Ohm, My lord!

February 2019

AI-driven Arcade (Roguelike Dungeon Crawler / Shoot Em Up)

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Criteria

- NPC react to each other

- Prioritising target enemy, fighting each other

- NPC react to environment

- Finding Charging Dock (for regaining health)

- NPC react to player

- Attacking & Chasing

- NPC has at least 2/3 behavioral states (Idle doesn't count)

- Chase & Attack (+ When hit target & fight with other NPCs)
- Flee & Recharge (Prioritising health > damaging targets)
- NPC Synergy-Combo System

- NPC has pathfinding algorithm (Planner AI, A*, Dijkstra, Potential Fields, Boids)

- Enemy NPCs use an A* pathfinding algorithm

- Behavior Tree (self written)

- With Action, Timer, Sequence, Selector and Inverter Nodes inheriting from an interface -> abstract class architecture.

Optional

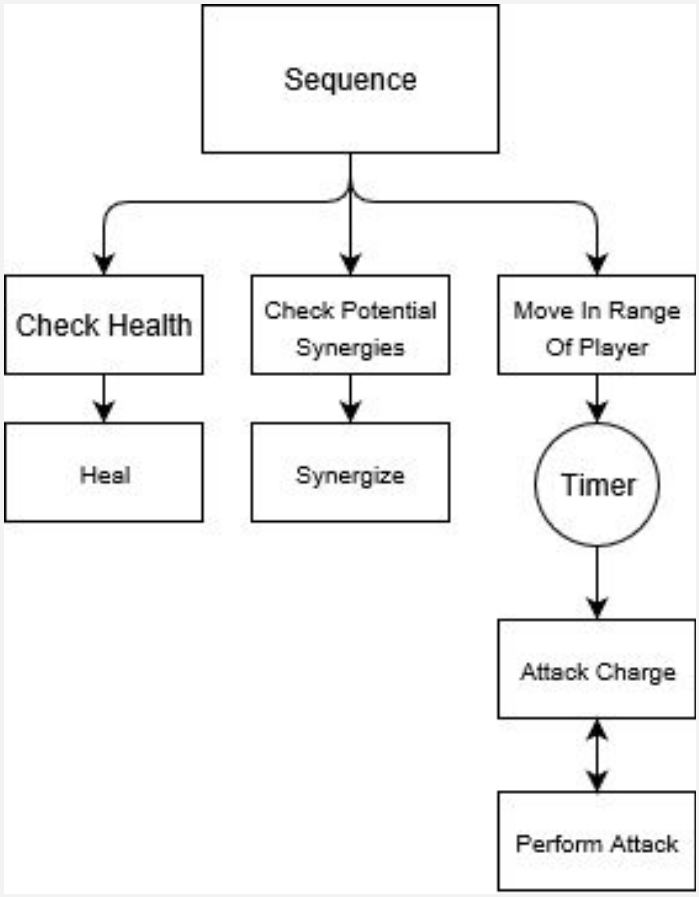
- Learning A.I

Concept

Ohm, My Lord!
Teaching electronic circuit basics to noobs, in a fierce bullet hell roguelike combat scenario.

The game features a procedural map with electronic components that come per room and try to kill (short circuit) the player.
Some of these enemy NPC components can combine (such as a potmeter and an LED) to become more powerful, new synergetic entities.
Enemy AI is aware of this, and its surroundings regarding other NPCs, making them act out on logical desires/combinations at certain circumstances.

To name a few of the current NPCs in the game, you have an **LED**. This is a medium-ranged enemy that shoots electrical bolts.
As a contrast to this you also have the **POT** (potmeter) enemy. This is a slower, more close-ranged enemy relying on stronger melee attacks.
These enemies all feature distinctive behavior trees, which work with three branches:
- Charge & Attack (Chase the player with A Pathfinding, and use distinctive attack type)*
- Flee & Heal (Health #1 priority)
- Combine & Synergize (Acknowledge surrounding enemies + calculate situational efficiency)



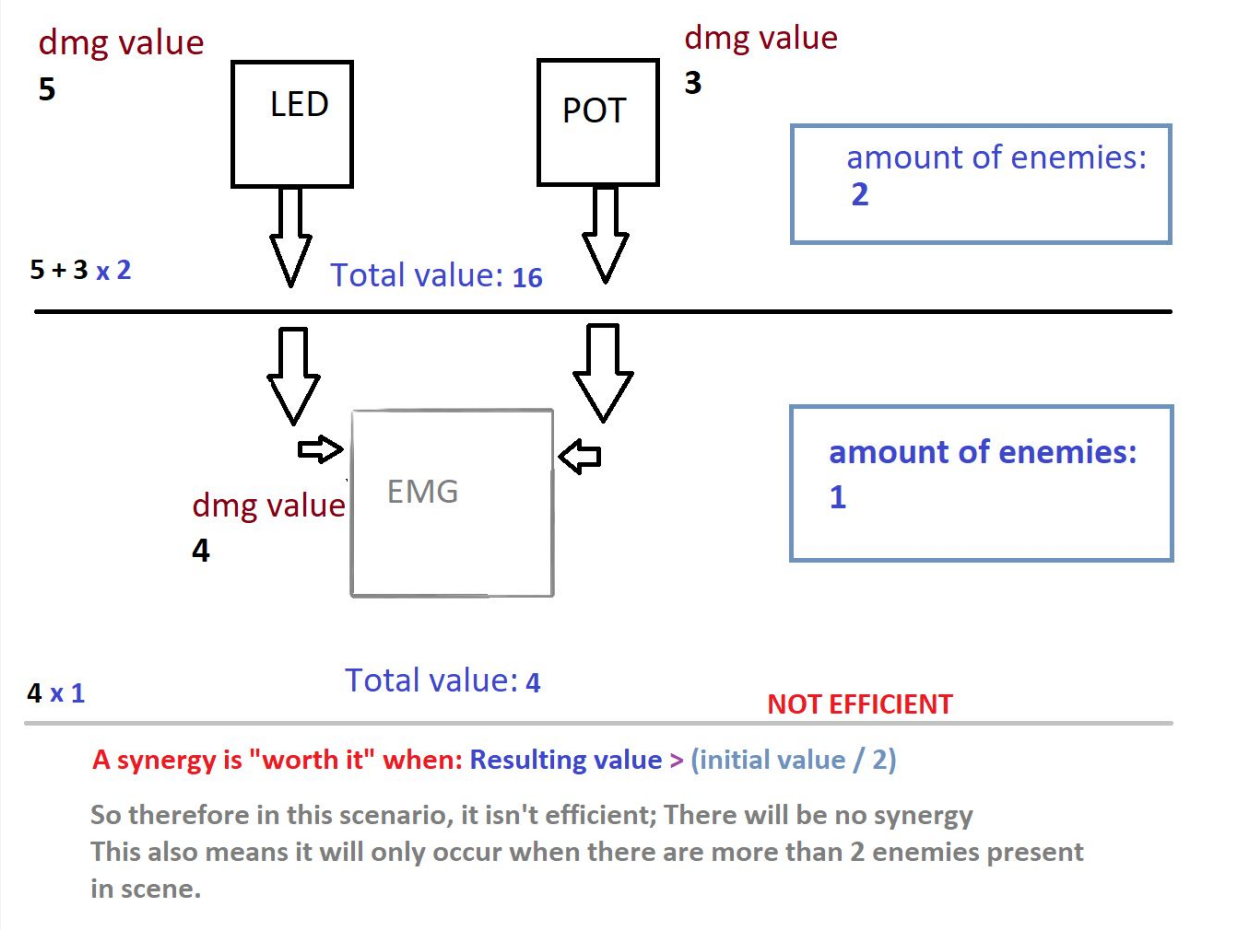
These electronic components can combine forces to form electrical circuits which adds more depth to playstyle, and strategy & complexity to the overall game. This is called the **Synergy System**. It works by letting the enemy NPCs consider the best efficient move, every frame.

*The **Synergy system** is based on this equation:*

***vI** = (Sum of all enemy power values in scene) * [Amount of enemies in scene]*

***vR** = (Sum of all enemy power values left in scene & the resulting synergy) * [Amount of enemies remaining in scene]*

*Synergy can happen when **vR > vI / 2***



Once any AIs synergize, difficulty needs to be adapted accordingly.
An AI has the chance to know everything in-game, so therefore there needs to be a compromise for the player.
- Farcry let's a camp of enemies allow to shoot limited rounds at once, for giving the player a chance to survive the battle.
- Skyrim let's you put a bucket over an NPCs head to rob them unnoticeably
- Uncharted let's a group of gunmen react to the first gunshot, granting the player a few shots before they respond.
- Arkham prevents NPCs from turning around (without losing subtlety), so the player can sneak up behind them.
- In Breath of the Wild enemies scan the environment to pick up weapons, light them on fire, etc. They know how to use the game's systems accordingly, just like the player.

*It's all about making the game **feel** fair, and unbiased.*
"**Good AI tells you what it's thinking**, in the form of sonic or visual feedback."

-> This game lets the player know what an AI is prioritising, by having visual icons above their head, representing the current state.

-> Also, by playing the game and learning the AI behaviors the player will notice that enemies **can be angered by each other**. This will happen by successfully leading two NPCs into each other's attack ranges. After this they will fight out the owner of the damage source that hit them.
Since the player can take great advantage of this pretty easily, the damage that an enemy deals to another enemy has been nerfed to be half of the total attack damage of the offensive NPC.

AI only comes off as "smart" when the player has a way of noticing their thoughts. Such as, when an AI can remember doors being left opened/closed, the player has no way of knowing it is capable of such a thought, UNLESS there is some form of feedback like a verbal acknowledgement
"Did I leave that door open?"

Good AI is predictable, ex. When turning off a power generator triggers a consistent AI reaction of checking it out and fixing it, the player can essentially gain this knowledge and use it as a resource / strategy in future gameplay.

Good AI has own goals, this goes beyond *kill the player*.

-> This game AI has priorities based on current health values, and surrounding NPCs. They can form stronger entities by combining together, but they can also flee to the nearest charging dock (for power / health) to recharge health. The player can also take advantage of this!

Potential ideas for the future of this project:
- Hitting NPCs with certain projectiles in certain areas, causing more damage (destroying resistor parts on the LED).
- Responding to EMP / electromagnetic fields
- EEPROM memory IC: Enemy NPCs that remember player behaviors and nuances
- Boids AI for flying electrons
- Potential Fields for crowd-behavior (people piling up in a circle around player, if the player moves people move back in the respective direction)

AI Analysis (Opdr. 1)

For AI research I decided to analyze the states and behaviors of the alien in
Alien: Isolation

The Xenomorph is the main antagonist NPC in Alien: Isolation.
It's purpose in the game is to provide the player with tense moments, by hunting the player down and using its senses to actively search for prey.

What I understood from its game behavior is that the AI of the Xenomorph is actually divided into what I call these two parts:
- Overhead AI
- Sensory AI

The Sensory AI works on sound made by the player (such as the motion tracker, and crouching vs walking). The Xenomorph can also hear the player subtly through listening to the microphone input. After this the player has a few seconds to find a hiding place, before the Xenomorph goes into hunting state. The Xenomorph also has a line of sights, through not obvious at first sight. This gets used as a pathfinding guide to the player.

*The alien can pick up on certain behaviors, such as throwing flares. If the player consistently has the same nuances, the Xenomorph will learn to target the place where the flare has been **thrown from**, instead of **to**.*

Pros of the AI:
The balance between the all-knowing (overhead) AI and the individual senses of the Xenomorph makes for great and semi-realistic behavior of the Xenomorph ingame. It only acts if it's sure to have spotted its prey.

Cons of the AI:
In my opinion, the fact that the Xenomorph always teleports near the vicinity of the player seems kind of unrealistic and too limiting for game scenarios. I would like to add secondary goals to the Xenomorph, so its AI is not centered around **just** the player, but perhaps hunt for other things or even breed. (If that even is possible for a Xenomorph)

Log

15-02-2019 (30 min):

Brainstorming

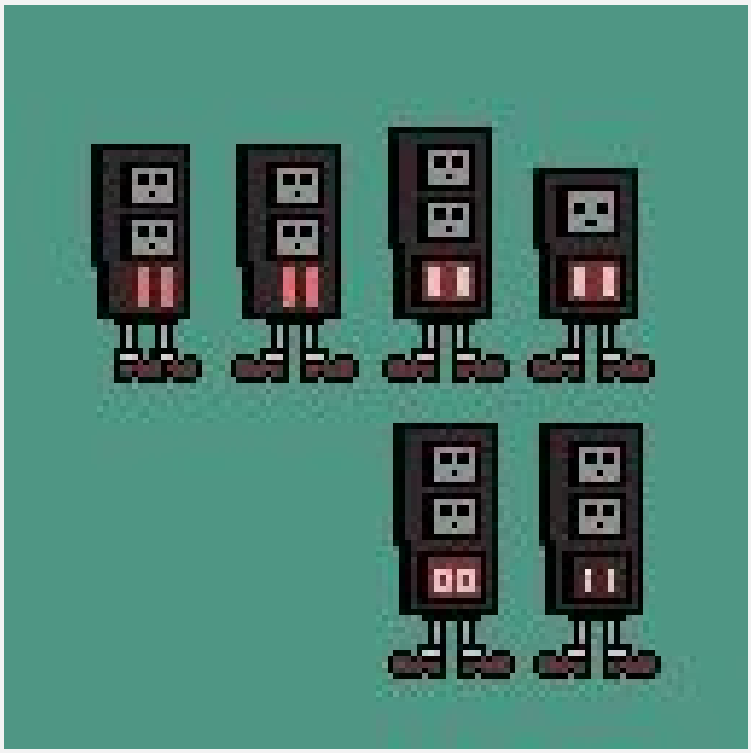
25-02-2019 (1 hour):

Ideation + Project setup

03-03-2019 (2 hours):

Character Iteration + Color Pallette + Art Style Research

https://www.fortressofdoors.com/doing-an-hd-remake-the-right-way/

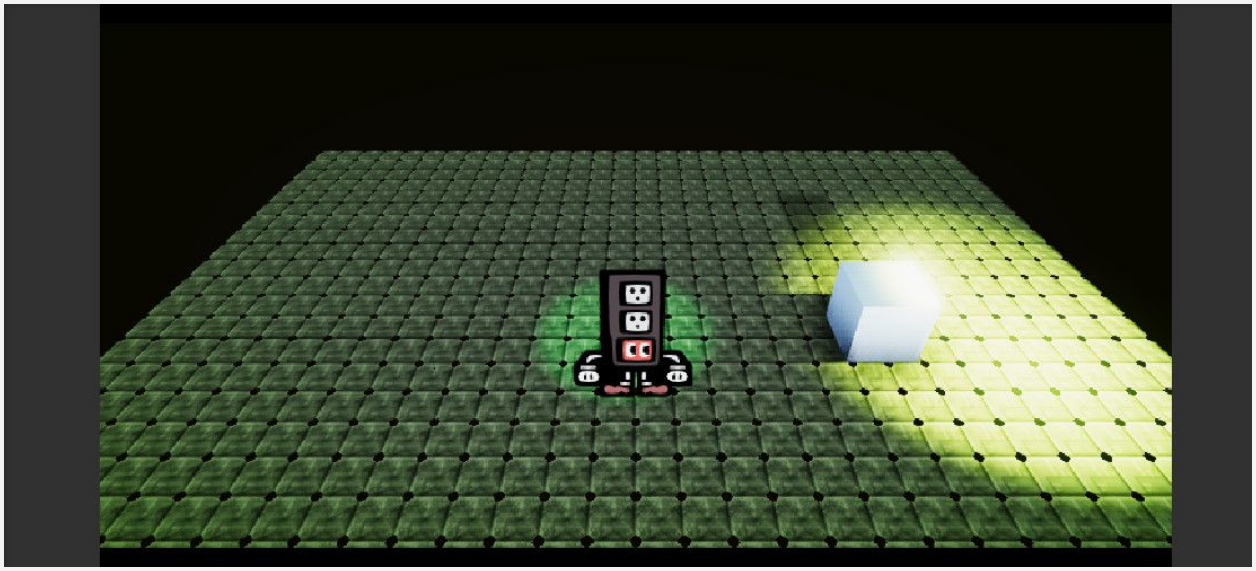


04-03-2019 (2 hours):

Character Development + Implementation

06-03-2019 (2,5 hours):

Character Development + Lighting + Game Art Style Iteration



07-03-2019 (2,5 hours):

Character Animation Design

09-03-2019 (7 hours):

Character Animation Implementation + Level Generator System Design + Development

10-03-2019 (4 hours):

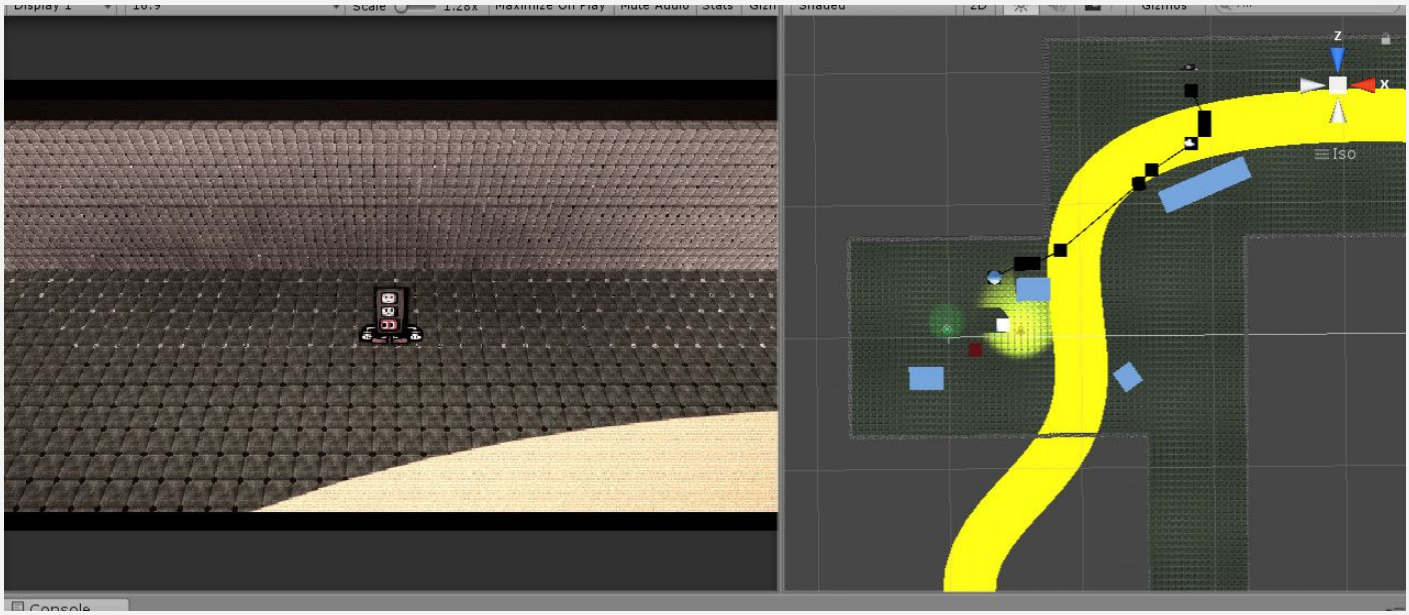
Started health system design; IDestroyable interface, with a MonoBehavior wrapper for objects.
Smart Cursor mechanic written & added. Began with the player's shooting bolts ability.

01-04-2019 (7 hours):

A* pathfinding algorithm implementation & experimentation. Altered the visual style and screen effects.

https://www.youtube.com/watch?v=-L-WgKMFuhE&index=1&list=PLFt_AvWsXl0cq5Umv3pMC9SPnKjfp9eGW

https://www.youtube.com/watch?v=y3_q4dn7_g8



05-04-2019 (3 hours):

Creation of a LED-light enemy NPC. Texture + Shading.

07-04-2019 (9 hours):

Bolt (Projectile) physics + Damage system. Implementation of the IDestroyable interface (which handles health, damaging and OnDeath events). Added visual feedback for enemy hits, in the form of text & texture response of the enemy to said damage source.

Fast iterative design process & technical prototype of Behavior Tree system.

08-04-2019 (5 hours):

Further development of the LED enemy Behavior Tree.

15-04-2019 (4 hours):

Projectiles, Recoil & Damaging system for player & LED enemy.

Added Health UI.
Behavior Tree of LED regulates distance to player before charging for a ranged attack.

21-04-2019 (6 hours):
Made assets for three new enemy types. Potmeter, Button and Electromagnetic component enemy.
Implemented AI for the potmeter enemy,which has stronger attacks, and uses melee when close to the player.
By passing damage sources as parameters enemies now can be angry at one another and target each other.
Started implementing the Enemy Combining Recipes System, which lets all NPCs check the room for any other types of nearby NPCs, and adds a situational behavior state that determines if two certain NPCs can combine powers to become synergetic (a whole new NPC in itself), and when to use this.

26-04-2019 (6 hours):
Added a new A.I state, regarding the prioritisation of the NPCs health when it is low. With this they will flee to the nearest charging dock. (Which is also a new environmental feature)
Added failstate screen & restart game option
A.I battles can now fully be watched from a distance (it is fun!)
Added electrical icons above NPCs, which act as visual feedback for the various AI behaviors.

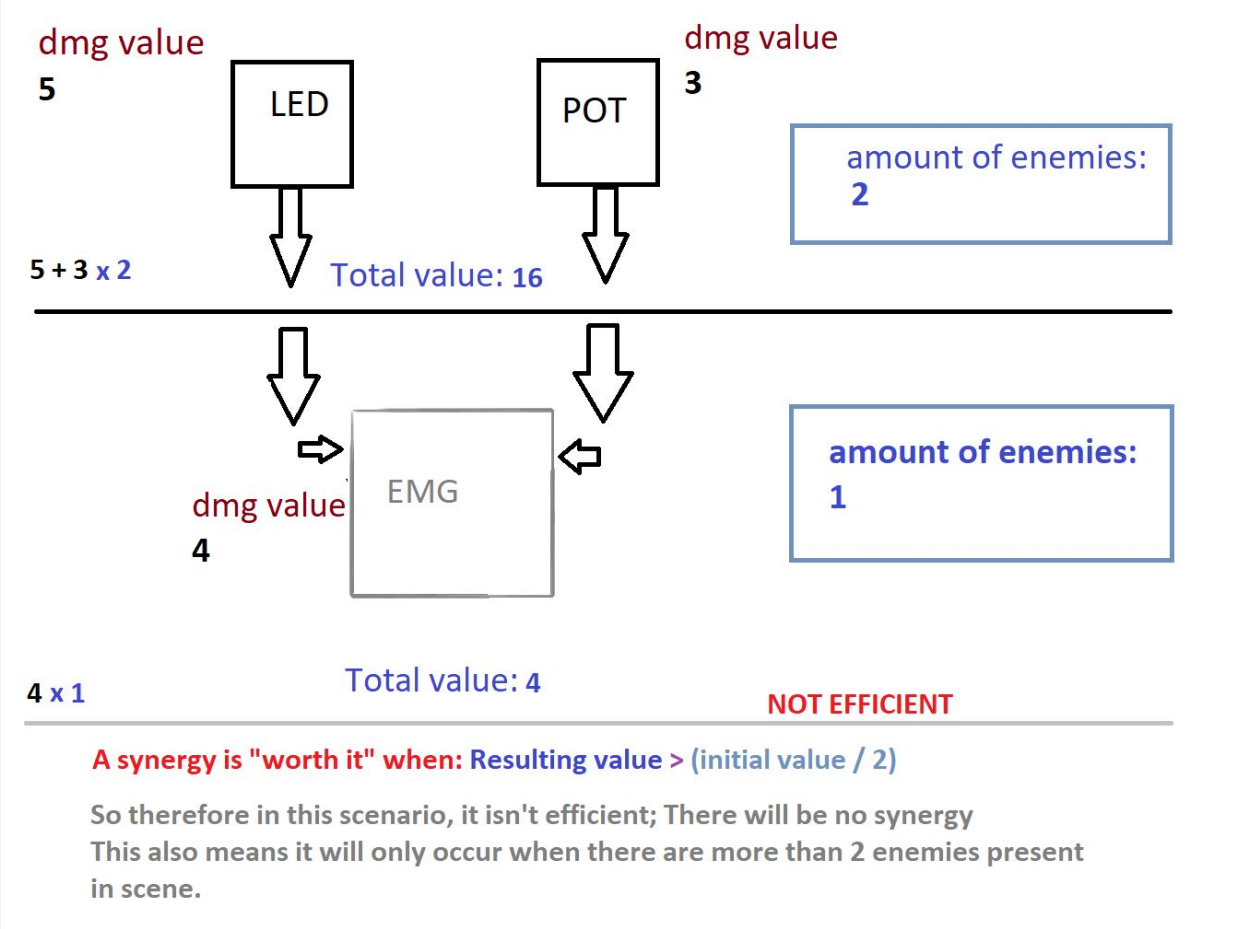
30-04-2019 (7 hours):
Implemented distinguishable AI for the EMG enemy (The third enemy type). Due to time constraints I will use this enemy as the Synergy combination of a LED + a Potmeter. If they desire, two of those NPCs will combine into one EMG NPC, approaching the player with a more swirl-based ranged attack.

*The **Synergy system** is based on this equation:*

***vI** = (Sum of all enemy power values in scene) * [Amount of enemies in scene]*

***vR** = (Sum of all enemy power values left in scene & the resulting synergy) * [Amount of enemies remaining in scene]*

*Synergy can happen when **vR > vI / 2***



Examples:

POT: 3

LED: 5

Amount of enemies: 2

Total: 16

===

EMG: 4

Amount of enemies: 1

Total: 4
(NOT EFFICIENT)
---

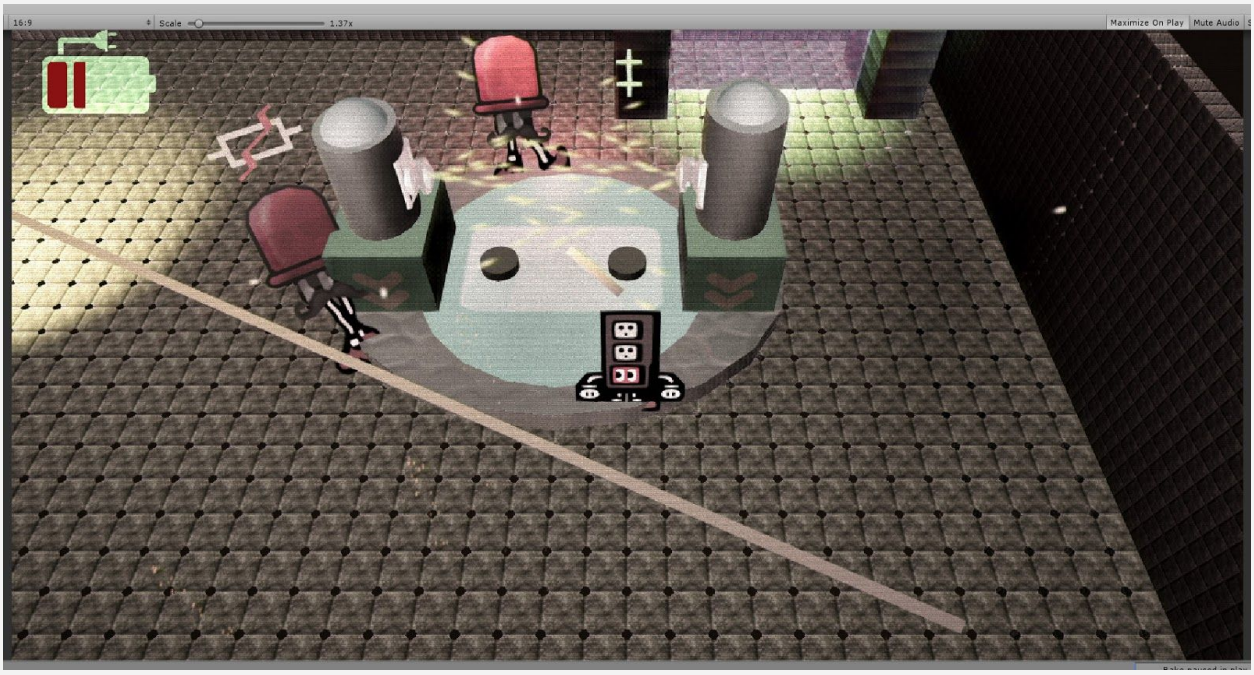
1 POT: 3
2 LED: 10
Amount of enemies: 3
Total: 39
=====
LED: 5
EMG: 4
Amount of enemies: 2
Total: 18
(NOT EFFICIENT)
----

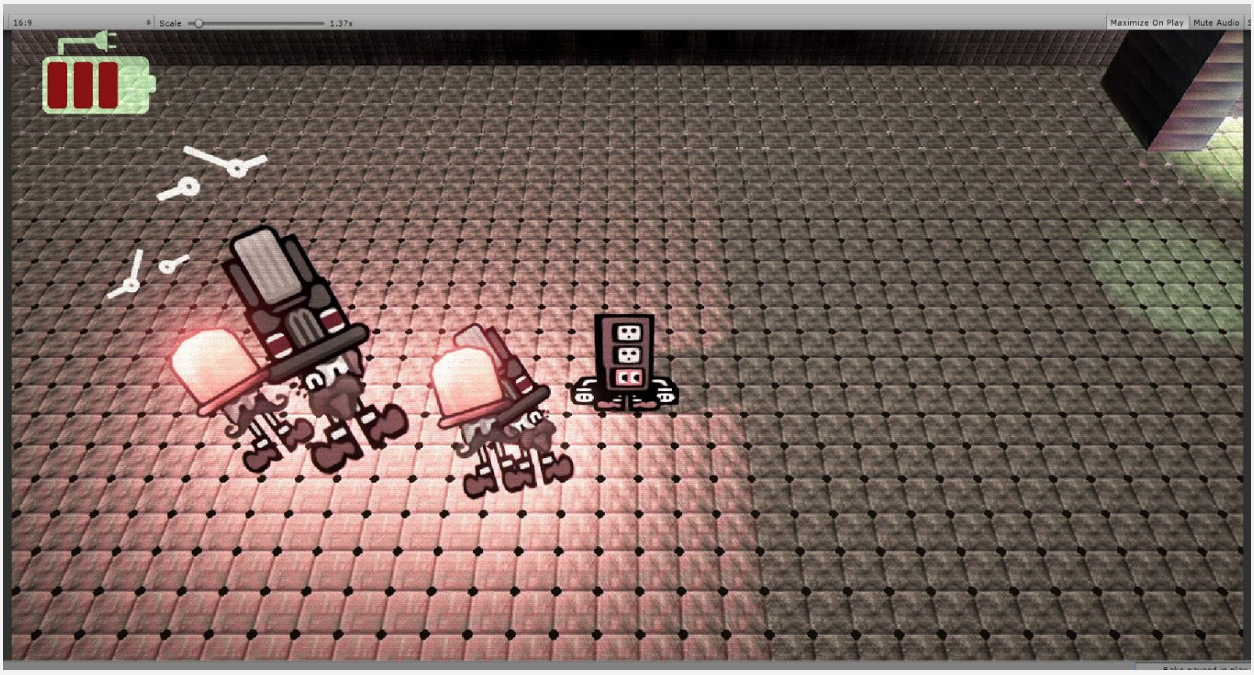
3 POT: 9
4 LED: 20
Amount: 7
Total: 203
=====
2 POT: 6
3 LED: 15
1 EMG: 4
Amount: 6
Total: 150
(EFFICIENT)
-----

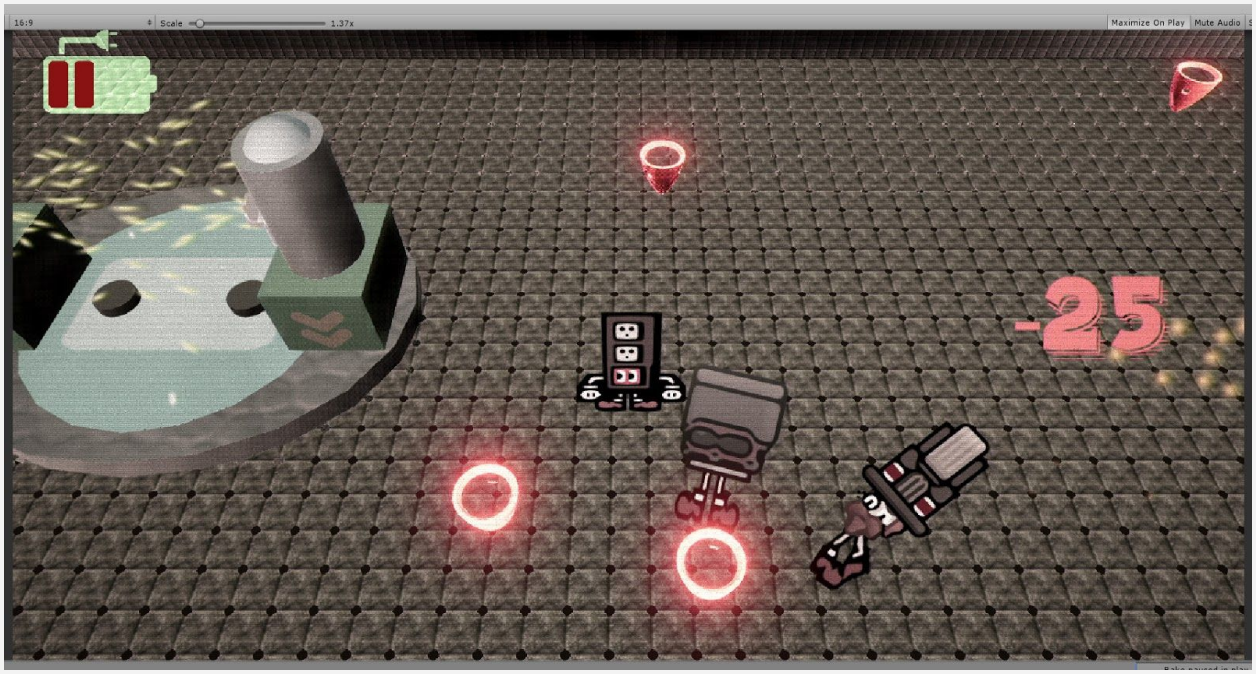
2 LED: 10
2 POT: 6
Amount: 4
Total: 64
====
1 LED: 5
1 POT: 3

1 EMG: 4
Amount: 3
Total: 36
(EFFICIENT)

01-05-2019 (8 hours):
Synergy system now fully works. Finalising prototype of project.






16:9
Scale
1.37x
Maximize On Play
Mute Audio
-25

Inspirations

- F.E.A.R (Goal oriented action planning of the enemies)
- SCP - Containment Breach (Various SCP AI)
- Cuphead (Walt Disney Cartoon-ish style)
- Enter the gungeon
- Nuclear Throne
- Binding of Isaac
- Ikaruga (Bullet hell game w/ polarity of lasers)
https://www.youtube.com/watch?v=MivqpCN-AsE&t=342s

https://www.fortressofdoors.com/doing-an-hd-remake-the-right-way/

https://www.youtube.com/watch?v=tlk6-Qyz70w
https://www.youtube.com/watch?v=yy8zZyxB-ZA
https://www.youtube.com/watch?v=A-Y4kNCxUEU&t=4s **(Visual FX / Hack n Slash)**

Research

Quick mind candy:
https://www.youtube.com/watch?v=p4KqryLMseQ

Goal oriented action planning shooter Ai in Unity
https://www.youtube.com/watch?v=lPW6q31dLOU

Menace System AI Alien: Isolation
https://www.youtube.com/watch?v=Nt1XmiDwxhY

Evolution simulator
https://www.youtube.com/watch?v=GOFws_hhZs8

Potential Fields
https://www.youtube.com/watch?v=3cOAwv1LCIA

Motion Planning (Robotics)
https://en.wikipedia.org/wiki/Motion_planning

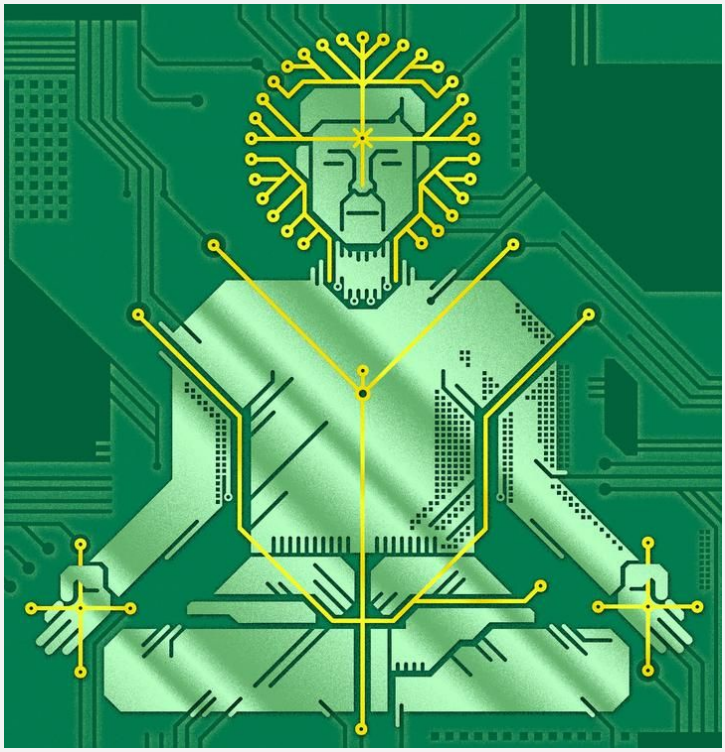
What makes good AI?
https://www.youtube.com/watch?v=9bbhJi0NBkk

SCP-079 Overhead AI Behavior (SCP-Containment Breach)
https://scpcb.gamepedia.com/SCP-079
While the remote door control system is on, SCP-079 will sometimes open and close doors, indicated by a certain high-pitched whine that plays. This can be inconvenient and sometimes hazardous if the player is trying to elude a hostile SCP. SCP-079 will also open the door to SCP-012's containment chamber when the player approaches it in an attempt to kill them. If the player enters the large testing chamber and attempts to pick up SCP-682's document in the center of the chamber, SCP-079 will release gas from the ceiling and say via intercom, *"You're not getting out."*. SCP-079 will also open the doors to Dr. L.'s Office when the player approaches it.

Upscale filters for sprites
https://www.fortressofdoors.com/doing-an-hd-remake-the-right-way/

Behavior Tree Research
https://en.wikipedia.org/wiki/Behavior_tree_(artificial_intelligence,_robotics_and_control)
https://hub.packtpub.com/building-your-own-basic-behavior-tree-tutorial/
http://www.gamasutra.com/blogs/ChrisSimpson/20140717/221339/Behavior_trees_for_AI_How_they_work.php
https://www.youtube.com/watch?v=NU717sd8oUc


ABSOLARE




ALLNIC


SALE
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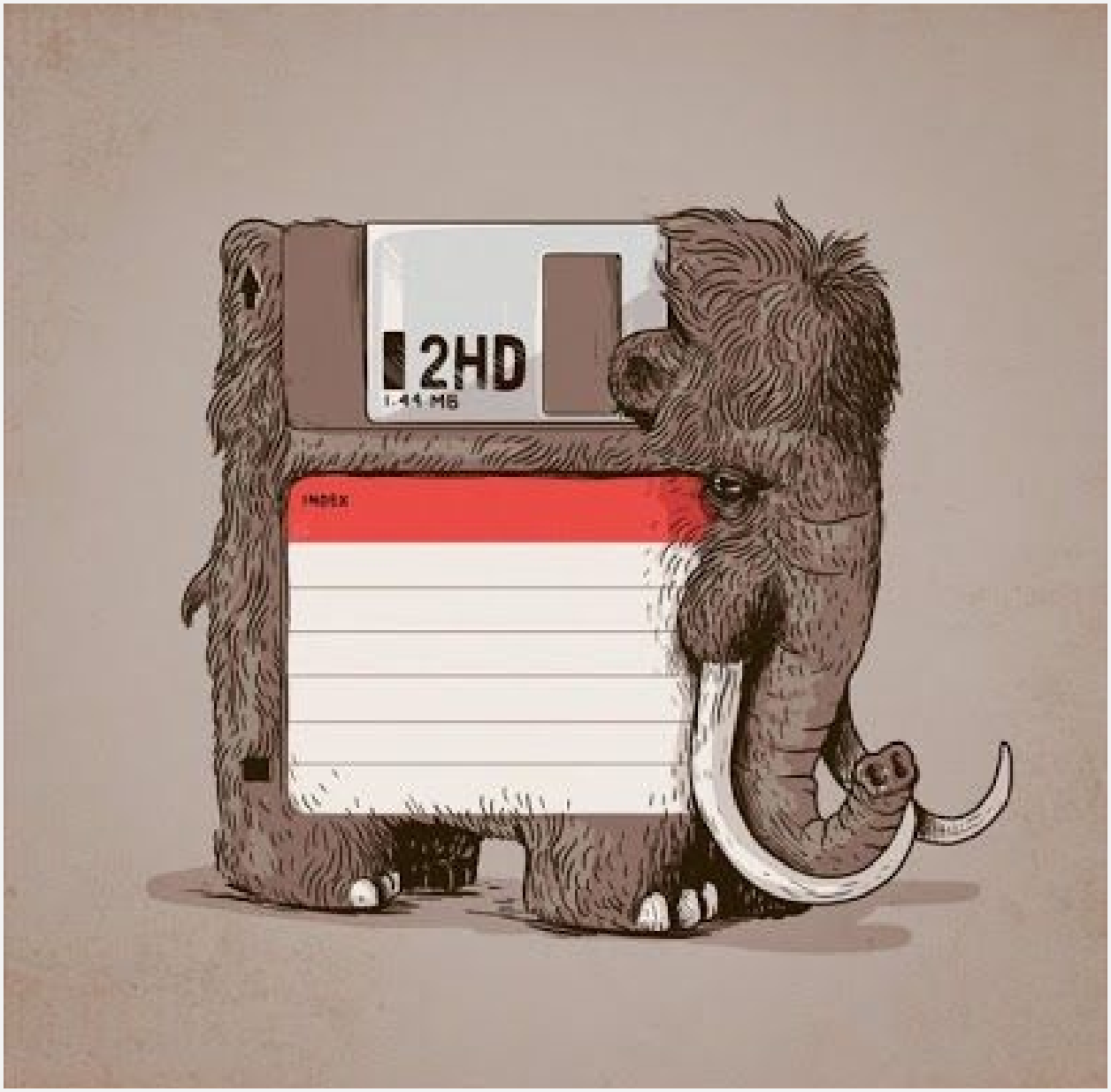
9975
7
8650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“THE WHITEBOARD TEST”

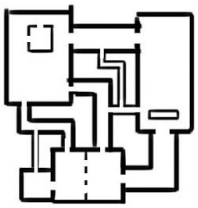
Level designers aspiring to work in the game industry are often asked to perform a “whiteboard test” – to sketch out a first person multiplayer level and explain it.

Below are some examples, and what they might say about you. (To “pass”, you might have to be able to sketch at Advanced or Expert level)

A lot of this “progression” is tied to advances in CPU and GPU power. **Also, I’m not saying the right-most is the best level, but it’d be the most “well-crafted.”**

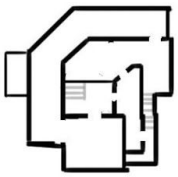
BEGINNER
over-complicated structureless mess, has probably never tried to build this in a level editor tool, no clear flow or differentiation... no attempt to break lines of sight, no really discernable patterns

scrawled on the back of your history textbook during algebra class



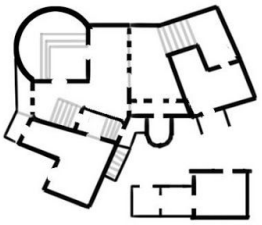
INTERMEDIATE
understands design theory but applies it very literally... very boxy floorplan that unimaginatively breaks line of sight, results in “room-hallway-room” syndrome... maybe you’re an avid modder or a student with a lot of talent and potential, but you still need a lot more practice

huge Half-Life 1 Deathmatch levels your first Natural Selection map



ADVANCED
simpler, more memorable floorplan, good use of patterns, good mix of narrow vs. open differentiation, and nice mix of height with stairs... but matchy-matchy 45 degree bends feel a lot like a “video game level” (though many designers and games would never really care about that)

graybox in a vacuum, probably sci-fi, Quake 3 levels, “pure gameplay”



EXPERT
meaningfully breaks from grid, clear research of real-life buildings, imbues spatial differentiation with cultural differentiation, “tells a story”, careful use of symmetry... still relatively simple and memorable floorplan, still breaks line of sight... still a “video game level” but it has non-abstract internal logic to it

an Uncharted 4 level, recent CS:GO maps, usually anything overtly concerned with a narrative aesthetic of photorealism and an art budget to go for it

“The Whiteboard Test” by Robert Yang (@radiatoryang) www.debacle.us