Design Document: Play With Fire

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3. Environment

3.1. Components

3.1.1 Blocks

The environment is entirely constructed out of 1 unit cubes (actually about 4 m per side, therefore 1 unit = 4 m). These cubes have different colours, and are textured to resemble specific materials.

3.1.2 Objects

Objects are simply clusters of blocks. For instance, a vertical column of ten blocks is an object. Four such columns with a flat plane of blocks across the top is a 'Table' object.

Clearly, because objects are made of cubic blocks, they are abstract in nature, but the player will still be able to make out what these objects represent.

3.2. Gravity

Gravity always pulls blocks and objects downwards. The gravity value is 10 units per second per second, with a terminal velocity of 5 units per second.

Objects fall vertically downwards until any one of their constituent blocks hits another block underneath – then they stop. This applies, even if the resultant structure would look physically impossible. As long as there is a block underneath, the object will balance where it is.

3.3. Types of Block

The following are the types of Block that all objects are made of:

Block Type	Block Colour	Melt	Burn	Burn Time	Ignition Time
1: Leaf	Green	No	1: Yellow Hot	10 seconds	0.1 seconds*
2: Wood	Brown	No	2: Orange Hot	15 seconds	1 second
3: Coal	Black	No	3: Red Hot	60 seconds	1 second
4: Plastic	Pink	2: Orange Hot	3: Red Hot	15 seconds	1 second
5: Metal	Blue	4: Blue Hot	5: White Hot	90 seconds	1 second
6: Stone	Grey	5: White Hot	No	–	–
7: Fire	Red	No	No	–	–

*In fact, ignites slower except when exposed to extreme heat.

Note

No block may ever be at a heat level higher than that shown in its Burn column or Melt column (whichever is higher).

The following table shows the tints of blocks when they are melted or burning:

Block Type	Block Colour	Melted Texture	Meted Tint	Burning Texture	Burning Tint

Leaf	Green	–	–	Burning Leaves	Yellow
Wood	Brown	–	–	Burning Wood	Orange
Coal	Black	–	–	Hot Coals	Red
Plastic	Orange	Molten Plastic	Orange	Burning Plastic	Red
Metal	Blue	Molten Metal	Blue	White-hot Metal	White
Stone	Grey	Lava	White	–	–

3.4. Burning

3.4.1 Ignition

The temperature at any point in the game field (for the purposes of checking for ignition) is based upon the temperatures of the surrounding blocks. The process of determining if any given block ignites is as follows:

- Check for neighbouring blocks of the same material that are on fire, and have been burning for at least as long as the ignition time. If they exist, the current block catches fire.

If not, calculate the Effective Temperature for that block:

- Burning blocks within 1 unit (including diagonals which are technically 1.4 units away) provide 0.5 of their burn temperature.
- Burning blocks within 2 units (including diagonals which are technically 2.8 units away) provide 0.1 of their burn temperature.
- Burning blocks within 3 units (including diagonals which are technically 4.2 units away) provide 0.02 of their burn temperature.

Blocks are only counted as Burning if they have been on fire for at least as long as the ignition time for their relevant material.

If the temperature at any given point is higher than the required temperature for ignition for any given block, it catches fire (and then burns at the same temperature as its ignition).

Note

The three parametric values above are the temperature radiation coefficients (TRC1, TRC2 and TRC3). The values given should be considered default values – tweaking will be required.

Ignition takes 1 second. During this time, the block is considered to be at 0 temperature (not at its burning temperature). Only once it is alight does it take on its new temperature.

For example, consider the following example (in 2 dimensions):

0 seconds: The tree begins burning at the centre top (as indicated by the '1' – which is the temperature for burning leaves):

			1						

1 second: The neighbouring blocks immediately ignite. The blocks around have temperature determined only by the originally burning block:

		(1)	1	(1)					
	0.1	(1)	(1)	(1)	0.1				

	0.1	0.1	0.1	0.1	0.1				

2 seconds: The fire spreads. Notice how the 'bow wave' of the fire has risen from 0.1 to 0.36.

		1	1	1					
	(1)	1	1	1	(1)				
	(1)	(1)	(1)	(1)	(1)				
		0.36	0.36	0.36					
			0.06						

3 seconds: The leaves are fully alight. The wood is still safe.

		1	1	1					
	1	1	1	1	1				
	1	1	1	1	1				
		(1)	(1)	(1)					
			0.44						
			0.06						

4 seconds: The temperature at the top of the trunk is now effectively 2.1. This ignites the wood (which burns at Temperature 2).

		1	1	1					
	1	1	1	1	1				
	1	1	1	1	1				
		1	1	1					
			(2.1)						
			0.4						

5 seconds: The temperature at the top of the trunk is now effectively 2.1. This ignites the wood (which burns at Temperature 2).

		1	1	1					
	1	1	1	1	1				
	1	1	1	1	1				
		1	1	1					
			2						
			(2)						

6 seconds: The entire tree is burning.

		1	1	1					
	1	1	1	1	1				

	1	1	1	1	1				
		1	1	1					
			2						
			2						

Notice that there is a maximum temperature that a given material can contribute to another material. Imagine that there was metal in the centre of the tree:

		1	1	1					
	1	1	4.2	1	1				
	1	1	4.2	1	1				
		1	1	1					

The temperature from the burning leaves would not be enough to ignite the metal.

3.4.2 Burning Out

After the Burn Time for a block has expired, the block is removed from the world completely.

Any blocks or objects that were resting upon that block then fall down. Thus the shape of the world changes over time as more objects and blocks burn to nothing.

3.4.3 Polling Blocks (Checking for Ignition)

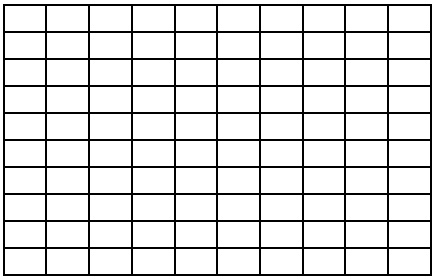
The game engine should poll the blocks of the world at the fastest rate feasible without causing slowdown – blocks near to the player should be polled in as close to real time as possible, whilst blocks far from the player are lower priority. But within an approximately ten second cycle, all blocks in the game world should be polled at least once to determine if they start any fires nearby.

3.5. Melting

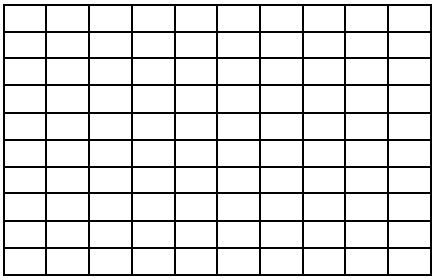
3.5.1 Collapsing

When an object melts, it means that it ceases to be treated as a composite object of blocks and instead becomes a collection of unconnected blocks.

Consider the following diagrams (in two dimensions for simplicity):



This shows a Tree object, made of a set of Leaf blocks on top of a Wood block pole. It is standing on a Plastic block table.



The plastic table melts. The tree falls into the table (which has effectively inverted itself by melting) but gets stuck on the edge of one of the 'legs'.

In point of fact, in this example, the tree would also start burning, since the ignition temperature for the

tree is less than that of the melting point of plastic.

3.5.2 Gravity for Melting Objects

To make melting objects look like they are melting, the gravity effect on the blocks of an object which has melted should be variable.

Set the gravity for each block to be between 1 and 5 units per second per second, with a terminal velocity of 5 units per second. This will give the impression of melting.

3.5.3 Pushing Through

The other effect of melting temperatures is that the player can push through a barrier if they are hot enough to melt.

> *For instance, if the player is Orange Hot (2) and there is a 'wall' of Plastic Blocks ahead of them, they are hot enough to melt these blocks and they can push through. The player simply moves up to the block, and moves through.*
>
> *Their movement is slowed to 75% of normal when they push through.*

After pushing through, the block where the fireball passed is removed from the field, exactly as if it had been burned out.

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