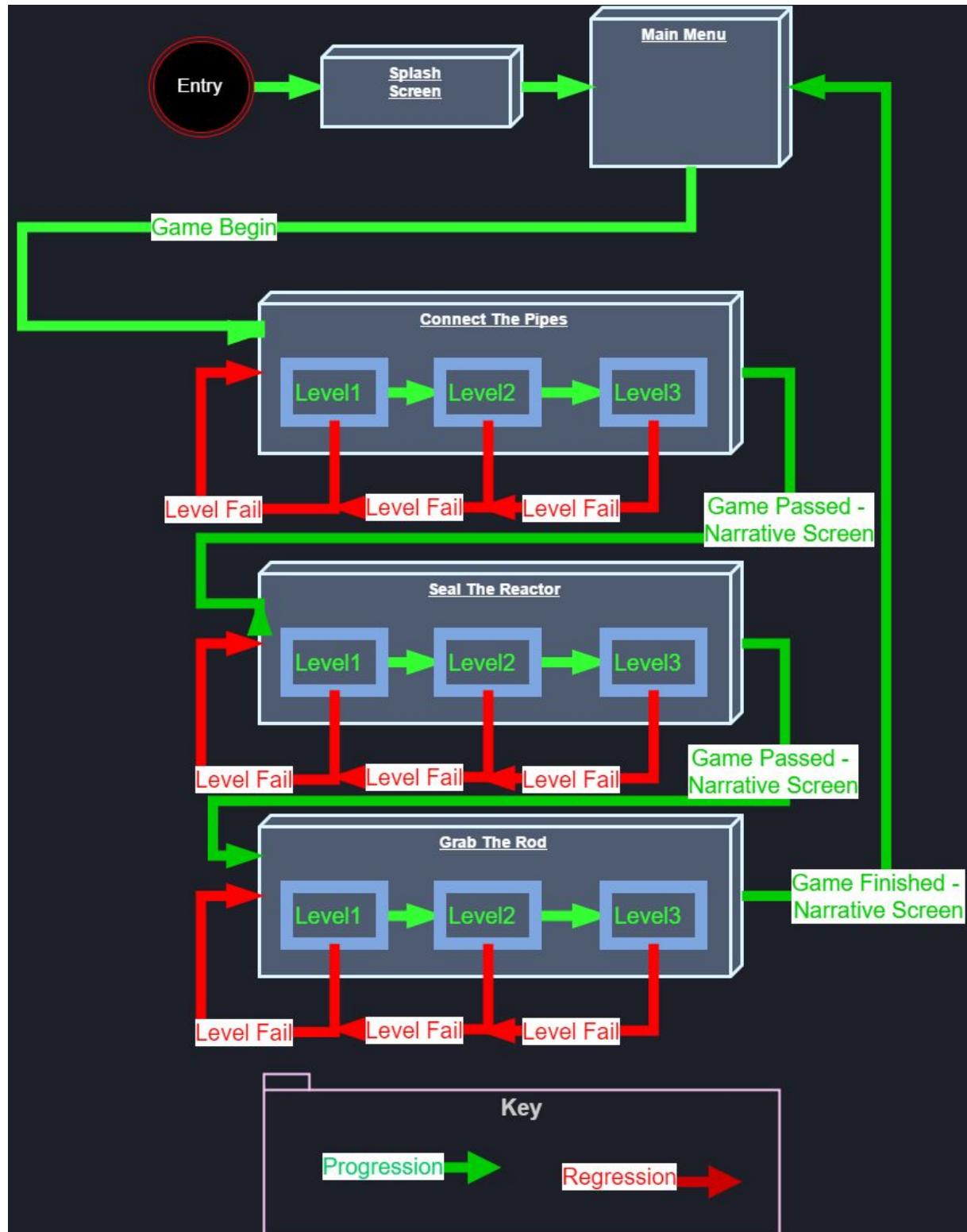


sisyphean task of sealing holes that keep appearing with increasing frequency. A battle against time, the player is meant to be under continuous pressure, colorful and eerie red glow representing the high pressure high temperature environment.

Grab the Rod

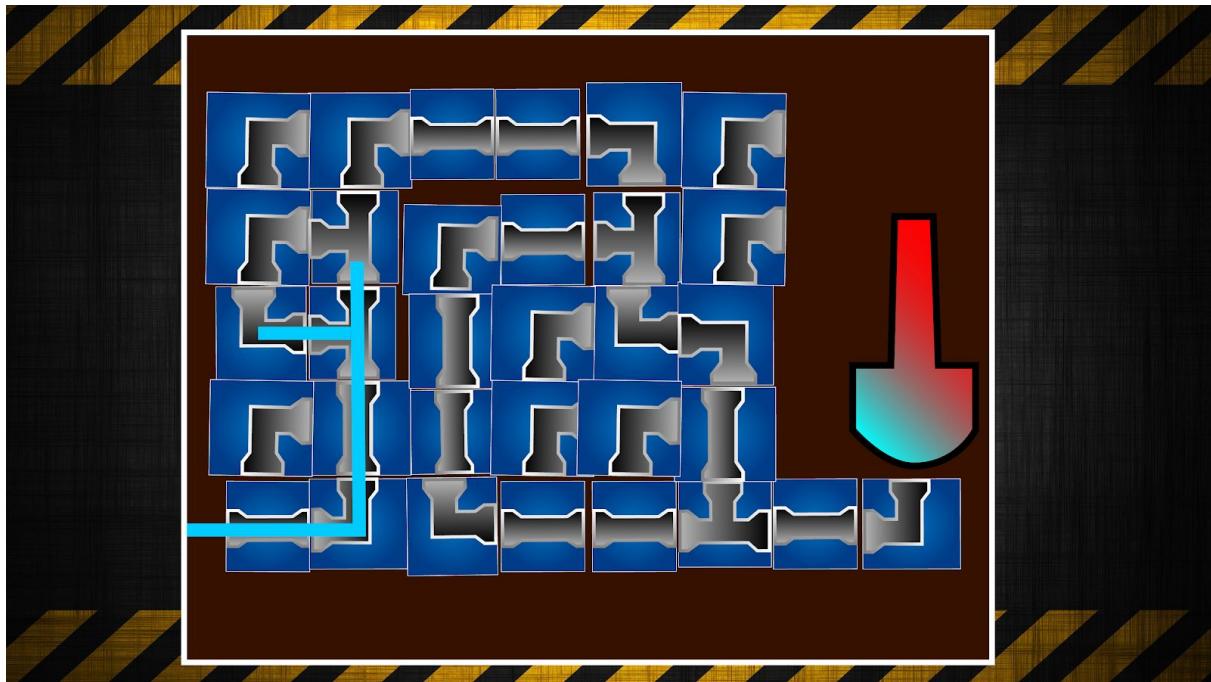
Three Levels for the three reactors. Different stages of devastation, more and more rocks with each level. The levels are meant to bring across delicate tasks and the time pressure everyone is under.

Level Flow Chart

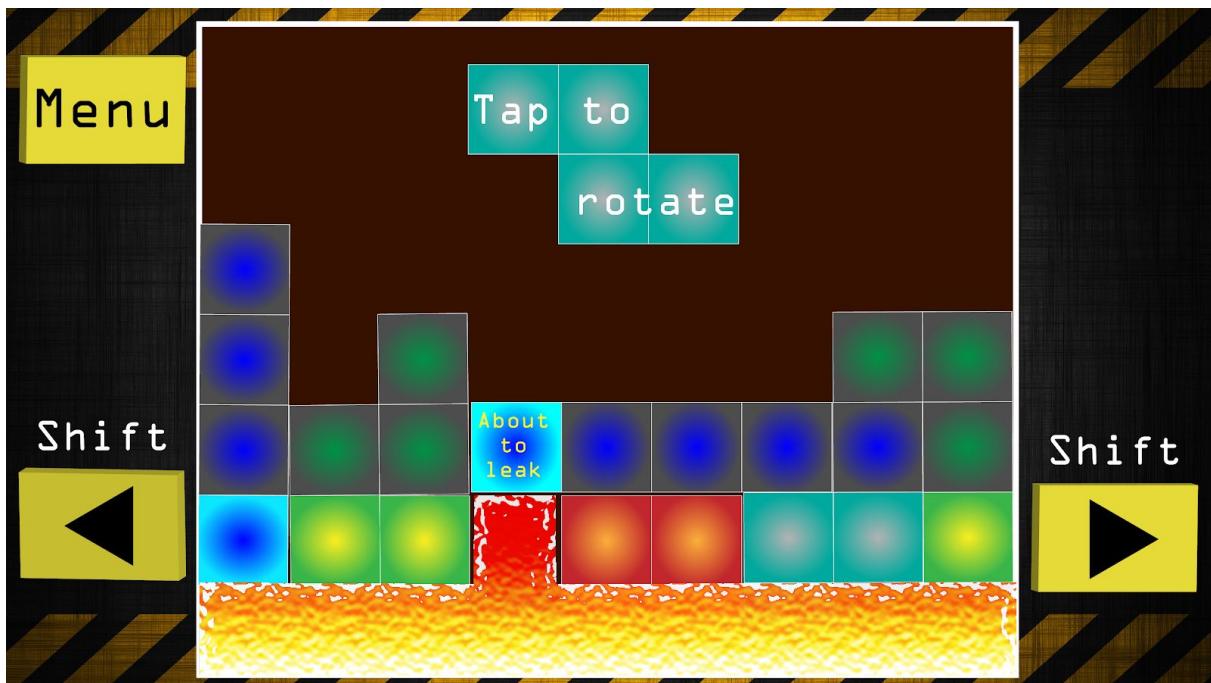


Mock-ups/Concepts

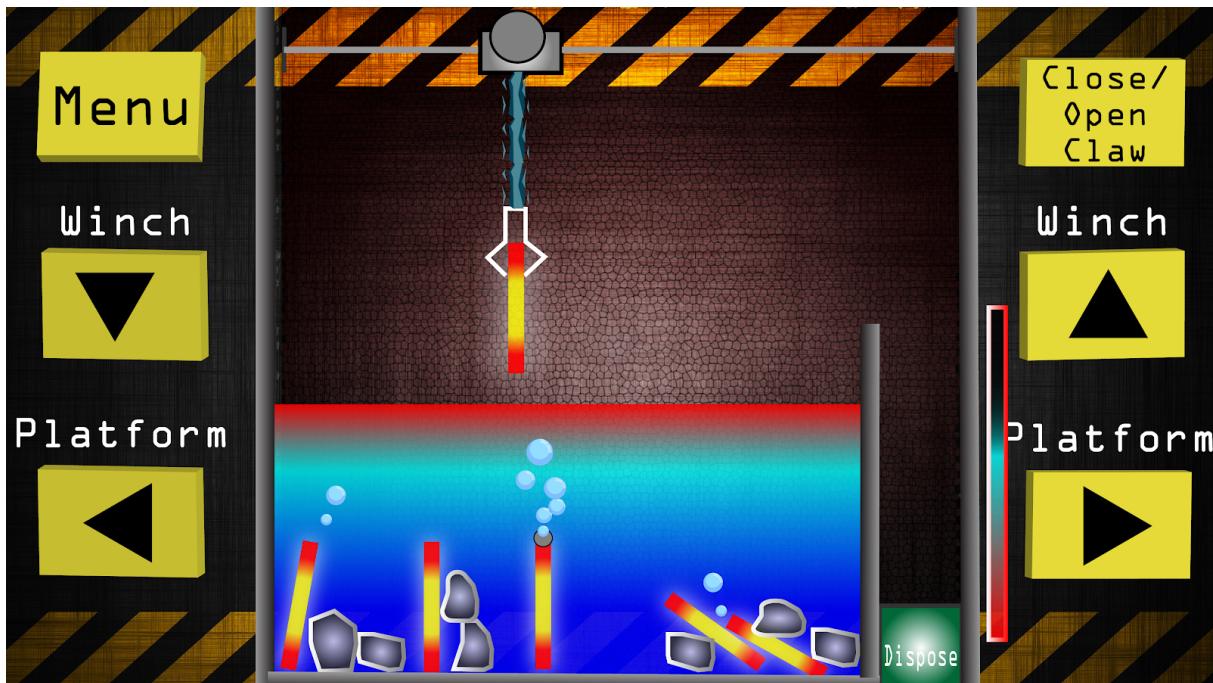
Connect the Pipes



Seal the reactor Game



Grab the Rod Game



Moodboard



Systems

- **Main Menu System / Gameflow (level loading etc).**
- **Input touch and mouse support.**
- **Camera System - 2D head on**
- **Transition and art for the pre- and post - level.**
- **Animation Systems.**
- **Water flow mechanic for Connect the Pipes, merge diverge**
- **Rotation of pieces mechanic for Connect the Pipes**
- **Timer System**
- **Block rotation system and spawner**
- **Melted material representation and interaction system**
- **Fuel rod fragility system**
- **Crane and hook system.**
- **Timer**
- **Narrative and Objective screens.**

Feedback

The player would receive instruction at the beginning of each level.

In connect the pipes, the progress of the water through the pipe would act as the timer.

In seal the reactor, the level of the molten material will rise indicating progress. A Completed layer turns the same grey color, similar to concrete. If a section is about to be melted away, it turns a lighter colour until eventually breaking up and crumbling away.

In Grab the Rod, the amount of bubbles indicate the fragility of the rod. More bubbles = less health for the rod and the player should take extra care and dispose of the rod.

Camera

Camera remains static throughout the game, locked 2D head on view. Camera shakes is the player is doing poorly.



Story

Overarching Narrative

After the devastating tsunami which kills 20000 people and leaves half million homeless, a greater catastrophe is unfolding. With loss of power to the plant, and backup generators flooded desperate measures are taken. It is decided to directly inject water into the reactor in an attempt to cool it.. This decision was not taken lightly as the salts in the water permanently destroy the reactors.

The Player interacts with a character named Riku, that gives him the current state of affairs and guides the player experience.

Fire Trucks arrive on site and begin to pour water onto the reactors, helicopters are also called in and begin dumping water on the reactor building to little effect. To make matters worse, an oversight resulted in most of the water not making it to the reactor. The player relieves this situation in a minigame.

As reactor 1, 2 and 3 cores melt, the zirconium casing of the fuel rods react with the seawater and release hydrogen gas which begins to accumulate inside the reactor buildings. Explosions soon follow, exposing containment vessels, storage pools and in the process release large amounts of isotopes into the atmosphere. The second minigame takes place at this point, leaks in the containment vessels have to be found and sealed.

Years after the tsunami, the plant is as vulnerable as ever. Although the containment vessels were not directly damaged by the earthquake, the spent fuel pools were. Just prior to the tsunami, out of the 6 reactors at Fukushima Daiichi, 3 were actively generating power (Reactors 1,2,3). Reactor 4 was shut down for maintenance, while its storage pool contained as much spent and full fuel rods as the rest of the plant alone. The to-date scale of devastation pales in comparison to the catastrophe that would befall mankind should anything happen to the stored fuel. Its is projected that the entire northern hemisphere needs to be evacuated. The building has been reinforced, but large earthquakes continue to rock the region. Removal of fuel rods continues at the player is asked to operate the crane assembly, carefully removing the fuel rods out of the damaged pools.



Game Script

OPENING CUTSCENE, EXT. A few hours after the tsunami. RIKU if the work team manager on site, reporting on the situation. RIKU is calm by worried urging the player to action. PLAYER is an invisible entity.

RIKU

(Pops up from the corner of the screen)

Sir, we have lost all cooling to the reactors. There is only one things to do.

PLAYER

What do you suggest?

RIKU

We have to manually inject water into the reactors, the pipe system is complicated we need your help to make sense of it. There is something you should know, once we inject seawater into the reactors they will immediately begin to corrode and will be rendered useless.

PLAYER

We have no choice, begin injection.

(Screen fades, level objective screen is displayed)

Character Relationships

The player is in charge of RIKU, and calls the shots. RIKU provides helpful information and hints. The relationship is a constructive and a goal focused one.

Storyboards

Splash screen



Game Intro Screen



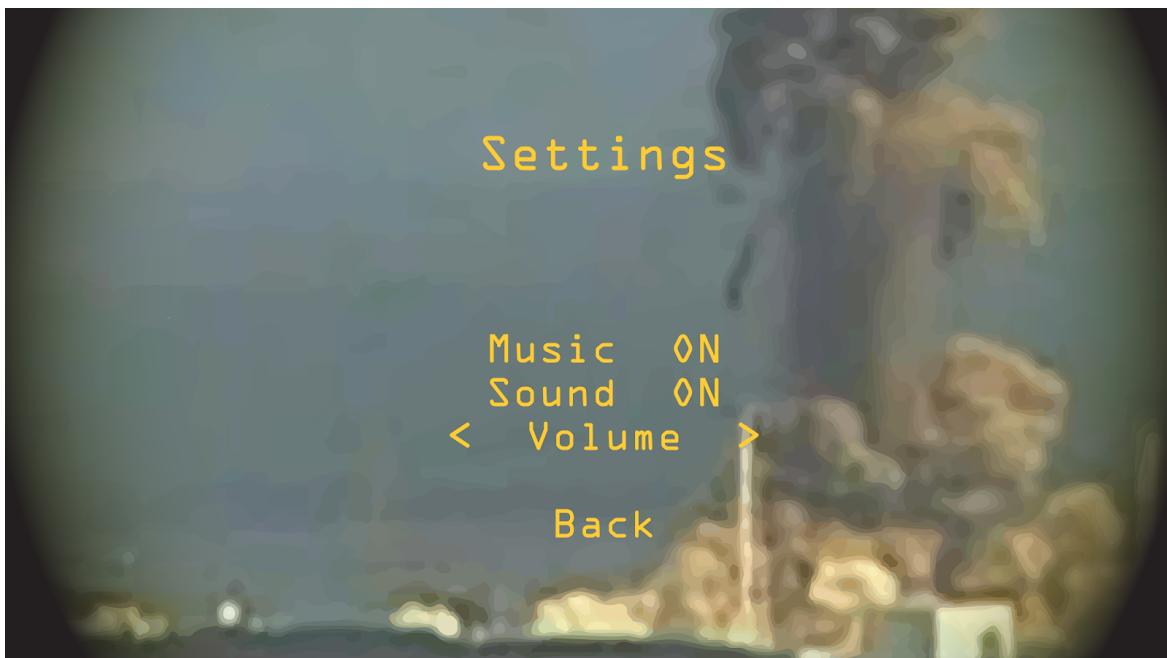


User interface

Main menu



Sub Menu



Credits

Credits

Games For good

Lead Design
Dmitrii Roets

Programming
Dmitrii Roets

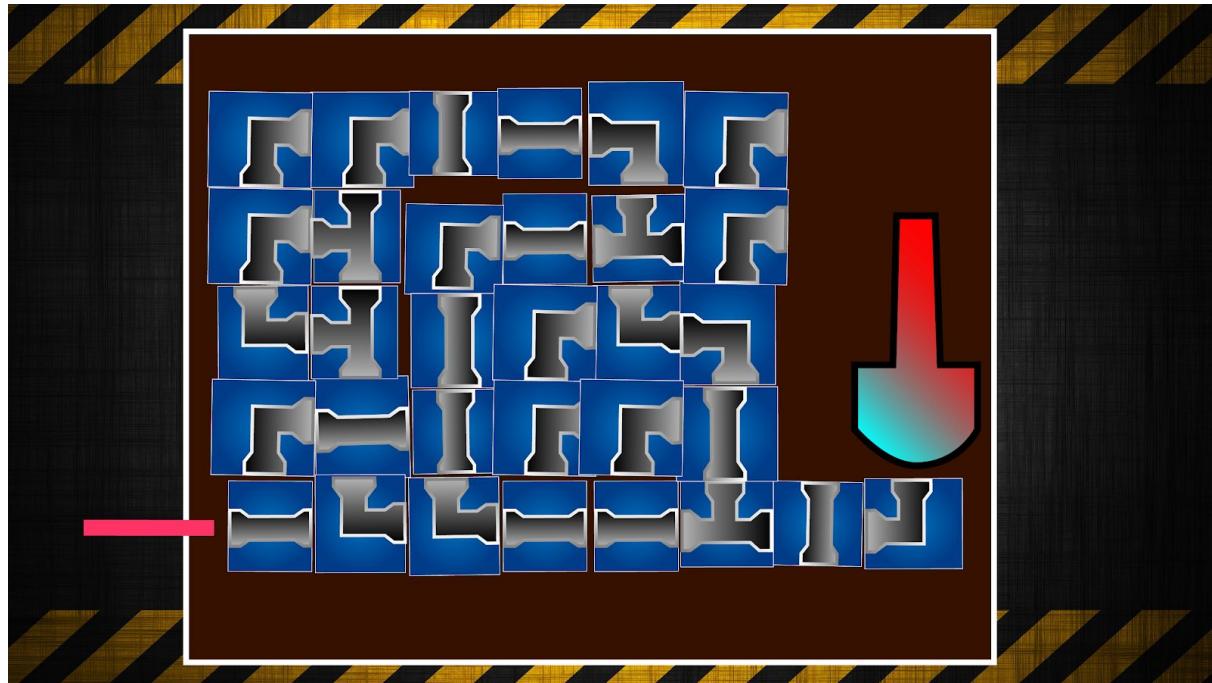
Art
Dmitrii Roets



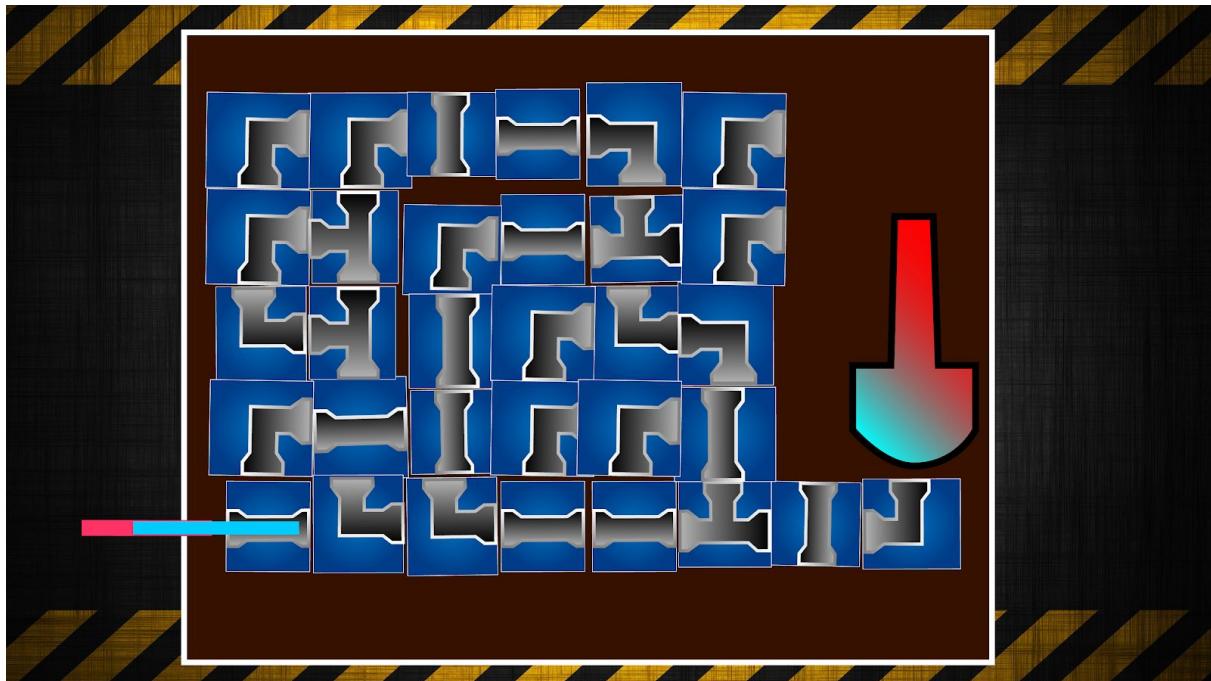
Game Play - Connect the pipes

Connect the pipes

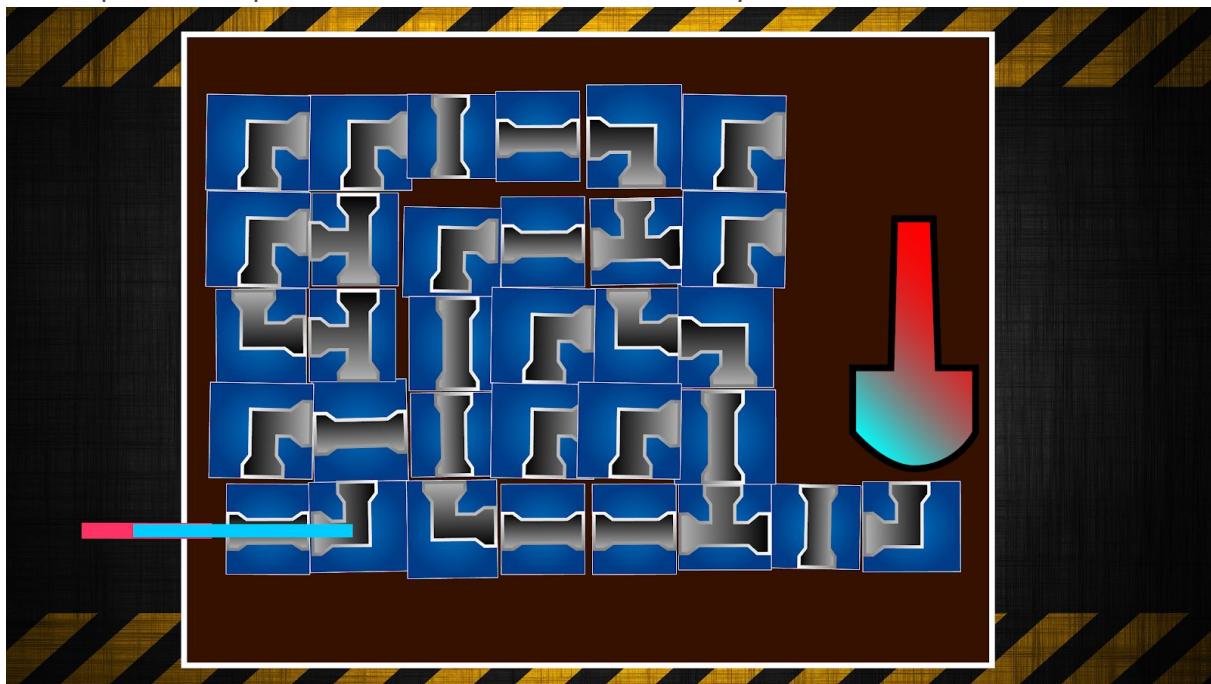
The level begins, the player has a moment to assess the situation



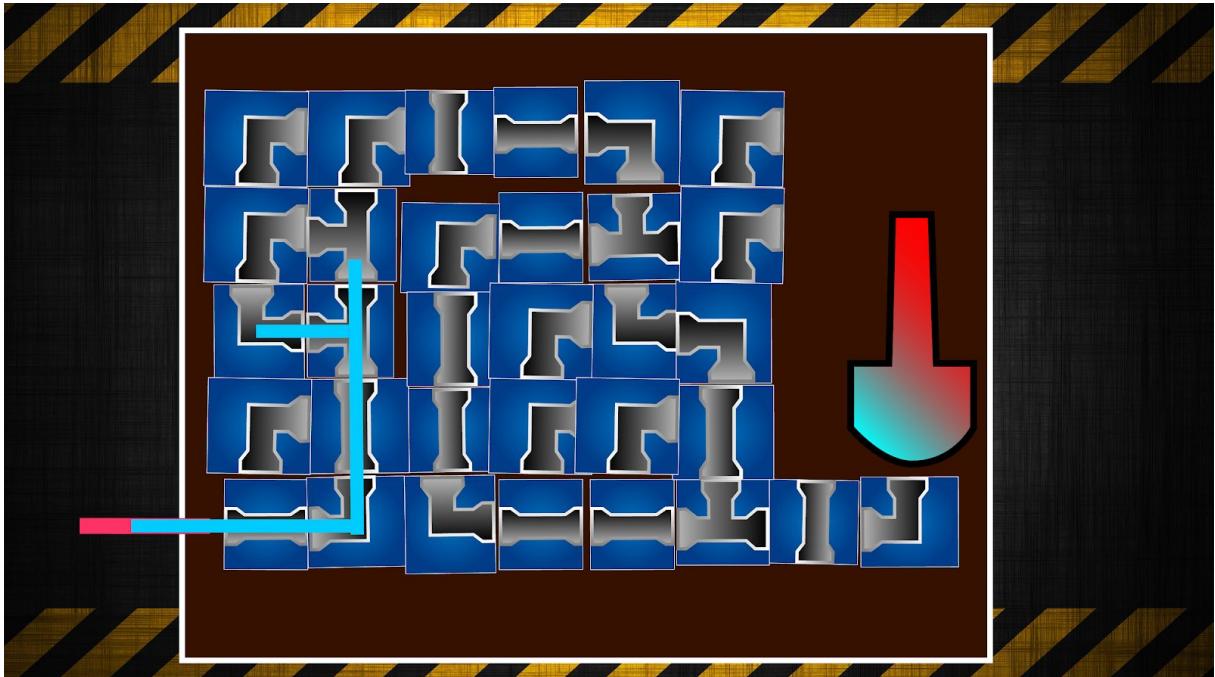
The water begins to flow



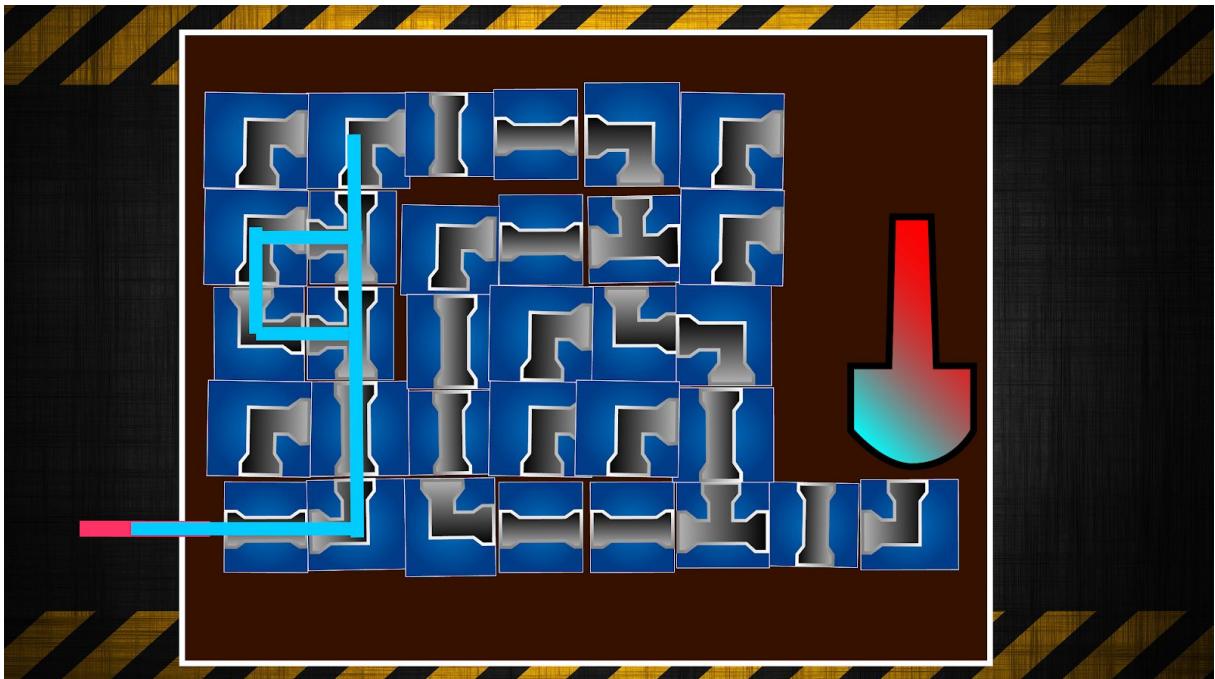
User Taps the next piece three times to rotate it correctly



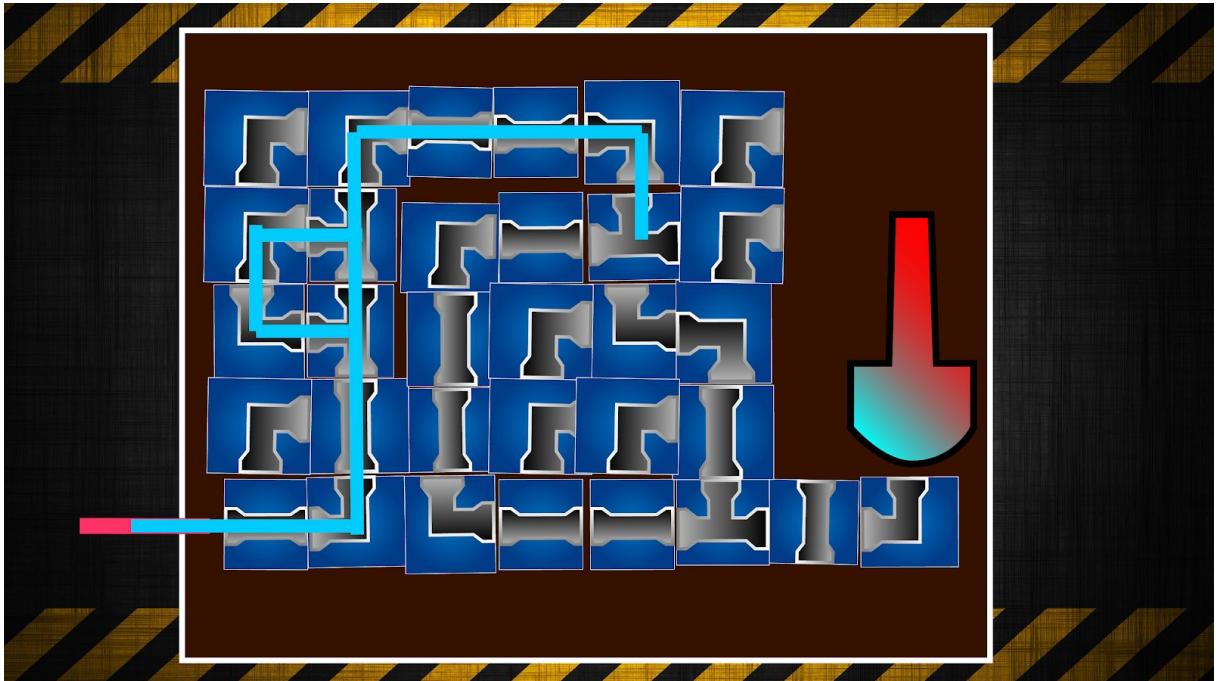
User rotates the next segments, the water splits



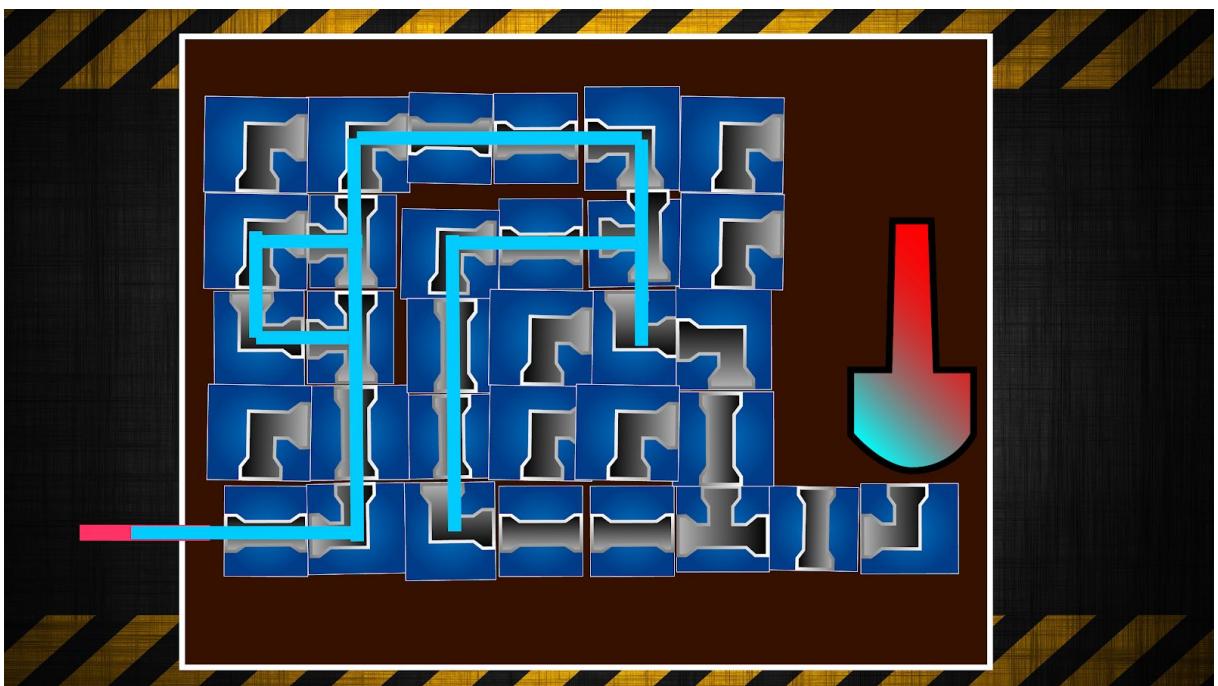
Water merges and the users needs to quickly prepare the next path



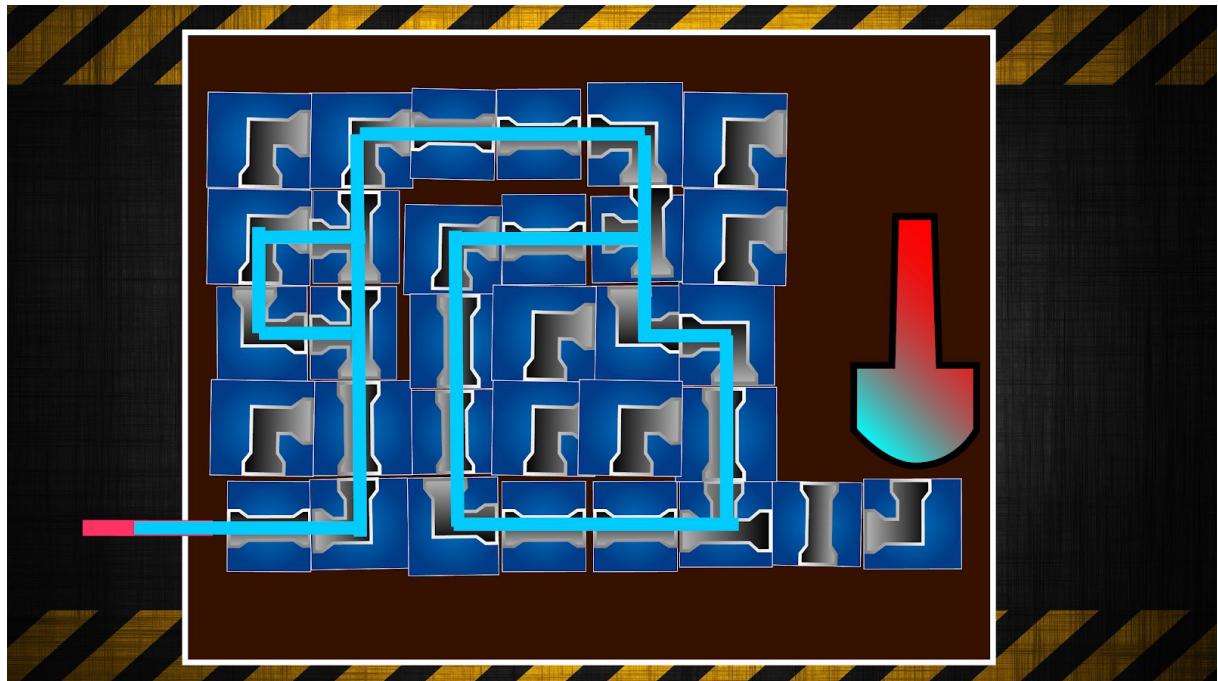
The player needs to act quickly here and figure out a way to rotate the T section correctly



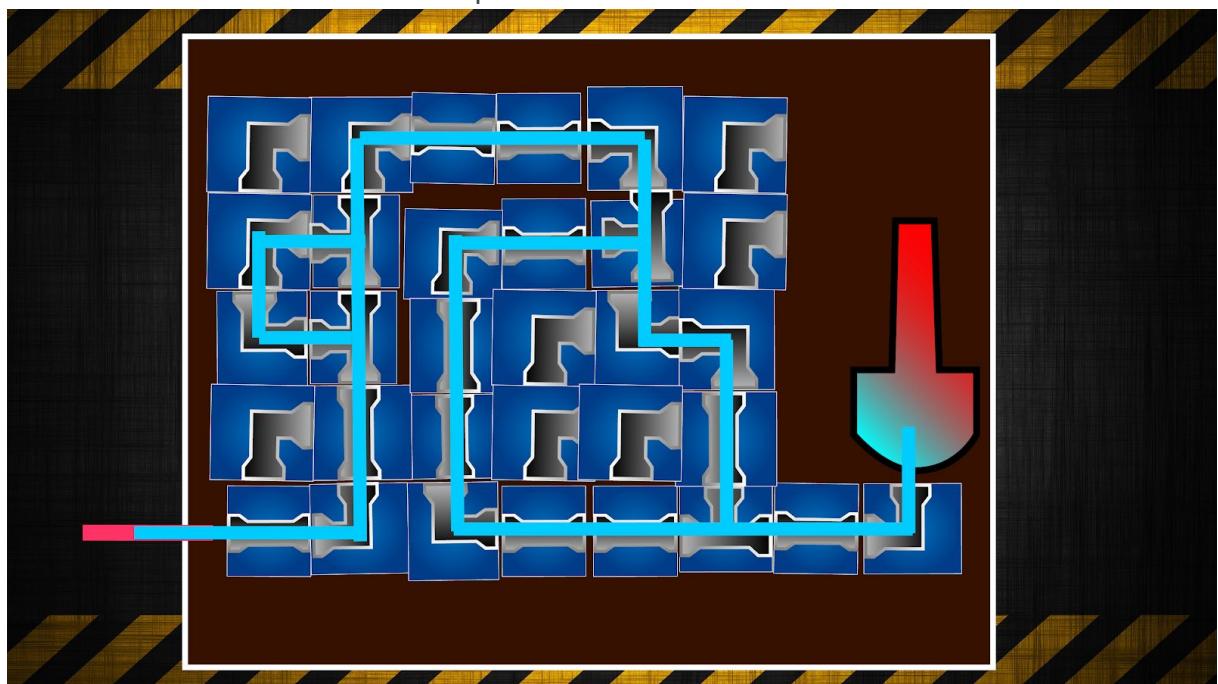
Almost there the water splits, and only one segment is left.



One more rotation

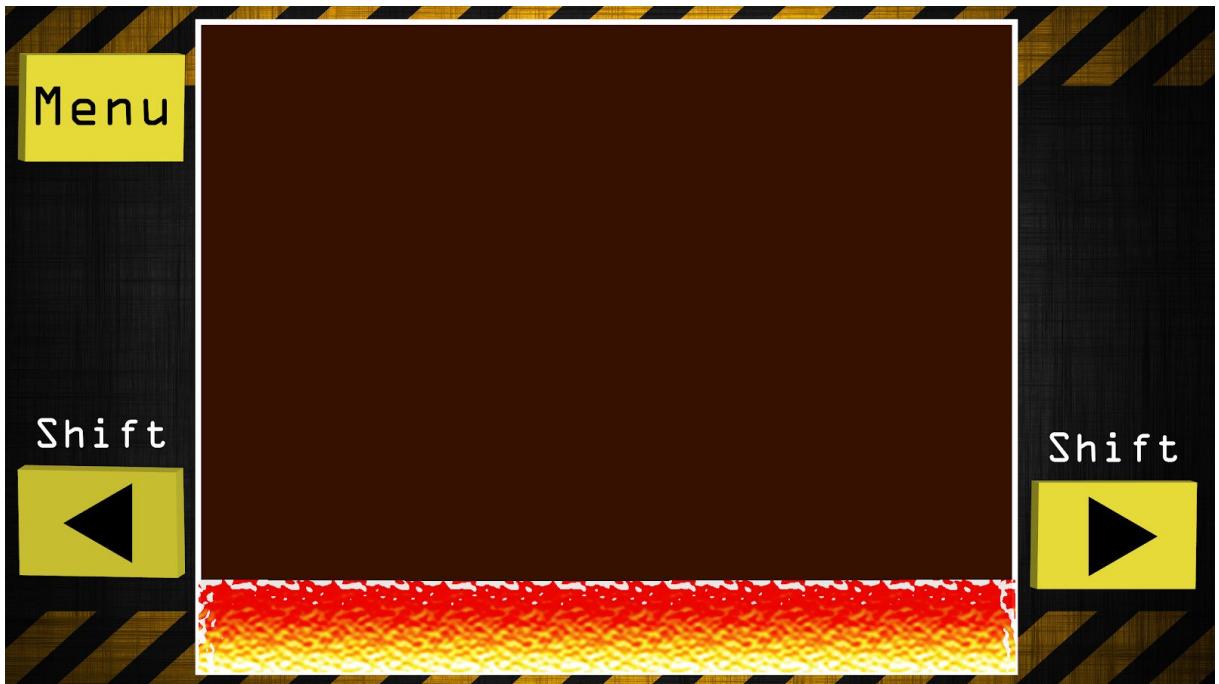


The level is complete and the reactor is filled

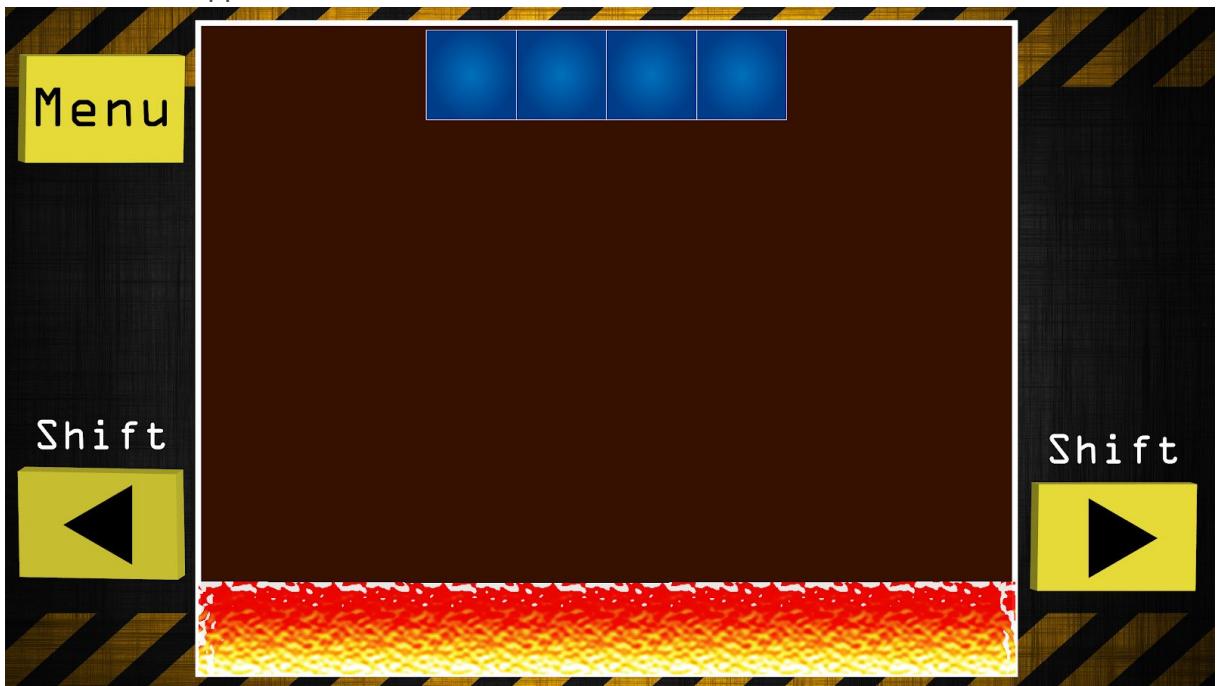


Gameplay - Seal the Reactor

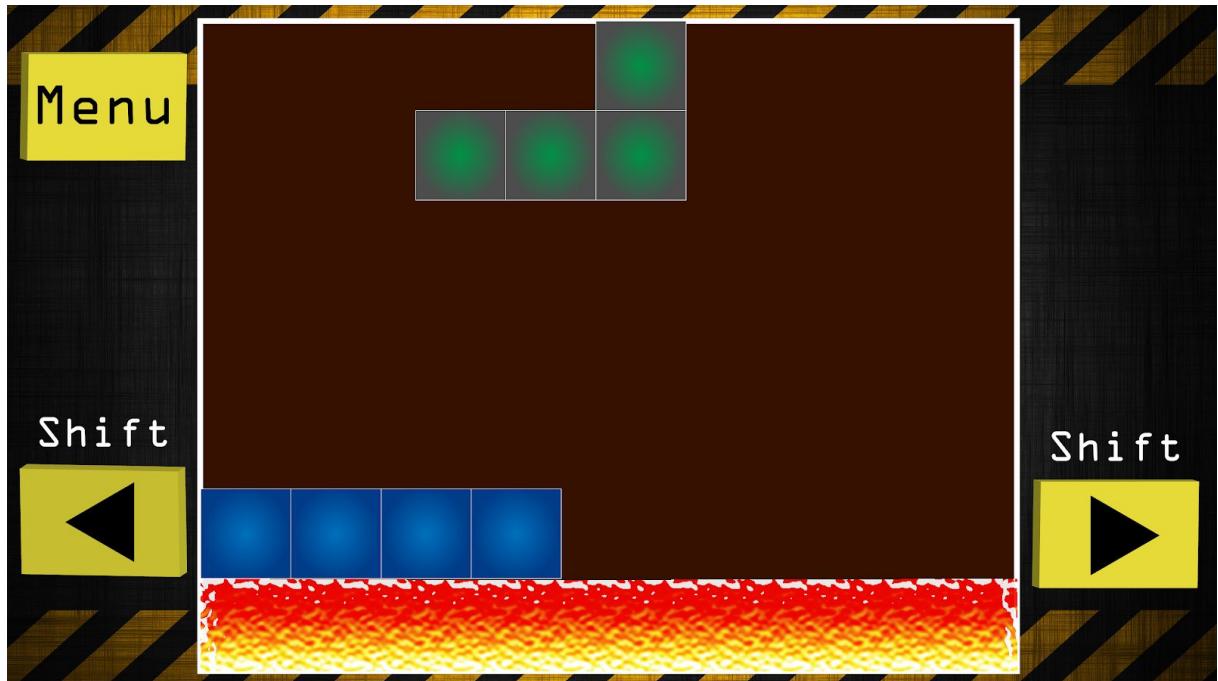
The game begins, the player can see the the molten material



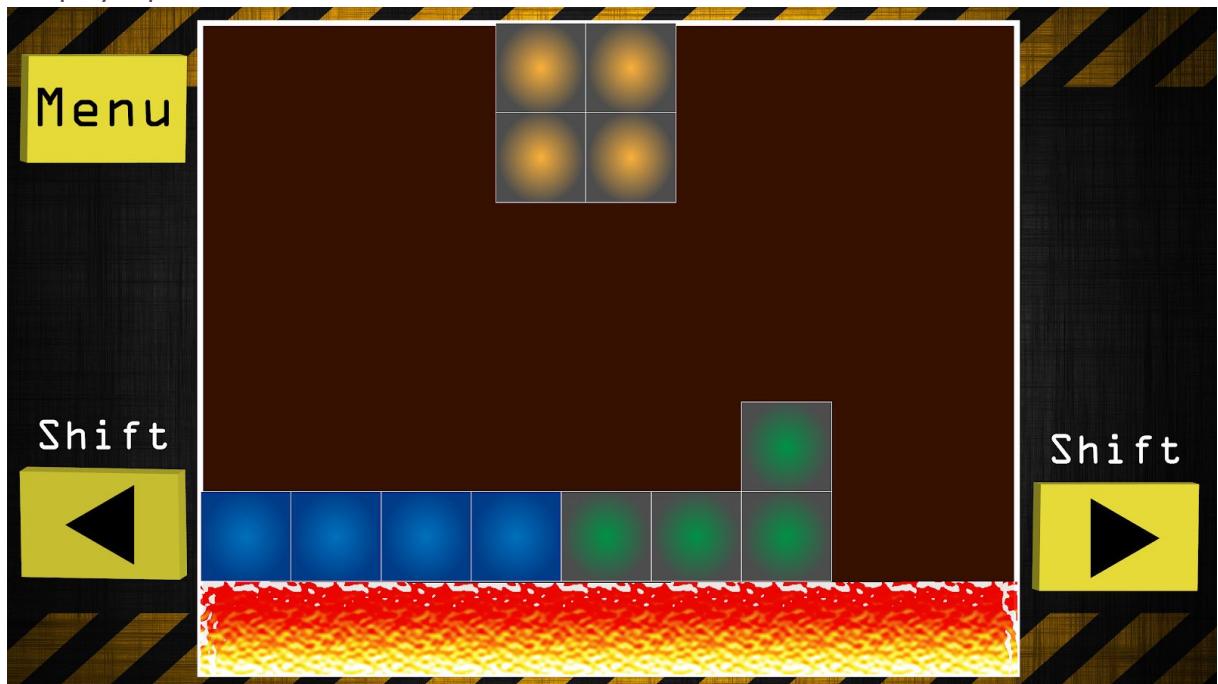
The first block appears



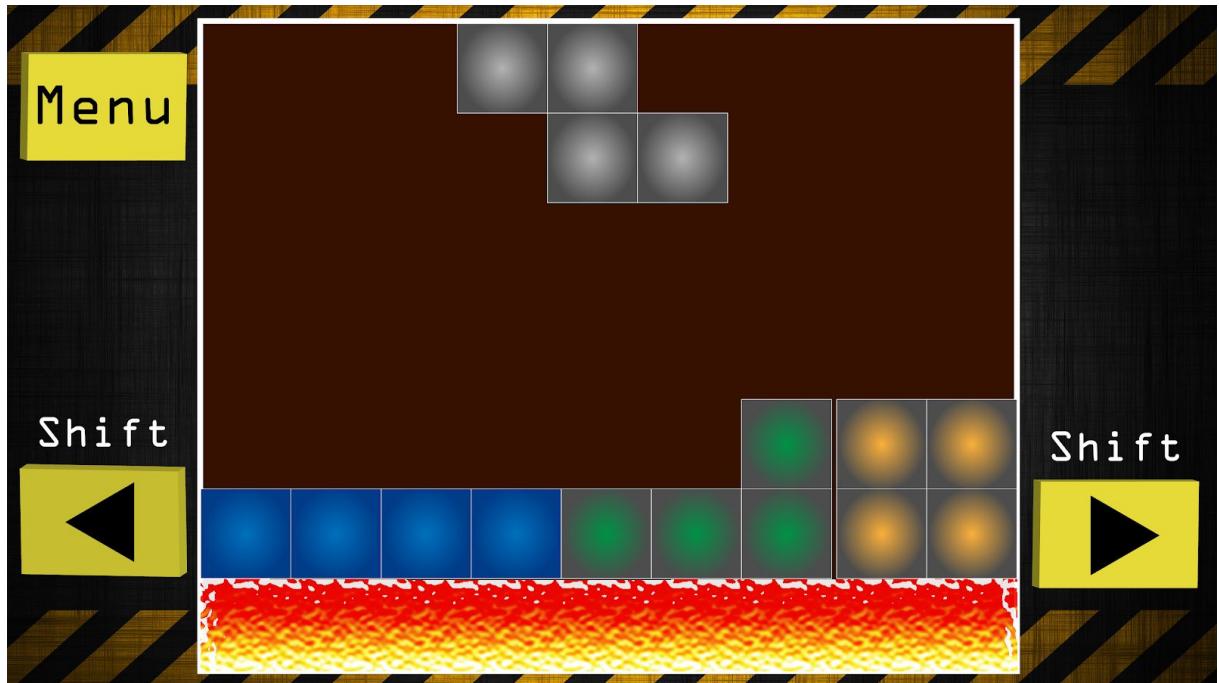
The user places the block above the melt, a new one appears



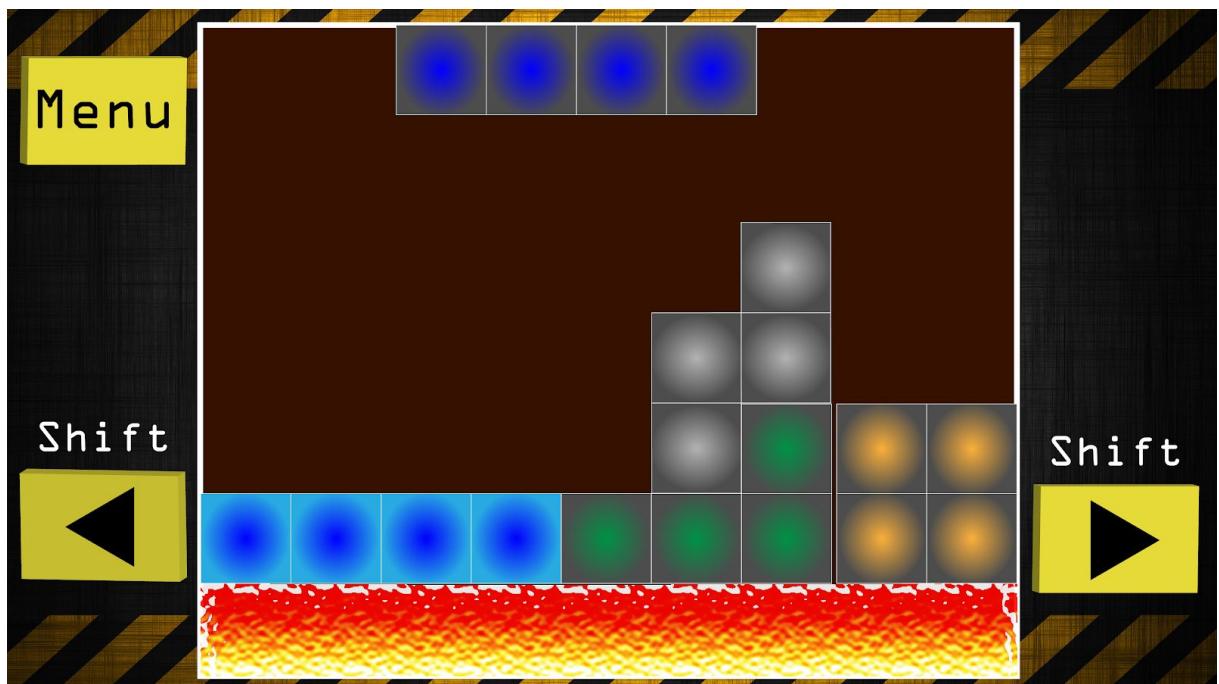
The player places the blocks inline



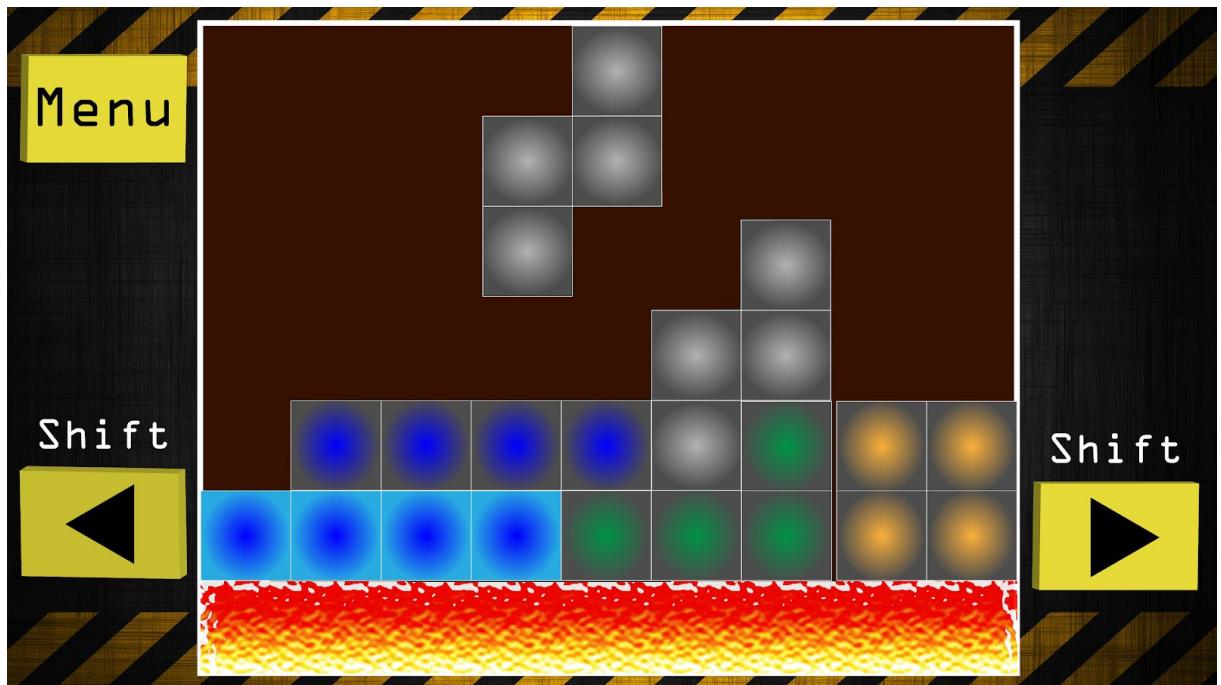
User places the square block



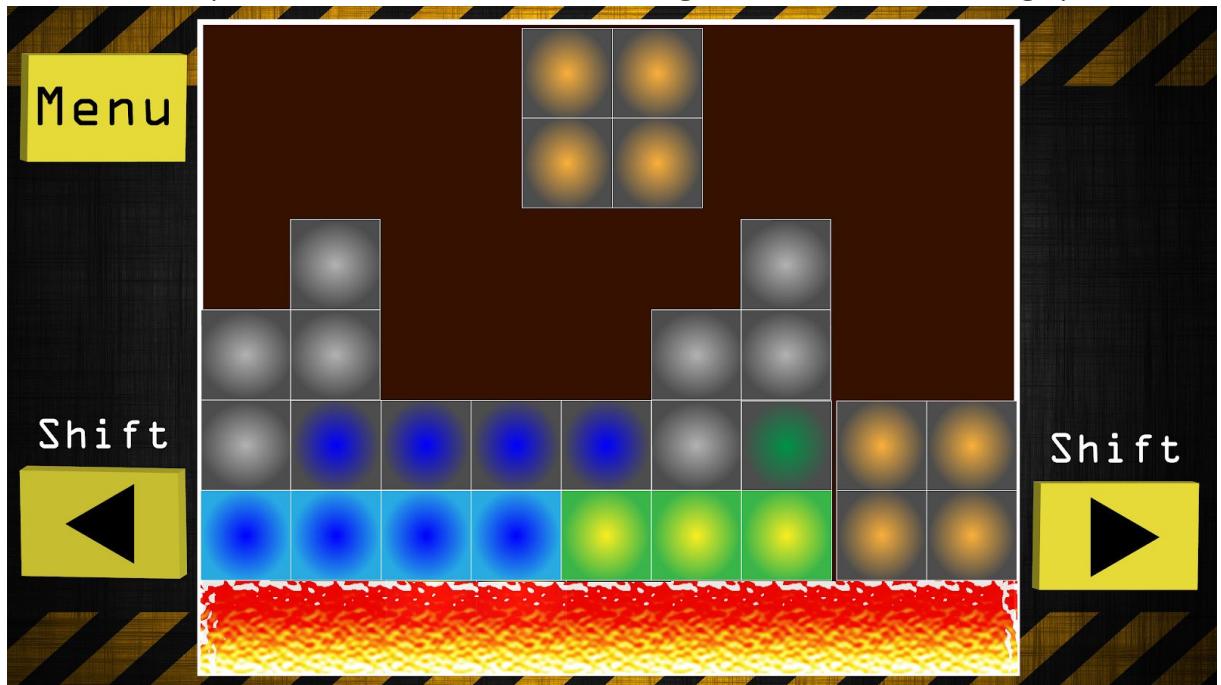
The original line piece begins to heat up



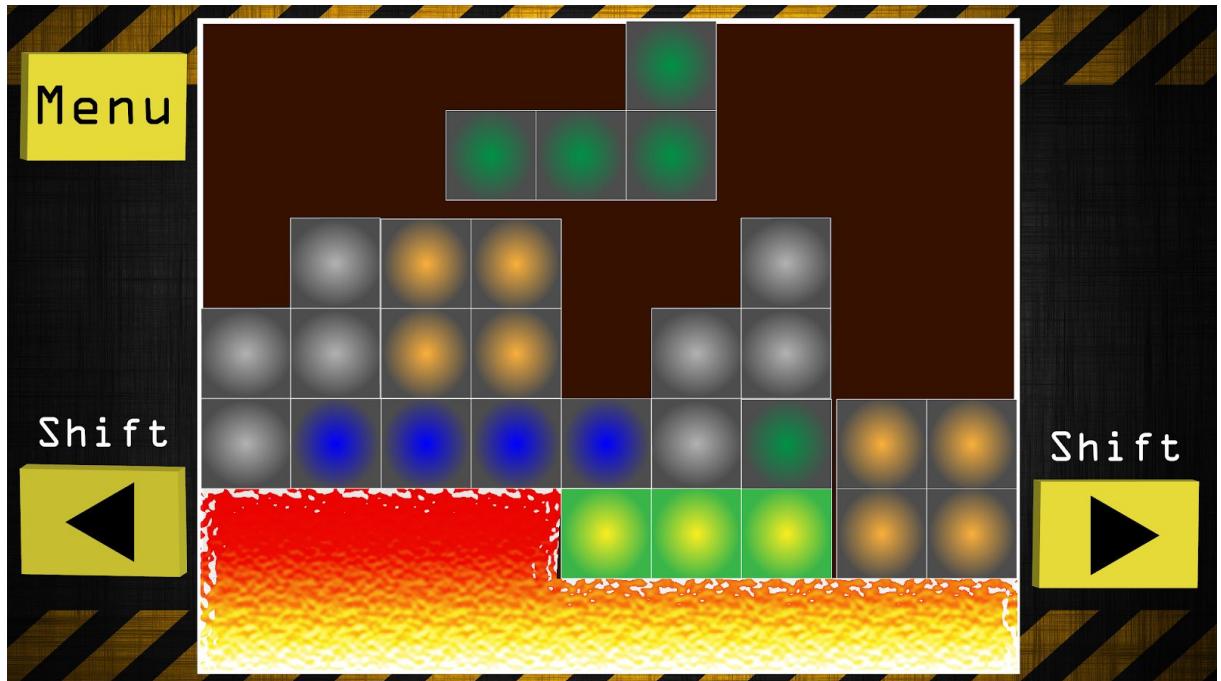
The user positions the blocks



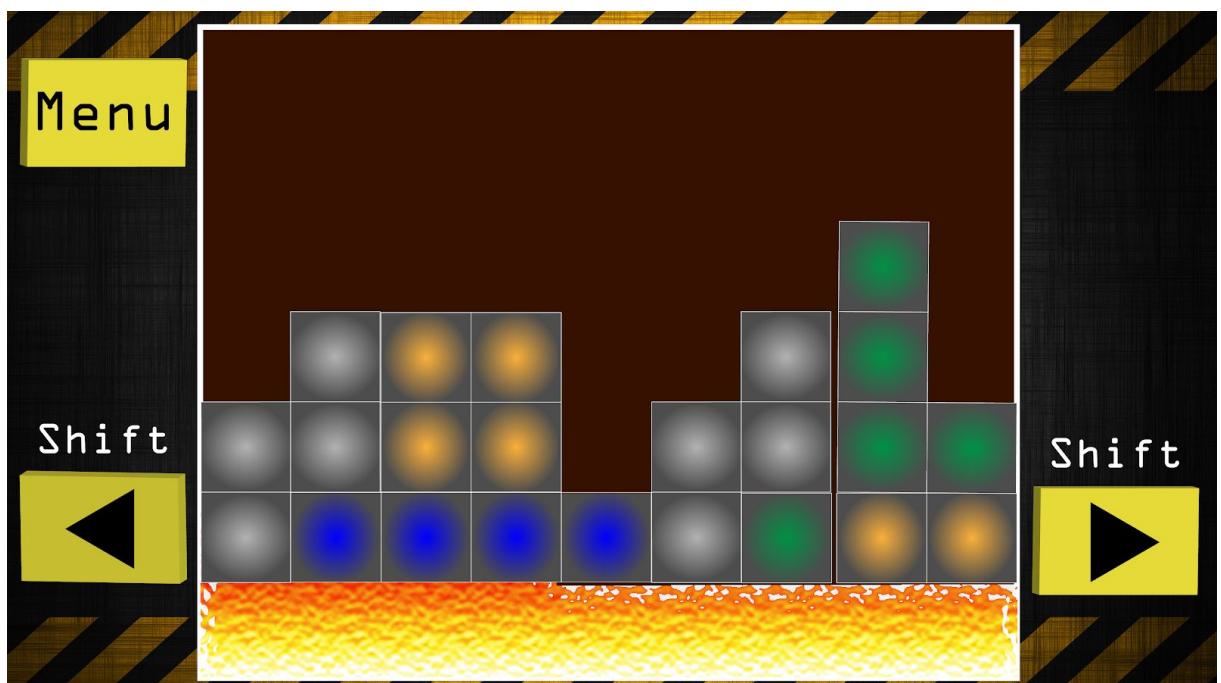
The first line piece is now about to melt, and the green I block is also heating up



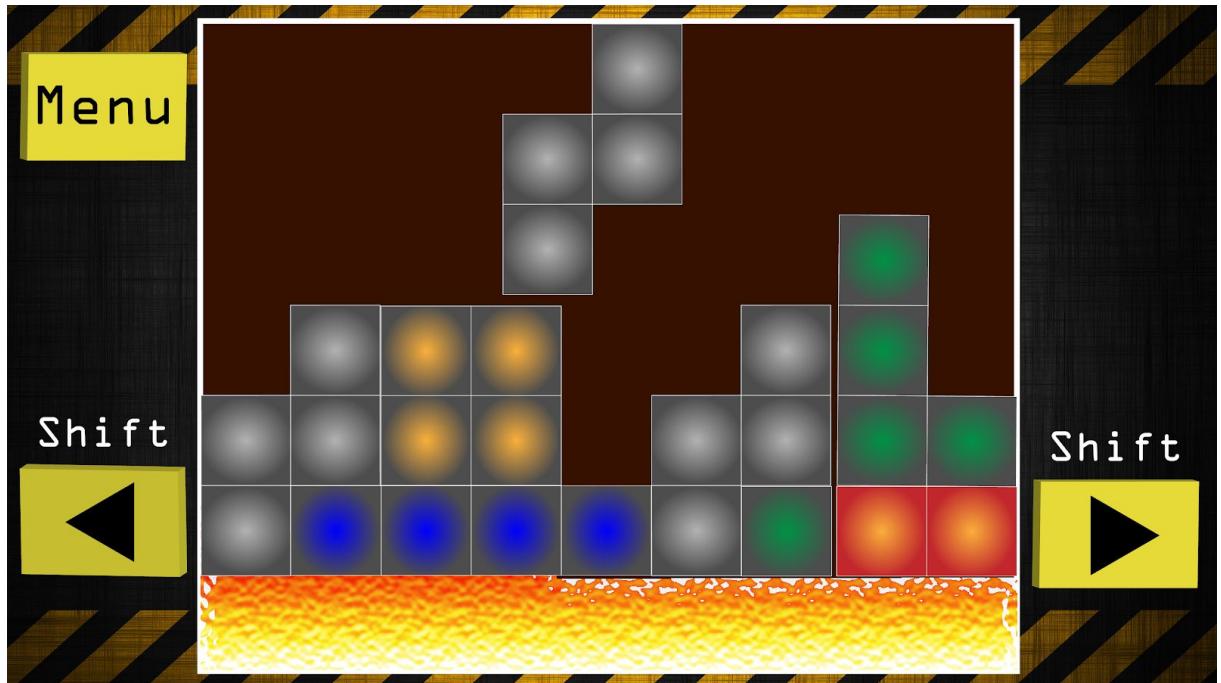
The melt spreads upwards



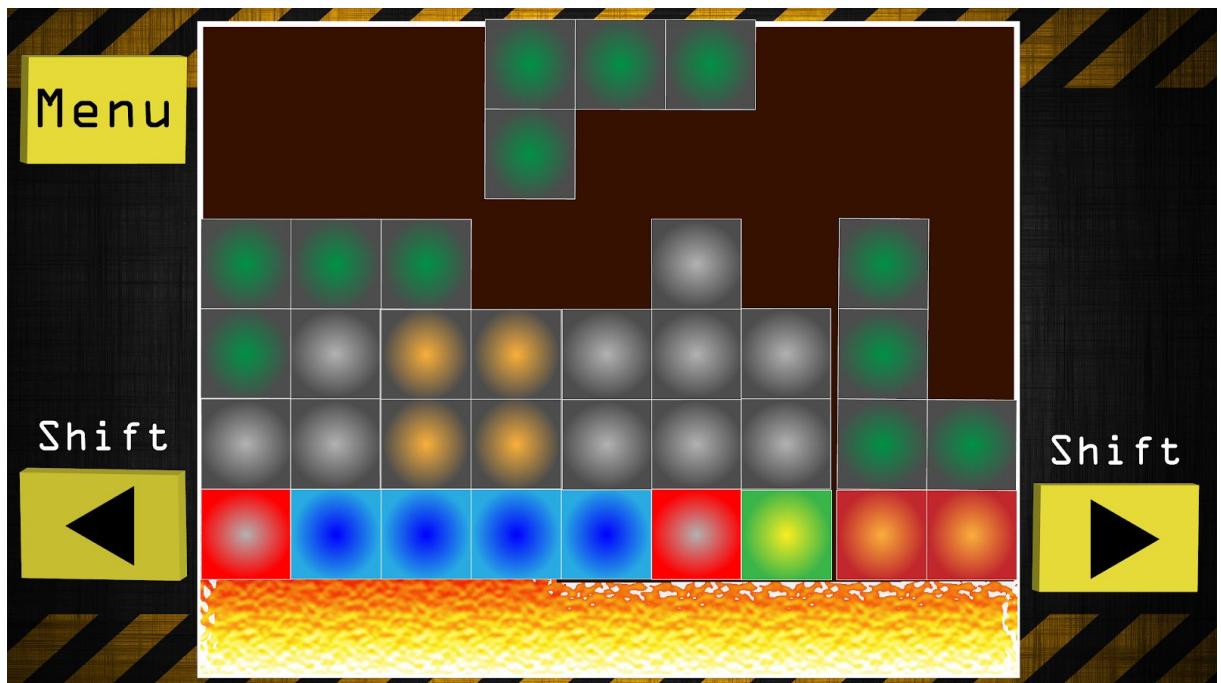
The blocks melt, the level shifts downwards



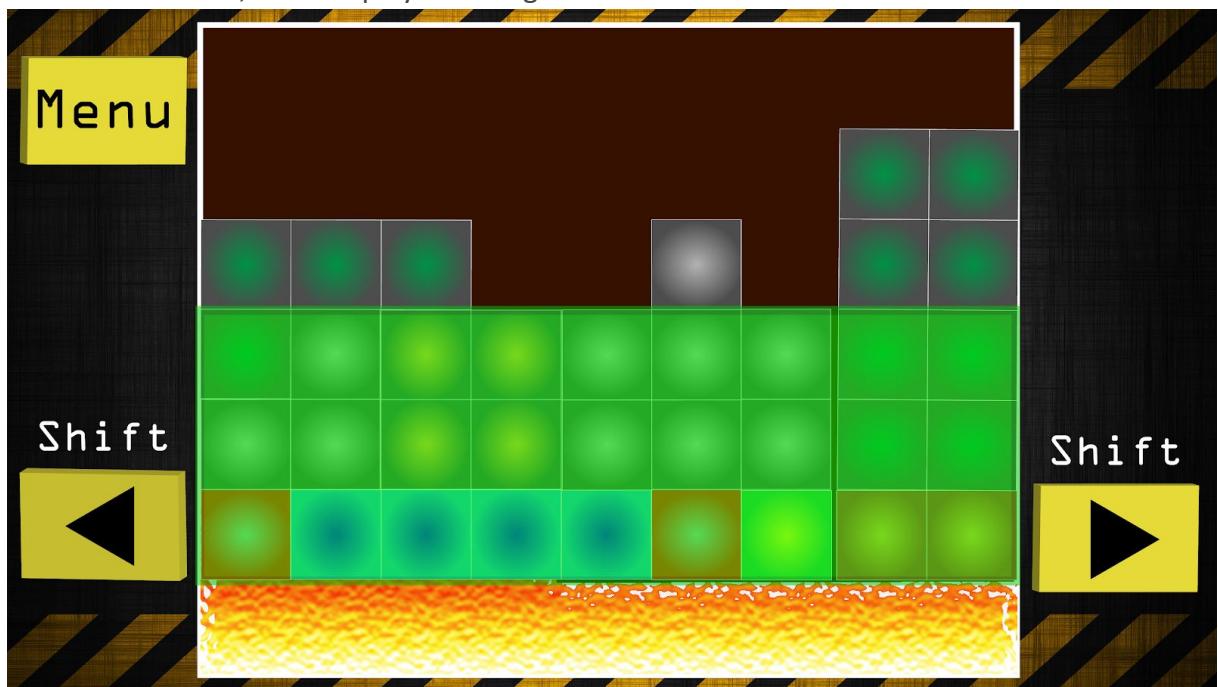
The player is almost ready to complete the level



The bottom blocks begin to heat up and the player is almost ready to complete the game.

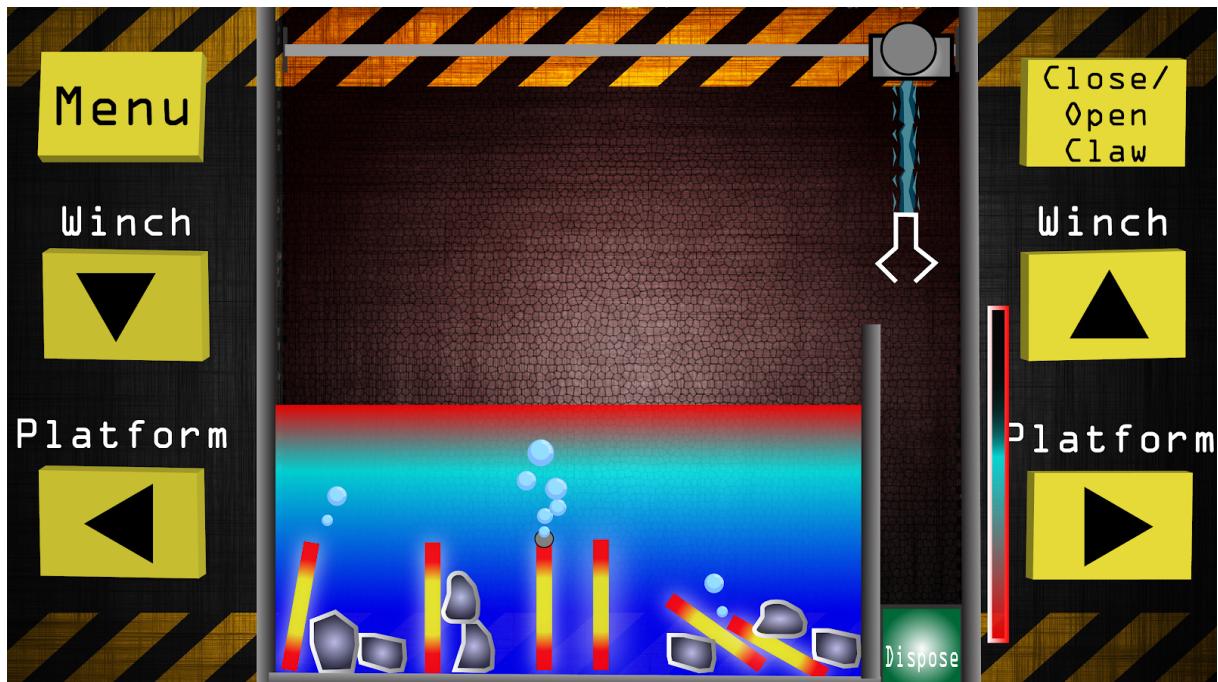


The bottom row is about to melt the player has very little time to put the last block in, and the player manages to do it in the last minute

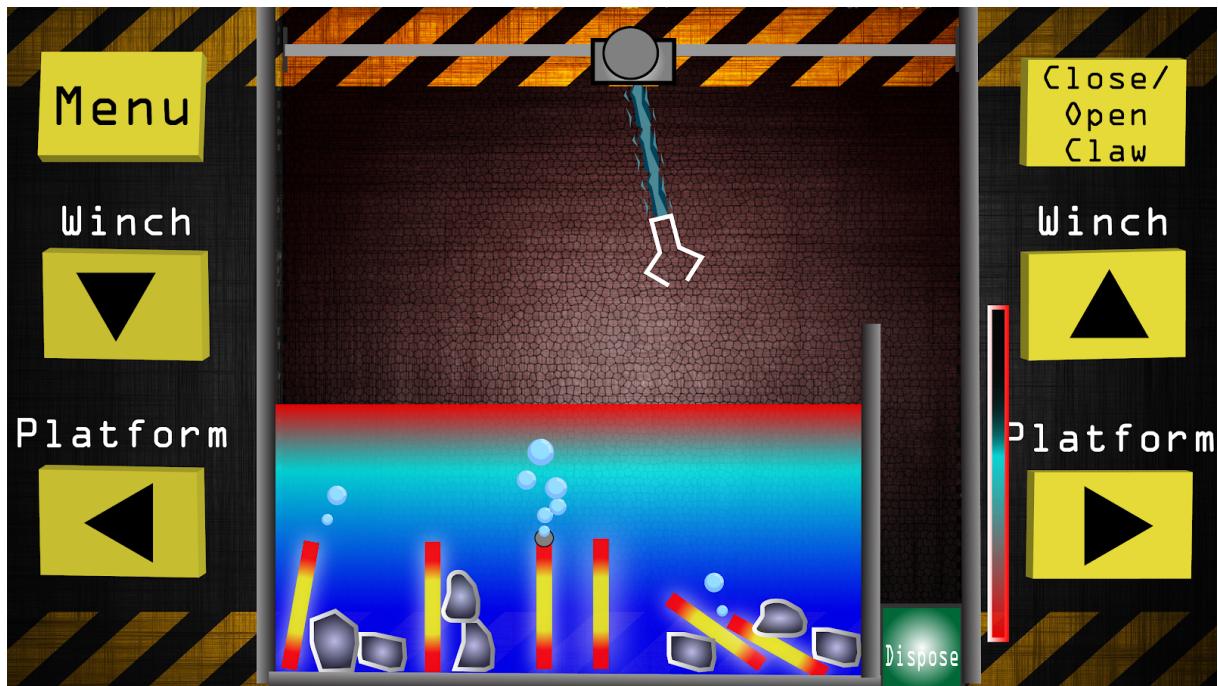


Gameplay - Grab the Rod

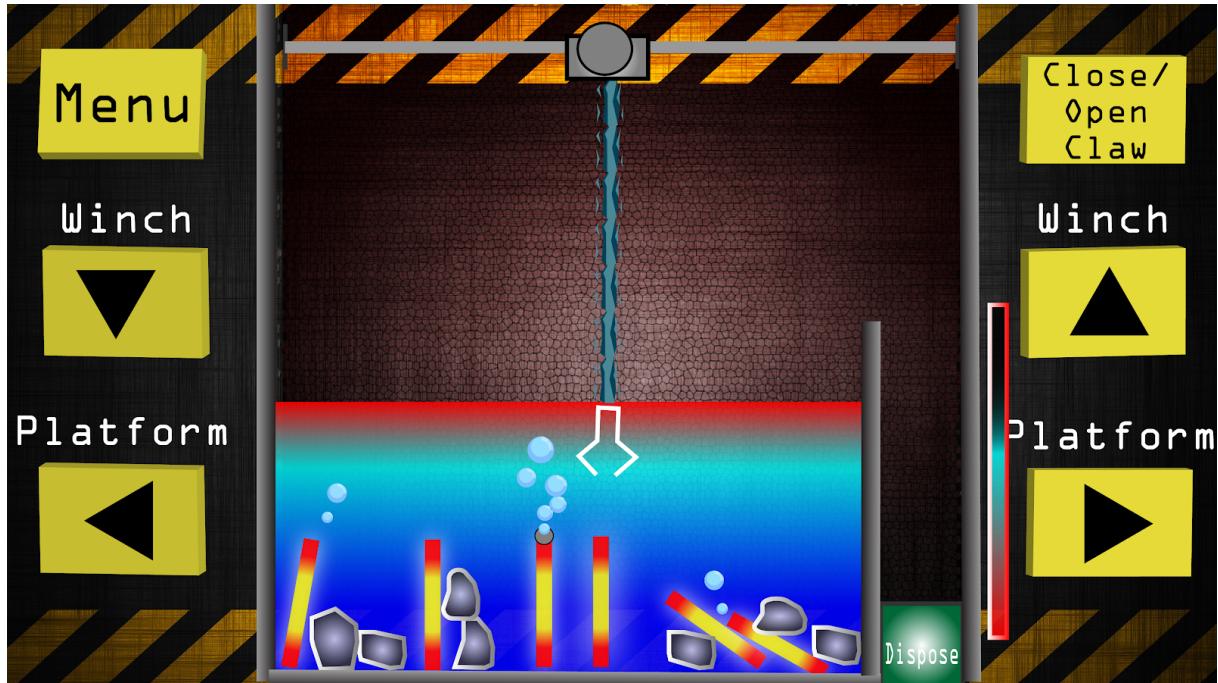
The game begins, the player must select a rod to go for



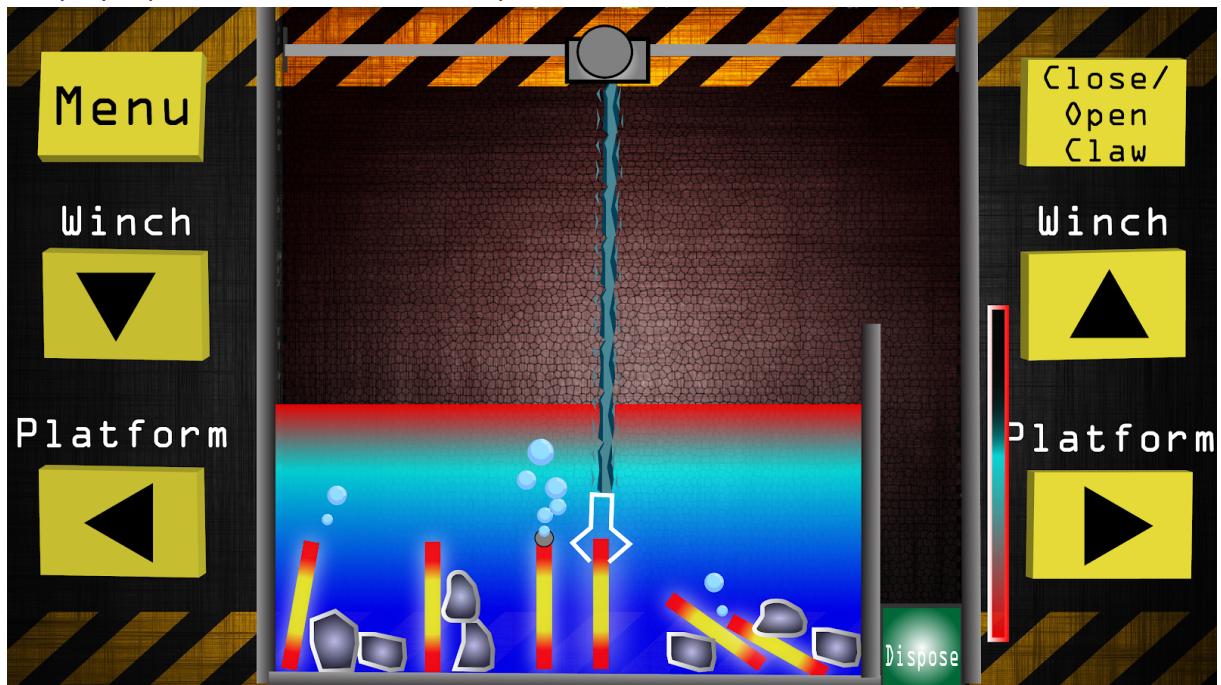
the player positions over the first rod and starts moving down. The hook swings back and forth as the player moves the base.



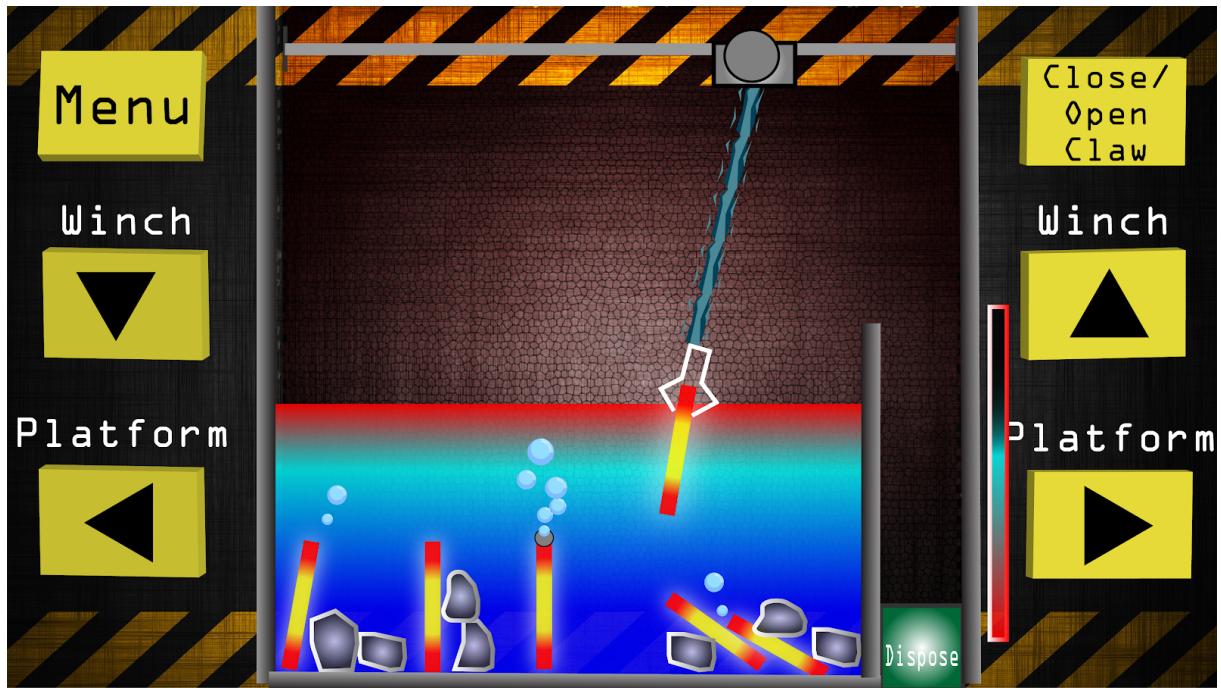
The player starts extending the string, the hook still swings slightly.



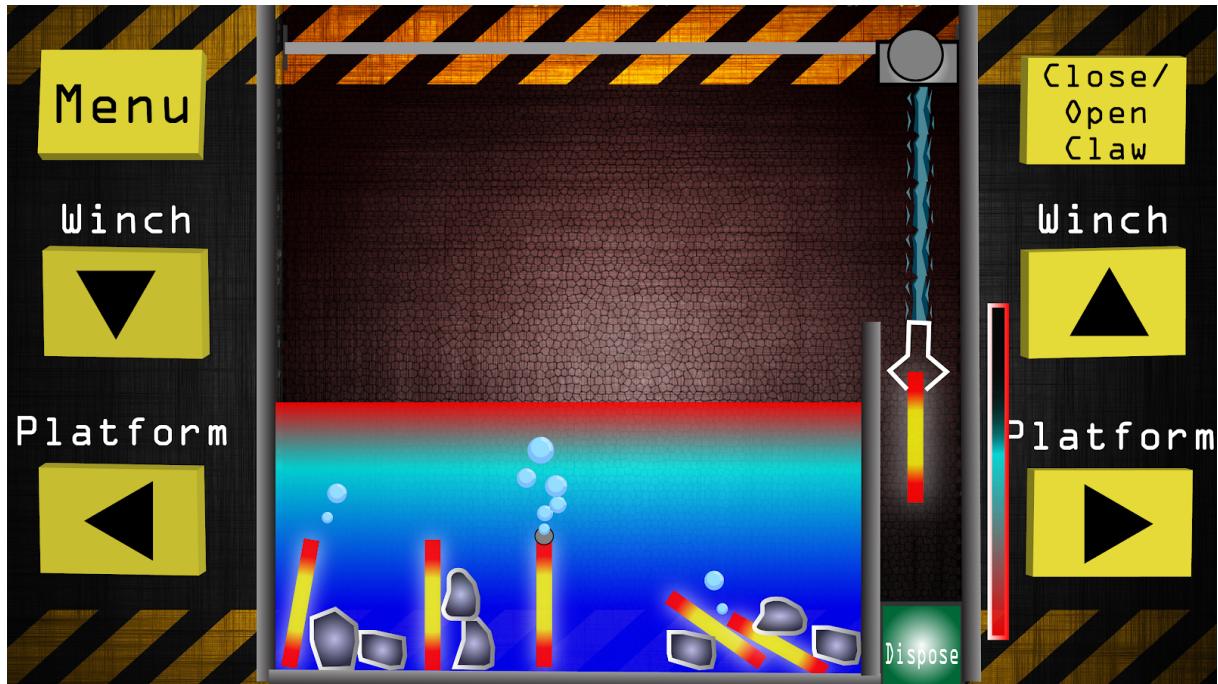
The player positions over the rod and presses the close button. The hook closes



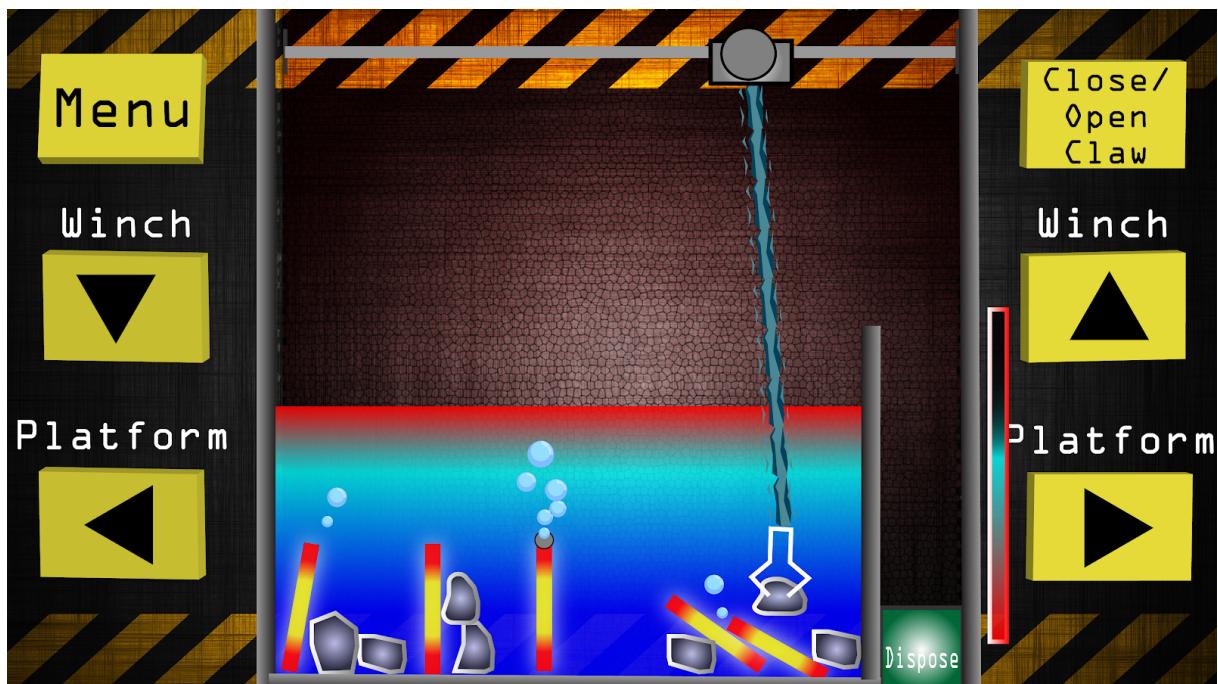
The player begins to lift the rod, still a little swinging motion. The player is in danger of hitting the wall with the rod



The player recovers by moving back towards the left in time and can now lower the rod into the dispose bin



In order to get the boom rods (which were knocked over) the rocks needs to be removed too. The player must take care and not drop them on the rods. Or drop the rock (which will roll on the bottom)



Once all the rods are removed, the game is won

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[Image of Melting]