GDC

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Fixing Bugs by Cloning Them in The Last Clockwinder

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Hi! I'm Matt Blair.

Founder at Pontoco

- Game design
- Engineering
- Management













How did we pull this off with just two (part time) engineers?



Input Replay system

- All bugs reproducible
- Fast iteration time in VR
- Automated gameplay testing
- Debug hardware issues without the hardware





Part 1: Fulfilling the gameplay promise

Part 2: Turning the mechanic into the workflow



Part 1:

Fulfilling the gameplay promise



The Promise of Clockwinder

- Puzzle-automation game with looping clones
- Mechanic should be as generous as possible
- Clones reproduce the player's actions perfectly, every time

"If I can do something, then my clone can do it too" *

* = Some terms and conditions may apply





Cloning Strategy

Two paths:

- 1. Record player actions and apply them like an animation
 - Only process necessary data
- 2. Record player *inputs* and simulate the resulting actions
 - No need to define which data is necessary Ο



Cloning Strategy







Cloning: Inputs

Unity InputSystem package

https://github.com/Pontoco/InputSystem/tree/asg/v1.4.2







Cloning: Inputs

Recording inputs



Input Recording File



Cloning: Inputs

Replaying inputs



Input Device (fake)



Cloning Strategy







Cloning: Actions

PlayerRig

- Player logic
- Physics colliders
- Interaction triggers

ClonePlayerRigClone meshAnimators

RealPlayerRig

- Camera
- Teleport Tool
- Cloning Tool
- Inventory



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Cloning: Actions

When the player is able to do something, clones are able to do it by default.



Cloning Strategy







Cloning: Outcomes

What makes clones not do the same thing as the player? Anything that is not part of the recorded inputs.



Cloning Strategy



"trigger button pressed"

"start hand grab"

"fruit is grabbed"





Cloning: Outcomes





Cloning: Outcomes

Can we record frame times?

No, because we have to update many clones in the same frame.

• All clones recorded and replayed at the same, fixed frame rate.

• All game logic goes in FixedUpdate. 🦀



Cloning Strategy



"trigger button pressed"

"start hand grab"

"fruit is grabbed"





Cloning: Outcomes

Outcome of certain collisions depends on physics engine state.

For important collisions, skip physics and use a custom solver.





Cloning Strategy



"trigger button pressed"

"start hand grab"

"fruit is grabbed"









The Promise of Clockwinder

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The mechanic becomes the workflow







Session Replay

We can extend replays to the entire development workflow.



Session Replay

Everything just worked!

... just kidding.



Session Replay: Challenges

- Replays need to start with the exact same saved data.
 - Add tools for copying and overriding save data.



Session Replay: Challenges

- Replaying a full game session takes a long time.
 - Add fast-forward modes to session replay.



Session Replay: Challenges

- Loading scenes takes variable time. •
 - Record number of loading frames, then simulate same number of frames during replay.



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- No more phantom bugs!
 - If we have replay data, we can see the bug again.
 - We can replay the session again to verify the fix.



- Fast iteration on features!
 - Record a session where you play the part you're working on.
 - Replay that session over and over as you iterate.

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- Recordings become automated tests!
 - Record a player doing a sequence of actions.
 - Replay the recording in the test runner to verify the outcome.



- Simulate devices that we don't actually have!
 - Get a remote player to capture a session recording on their hardware.
 - Replay that session on our own machines and simulate any problems that are occurring with the different hardware.



There are some *ighter to deal with.*



Sessions must be replayed from the beginning.

Jump to points in the recording using state snapshots (DOTS)

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Outcome of collisions depends on physics engine state.

Use UnityPhysics package



All game logic must occur in FixedUpdate.

Record time with input frames, apply recorded time during replay.

(If you know how to make Unity do this, let's talk!)



Use this in more games!

(i.e. your games)



Art of 'The Last Clockwinder': Visual Cohesion Anita Tung, Wednesday@10:30am

"Stuck in a Loop": Designing the Clones of 'The Last **Clockwinder'**

John Austin, Thursday@5:30pm



Thank you!

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Interested in what we're doing next? https://pontoco.com/jobs



