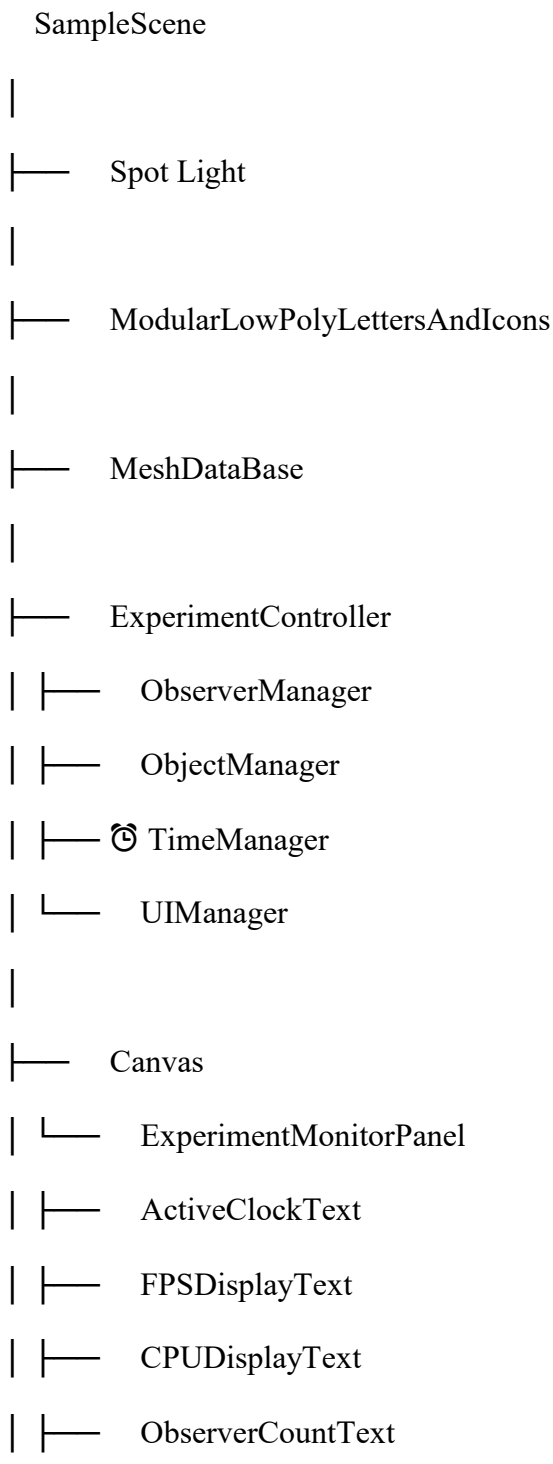
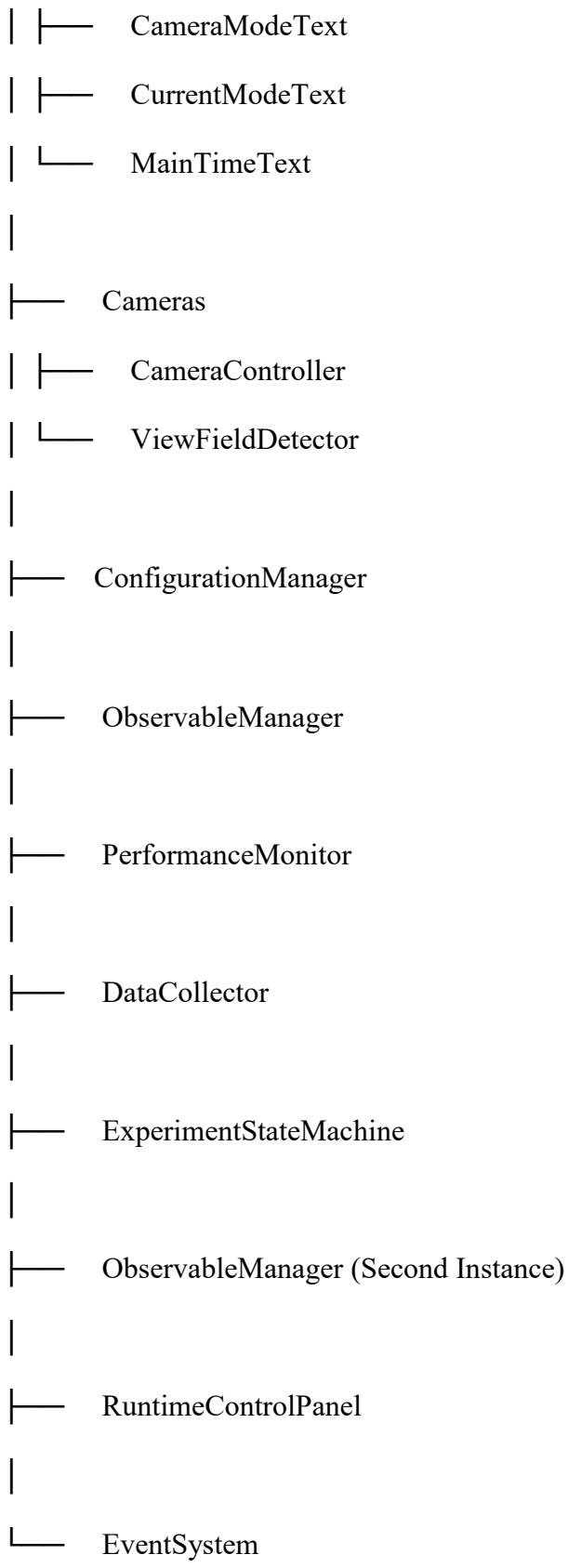
Unity Lazy Update Experimental Architecture Setup Manual - Complete Version

Scene Hierarchy

SampleScene





Core Component Detailed Configuration

1. ExperimentController (Main Experiment Controller)

Transform:

- Position: (0, 0, 0)
- Rotation: (0, 0, 0)
- Scale: (1, 1, 1)

ExperimentController (Script):

System Manager References:

├── Time Manager: TimeManager (Time Manager)

├── Object Manager: ObjectManager (Object Manager)

├── Observer Manager: ObserverManager (Observer Manager)

├── Observable Manager: ObservableManager (Observable Manager)

├── Configuration Manager: ConfigurationManager (Configuration Manager)

├── State Machine: ExperimentStateMachine (Experiment State Machine)

├── UI Manager: UIManager (UI Manager)

├── Camera Controller: CameraController (Camera Controller)

├── Performance Monitor: PerformanceMonitor (Performance Monitor)

├── Runtime Control Panel: RuntimeControlPanel (Runtime Control Panel)

└── Data Collector: DataCollector (Data Collector)

Experiment State:

├── Current Mode: Traditional

└── Is Experiment Running: [Based on runtime state]

Debug Mode Settings:

├── Debug Mode Enabled: [Configurable]

├── Debug Clock Count: 65536

├── Debug Add Clock Count: 500

└── Clock Spacing: 2.5

2. ObserverManager

ObserverManager (Script):

Configuration:

├── Observer Prefab: Observer

├── Experiment Controller: ExperimentController (Experiment Controller)

├── Observer Spacing: 5

├── Observer Y Position: 5

├── Selected Color: [Green]

└── Normal Color: [Default Color]

3. ObjectManager

ObjectManager (Script):

Basic Configuration:

├── Clock Prefab: Clock Variant

├── Clock Container: None (Transform)

└── Number Database: MeshDatabase (Clock Number Database)

Generation Configuration:

├── Spacing: 4

Cumulative Information (Read-only):

├── Total Clock Count: 0

├── Active Clock Count: 0

└── Next Clock Start Time: 0

System References (Configurable):

├── Time Manager: TimeManager (Time Manager)

├── Configuration Manager: ConfigurationManager (Configuration Manager)

├── UI Manager: UIManager (UI Manager)

├── Observer Manager: ObserverManager (Observer Manager)

└── View Field Detector: ViewFieldDetector (View Field Detector)

4. ⏰ TimeManager

TimeManager (Script):

Main Timeline:

├── Is Experiment Running: [Runtime State]

├── Is Paused: [Pause State]

└── Main Time: 0

Mode Time Records:

├── Traditional Mode Total Time: 0

├── Lazy Mode Total Time: 0

└── Current Mode Start Time: 0

Mode Switch History:

└── Mode Switch History: [List is empty]

5. UIManager

UIManager (Script):

Main Panels:

├── Configuration Panel: None (Game Object)

├── Ready Panel: None (Game Object)

├── Performance Panel: None (Game Object)

├── Comparison Panel: None (Game Object)

├── Warning Panel: None (Game Object)

├── Control Panel: None (Game Object)

└── Canvas: Canvas

Runtime Control:

├── Runtime Control Panel: None (Runtime Control Panel)

├── Add Confirmation Dialog Panel: None (Game Object)

└── Confirmation Dialog Prefab: None (Game Object)

Experiment Monitor Panel:

└── Experiment Monitor Panel: ExperimentMonitorPanel

Core Monitor Display:

├── Main Time Text: MainTimeText (Text Mesh Pro UGUI)

├── Active Clock Text: ActiveClockText (Text Mesh Pro UGUI)

├── Observer Count Text: ObserverCountText (Text Mesh Pro UGUI)

├── Current Mode Text: CurrentModeText (Text Mesh Pro UGUI)

├── Fps Display Text: FPSDisplayText (Text Mesh Pro UGUI)

├── Cpu Display Text: CPUDisplayText (Text Mesh Pro UGUI)

└── Camera Mode Text: CameraModeText (Text Mesh Pro UGUI)

Mode Switch Control:

├── Mode Switch Button: None (Button)

└── Pause Resume Button: None (Button)

Comparison Panel Components:

├── Traditional FPS Text: None (Text Mesh Pro UGUI)

├── Traditional CPU Text: None (Text Mesh Pro UGUI)

├── Traditional Update Rate: None (Text Mesh Pro UGUI)

├── Lazy FPS Text: None (Text Mesh Pro UGUI)

├── Lazy CPU Text: None (Text Mesh Pro UGUI)

├── Lazy Update Rate Text: None (Text Mesh Pro UGUI)

├── Fps Gain Text: None (Text Mesh Pro UGUI)

├── Cpu Saved Text: None (Text Mesh Pro UGUI)

└── Efficiency Ratio Text: None (Text Mesh Pro UGUI)

Other UI Components:

├── Fps Bar: None (Image)

├── Cpu Bar: None (Image)

├── Pause Button: None (Button)

├── Switch Mode Button: None (Button)

├── Reset Button: None (Button)

├── Save Data Button: None (Button)

├── Pause Button Text: None (Text Mesh Pro UGUI)

├── Tooltip Text: None (Text Mesh Pro UGUI)

├── Confirmation Message: None (Text Mesh Pro UGUI)

├── Confirm Add Button: None (Button)

├── Cancel Add Button: None (Button)

├── Objects In View Text: None (Text Mesh Pro UGUI)

└── Pending Updates Text: None (Text Mesh Pro UGUI)

System References:

├── Time Manager: TimeManager (Time Manager)

├── Object Manager: ObjectManager (Object Manager)

├── Observer Manager: ObserverManager (Observer Manager)

├── Experiment Controller: ExperimentController (Experiment Controller)

├── Performance Monitor: PerformanceMonitor (Performance Monitor)

└── Camera Controller: CameraController (Camera Controller)

6. Canvas

Canvas Component:

- Render Mode: Screen Space - Overlay
- Pixel Perfect: ☐
- Sort Order: 0
- Target Display: Display 1

- Additional Shader Channels: Nothing

Canvas Scaler:

- UI Scale Mode: Constant Pixel Size
- Scale Factor: 1
- Reference Pixels Per Unit: 100

Graphic Raycaster:

- Ignore Reversed Graphics: ☑
- Blocking Objects: None
- Blocking Mask: Everything

7. ExperimentMonitorPanel

Rect Transform:

- Pos: (100, -100, 0)
- Size: (100, 100)
- Anchors: (0.5, 0.5)
- Pivot: (0.5, 0.5)
- Scale: (1, 1, 1)

Vertical Layout Group:

- Padding: 50
- Spacing: 50
- Child Alignment: Upper Left
- Control Child Size: Width ☑, Height ☑
- Use Child Scale: Width ☑, Height ☑
- Child Force Expand: Width ☑, Height ☑

8. UI Text Components (TextMeshPro)

Common Configuration for All Text Components:

- Font Asset: LiberationSans SDF (TMP_Font Asset)
- Material Preset: LiberationSans SDF Material
- Font Style: B I U S ab AB SC
- Font Size: 36
- Auto Size: ☐
- Vertex Color: White
- Character Spacing: 0
- Word Spacing: 0

9. CameraController

Transform:

- Position: (0, 0, 10)
- Rotation: (0, -180, 0)
- Scale: (1, 1, 1)

Camera Component:

- Clear Flags: Skybox
- Background: [Sky Blue]
- Culling Mask: Everything
- Projection: Perspective
- FOV Axis: Vertical
- Field of View: 60
- Physical Camera: ☐
- Clipping Planes: Near 0.3, Far 10
- Viewport Rect: X 0, Y 0, W 1, H 1
- Depth: 0
- Rendering Path: Use Graphics Settings
- Target Texture: None (Render Texture)
- Occlusion Culling: ☑
- HDR: Use Graphics Settings
- MSAA: Use Graphics Settings
- Allow Dynamic Resolution: ☐
- Target Display: Display 1

CameraController (Script):

Camera Mode:

└── Current Mode: External Observer

Movement Control:

├── Move Speed: 10

├── Speed Multiplier: 2

└── Move Smoothing: 0.1

Zoom Control:

├── Zoom Speed: 0.1

├── Min Ortho Size: 5

└── Max Ortho Size: 50

Field of View Detection Settings:

├── Detection Interval: 0.1

└── Show Viewport Border: ☑

Visual Feedback:

├── Viewport Border: None (Line Renderer)

├── Spectator Border Color: [Green]

└── Observer Border Color: [Green]

10. ViewFieldDetector

Transform:

- Position: (0, 0, 0)
- Rotation: (0, 0, 0)
- Scale: (1, 1, 1)

Box Collider:

- Edit Collider: [Editable]
- Is Trigger: ☑
- Provides Contacts: ☐
- Material: None (Physic Material)
- Center: (0, 0, 10)
- Size: (0, 0, 0)
- Layer Overrides: [Configure Layers]

Rigidbody:

- Mass: 1
- Drag: 0
- Angular Drag: 0.05
- Automatic Center Of Mass: ☑
- Automatic Tensor: ☑
- Use Gravity: ☑
- Is Kinematic: ☐
- Interpolate: None
- Collision Detection: Discrete
- Constraints: [No Constraints]

View Field Detector (Script):

Debug Settings:

├── Show Debug Info: ☐

└── Detected Clock Color: [Green]

11. ConfigurationManager

ConfigurationManager (Script):

Current Configuration State:

└── Current State: [State Value]

Preset Configuration:

└── Presets: 3

Configuration Limits:

├── Max Clock Count: 10000

├── Max Observer Count: 10

└── Default Spacing: 2.5

System References:

├── Object Manager: ObjectManager (Object Manager)

├── Observer Manager: ObserverManager (Observer Manager)

├── UI Manager: UIManager (UI Manager)

└── State Machine: ExperimentStateMachine (Experiment State Machine)

12. PerformanceMonitor

PerformanceMonitor (Script):

Monitor Settings:

├── Enable Monitoring: ☑

├── Update Interval: 0.5

├── Fps Sample Size: 60

└── Show Debug Info: ☐

Performance Thresholds:

├── Low FPS Threshold: 30

├── High CPU Threshold: 80

└── High Memory Threshold: 1000

Performance Events:

├── Enable Performance Events: ☑

├── Performance Events: 0

└── Max Event History: 100

CPU Monitor Settings:

├── Default Target FPS: 60

├── Base CPU Usage: 20

└── Cpu Smoothing Factor: 0.3

System References:

├── Data Collector: DataCollector (Data Collector)

└── UI Manager: UIManager (UI Manager)

13. DataCollector

DataCollector (Script):

Data Collection Configuration:

├── Recording Duration: 10

└── Snapshot Interval: 0.1

Current State:

├── Is Recording: ☐

├── Recording Progress: 0

├── Current Clock Count: 0

└── Current Recording Mode: Traditional

System References:

├── Experiment Controller: ExperimentController (Experiment Controller)

├── Performance Monitor: PerformanceMonitor (Performance Monitor)

├── Object Manager: ObjectManager (Object Manager)

├── UI Manager: None (UI Manager)

└── Time Manager: TimeManager (Time Manager)

14. ExperimentStateMachine

ExperimentStateMachine (Script):

Current State:

├── Current State: Initialization

├── Previous State: Initialization

└── State Enter Time: 0

State History:

└── State History: 0

State Events:

├── On State Changed (ExperimentState, ExperimentState)

│ └── List is empty

│

├── On Configuration Entered ()

│ └── List is empty

│

├── On Ready Entered ()

│ └── List is empty

│

├── On Running Entered ()

│ └── List is empty

│

├── On Paused Entered ()

│ └── List is empty

│

└── On Data Collection Entered ()

└── List is empty

System References:

├── UI Manager: UIManager (UI Manager)

├── Configuration Manager: ConfigurationManager (Configuration Manager)

├── Experiment Controller: ExperimentController (Experiment Controller)

└── Performance Monitor: PerformanceMonitor (Performance Monitor)

15. ObservableManager (Second Instance)

ObservableManager (Script):

Update Statistics:

├── Frame Update Count: 0

├── Total Update Count: 0

├── Last Update Time: 0

└── Registered Object Count: 0

Performance Settings:

├── Max Updates Per Frame: 100

└── Enable Update Throttling: ☑

System References:

├── Object Manager: ObjectManager (Object Manager)

├── UI Manager: UIManager (UI Manager)

└── Performance Monitor: PerformanceMonitor (Performance Monitor)

16. RuntimeControlPanel

RuntimeControlPanel (Script):

Panel Control:

├── Panel Root: None (Game Object)

└── Overlay Background: None (Game Object)

Clock Adjustment:

├── Clock Adjust Input: None (TMP_Input Field)

├── Add Clocks Button: None (Button)

├── Remove Clocks Button: None (Button)

├── Current Clock Count Text: None (Text Mesh Pro UGUI)

└── Next Clock Time Text: None (Text Mesh Pro UGUI)

Quick Buttons:

├── Add 100 Button: None (Button)

├── Add 500 Button: None (Button)

├── Add 1000 Button: None (Button)

├── Remove 100 Button: None (Button)

└── Remove 500 Button: None (Button)

Observer Adjustment:

├── Observer Adjust Input: None (TMP_Input Field)

├── Add Observers Button: None (Button)

├── Remove Observers Button: None (Button)

└── Current Observer Count Text: None (Text Mesh Pro UGUI)

Control Buttons:

├── Continue Experiment Button: None (Button)

├── Apply Changes Button: None (Button)

└── Cancel Button: None (Button)

State Display:

├── Status Text: None (Text Mesh Pro UGUI)

└── Pending Changes Text: None (Text Mesh Pro UGUI)

System References:

├── Configuration Manager: ConfigurationManager (Configuration Manager)

├── Object Manager: ObjectManager (Object Manager)

├── Observer Manager: ObserverManager (Observer Manager)

├── Experiment Controller: ExperimentController (Experiment Controller)

├── State Machine: ExperimentStateMachine (Experiment State Machine)

└── UI Manager: UIManager (UI Manager)

Setup Steps in Detail

Step 1: Basic Scene Configuration

1. Create new Unity scene (Unity 2022.3.6f1)
2. Add Spot Light source
3. Set scene background color

Step 2: Core Controller Setup

1. Create ExperimentController empty object
2. Add ExperimentController script
3. Create four child objects and add corresponding scripts:

- ObserverManager → ObserverManager.cs
- ObjectManager → ObjectManager.cs
- TimeManager → TimeManager.cs
- UIManager → UIManager.cs

Step 3: UI System Setup

1. Create Canvas (automatically creates EventSystem)
2. Set Canvas to Screen Space - Overlay
3. Create ExperimentMonitorPanel child panel
4. Add Vertical Layout Group component
5. Create seven TextMeshPro child objects

Step 4: Camera System Configuration

1. Create Cameras parent object
2. Add CameraController and Camera components
3. Create ViewFieldDetector child object
4. Add Box Collider (Is Trigger) and Rigidbody

5. Configure ViewFieldDetector script

Step 5: Manager Component Settings

1. Create individual Manager objects
2. Add corresponding script components
3. Establish reference relationships in ExperimentController

Step 6: Reference Relationship Configuration

1. Drag all Managers to corresponding fields in ExperimentController
2. Drag UI Text components to UIManager
3. Configure cross-references between Managers

Key Configuration Points

Required Settings

1. **ViewFieldDetector's Collider must be set to Is Trigger**
2. **All Text components must use TextMeshPro**
3. **CameraController needs Camera component as well**
4. **ExperimentController must correctly reference all Managers**

Performance Optimization Suggestions

- Set ObservableManager's Max Updates Per Frame to 100
- Keep Enable Update Throttling enabled
- Set Detection Interval to 0.1 seconds

Debug Tips

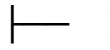
- Enable Debug Mode Enabled to see detailed logs
- Show Debug Info displays field of view detection information
- Show Viewport Border visualizes detection range

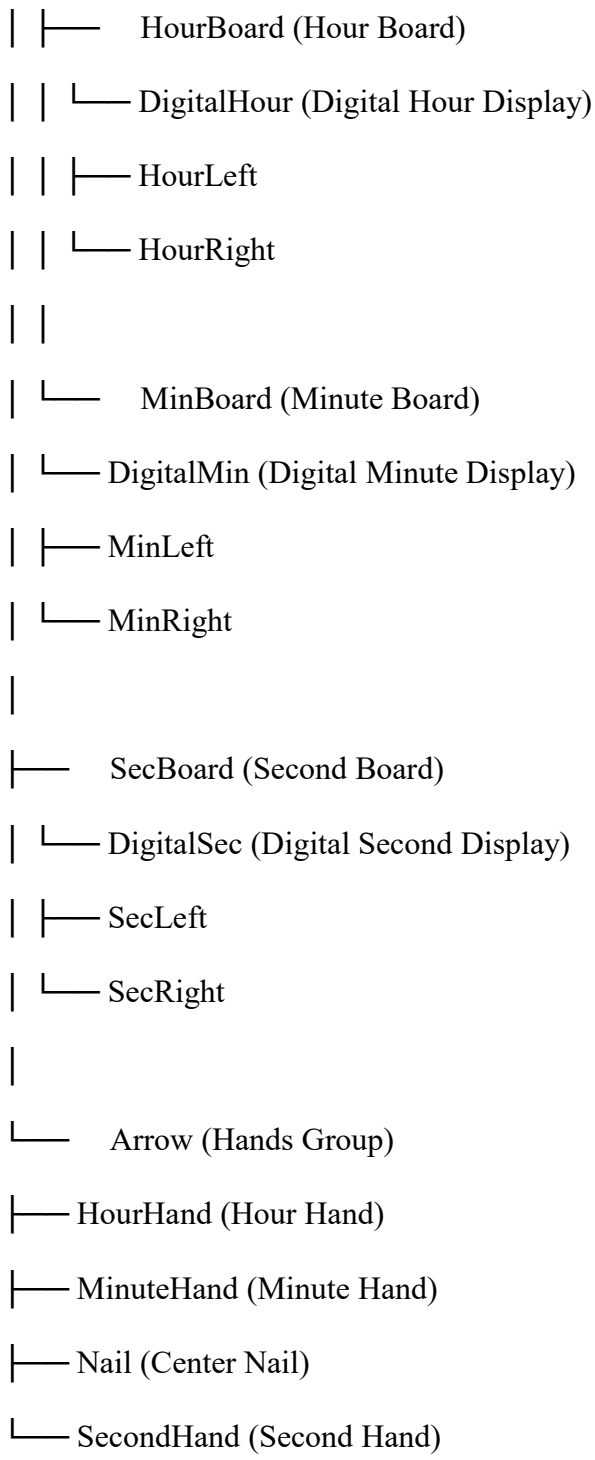
Clock Variant Prefab Detailed Configuration

Clock Variant Prefab Structure

Layer: TransparentFX
Prefab Source: Clock Free Asset (Asset Store)
Asset Link: https://assetstore.unity.com/packages/3d/props/interior/clock-free-44164

Clock Variant





Clock Variant Root Object Configuration

Transform:

- Position: (0, 0, 0)
- Rotation: (0, 0, 0)
- Scale: (10, 10, 10)

Sphere Collider:

- Is Trigger: ☑
- Center: (0, 3.576279e-08, -0.000977242)
- Radius: 0.1785129
- Layer Overrides: [None]

Clock Script Component Configuration

Clock Basic Information (Shared):

├── Clock Id: -1

├── Initial Time In Seconds: 0

└── Current Mode: Traditional

Traditional Mode Dataset:

└── Traditional State

├── Hour: 0

├── Minute: 0

└── Second: 0

Lazy Mode Display (Calculated from Main Time):

├── Hour: 0

├── Minute: 0

└── Second: 0

Lazy Mode State (Derived from Observable Record State):

└── Lazy State

├── Hour: 0

├── Minute: 0

└── Second: 0

Display Time:

├── Hour: 0

├── Minute: 0

└── Second: 0

Observable Record State Cache:

├── Current State Second: 0

├── Display Seconds: 0

├── Last Observe Time: 0

└── Time Elapsed: 0

Function State:

├── Has Evolution Function: ☐

└── Has Apply Function: ☐

Visual Components:

├── Pointer Seconds: SecondHand

├── Pointer Minutes: MinuteHand

└── Pointer Hours: HourHand

Digital Display Meshes:

├── Hourleft: HourLeft (Mesh Filter)

├── Hourright: HourRight (Mesh Filter)

├── Minuteleft: MinLeft (Mesh Filter)

├── Minuteright: MinRight (Mesh Filter)

├── Secondleft: SecLeft (Mesh Filter)

└── Secondright: SecRight (Mesh Filter)

Runtime State:

├── Is Active: ☐

└── Experiment Started: ☐

Child Object Detailed Configuration

Face (Clock Face)

Transform: Position (0, 0, 0)
Mesh Filter: Clock2
Mesh Renderer: Material - Clock

HourBoard (Hour Board)

Transform: Position (0.05, 0.03, 0)
Mesh Filter: Cube
Mesh Renderer: Material - Default-Material

HourHand (Hour Hand)

Transform: Position (5.627e-08, 7.848e-06, 0.1), Scale (1000, 1000, 1000)
Mesh Filter: HourHand
Mesh Renderer: Material - ArrowWhite

MinuteHand (Minute Hand)

Transform: Position (5.620e-08, 6.392e-05, 0.1), Scale (1000, 1000, 1000)
Mesh Filter: MinuteHand
Mesh Renderer: Material - ArrowWhite

SecondHand (Second Hand)

Transform: Position (4.307e-07, -1.716e-05, 0.1), Scale (1000, 1000, 1000)
Mesh Filter: SecondHand
Mesh Renderer: Material - ArrowWhite

Nail (Center Nail)

Transform: Position (4.862e-07, 4.133e-07, 0)
Mesh Filter: Nail
Mesh Renderer: Material - Default-Material

Key Technical Points

1. **Layer Settings**: All clock objects are on TransparentFX layer for special rendering handling
2. **Collider Configuration**: Uses Sphere Collider as trigger for observation detection
3. **Scale Factor**: Root object scaled 10x, hands scaled 1000x to ensure proper display
4. **Material System**: Uses Clock, ArrowWhite, Default-Material materials
5. **Digital Display**: Shows different numbers by replacing Mesh Filter's mesh

Clock Update Mechanism

Traditional Mode:

- Updates all clock displays every frame directly

- Calculates and rotates hands in real-time

Lazy Mode:

- Updates only when observed
- Uses Observable Record State cache
- Calculates current time through evolution function

Observer Prefab Detailed Configuration

- **Purpose**: Acts as internal observers in the experiment, simulating the "perception" behavior of NPCs or other in-game entities. Its ray detection is the core mechanism for triggering lazy updates.
- **Layer**: Default

Observer Root Object Configuration

Transform:

- Position: (0.32, 4.2, 0)
- Rotation: (0, 0, 180)
- Scale: (5, 5, 5)

Icon.011 (Mesh Filter):

- Mesh: Icon.011

Mesh Renderer:

Materials: Element 0 - Default-Material

Lighting:

- Cast Shadows: On
- Receive Shadows: ☑
- Contribute Global Illumination: ☐

Probes:

- Light Probes: Blend Probes
- Reflection Probes: Blend Probes
- Anchor Override: None (Transform)

Additional Settings:

- Motion Vectors: Per Object Motion
- Dynamic Occlusion: ☑

Box Collider:

- Edit Collider: [Editable]
- Is Trigger: ☑
- Provides Contacts: ☐
- Material: None (Physic Material)
- **Center: (0.003613681, 0.01899362, 0)**
- **Size: (0.3182663, 0.4485726, 0)**
- Layer Overrides: [None]

Observer Controller Script Configuration

Movement Settings:

- Move Speed: 5

Rotation Settings:

- Rotation Speed: 120

Ray Settings:

Ray Distance: 20

Ray Color: [Green]

Ray Hit Color: [Yellow]

Ray Width: 0.1

Last Raycast Time: 0

Detection Information (Read-only):

Detected Clock Count: 0

Detected Clock Names: [List] 0

Detection Status: Not Detected

Runtime Control Hotkeys

Z - Generate Clock

M - Generate Observer

X - Start Experiment

G - Begin Data Collection

B - Switch Update Mode (Traditional/Lazy)

C - Add More Clocks

Tab - Switch Camera Mode

P - Pause/Resume

R - Reset Experiment

This manual corresponds to Unity Version: 2022.3.6f1 Complete project contains all necessary script files Clock resources from Unity Asset Store: Clock Free