

Video Link:

https://drive.google.com/file/d/1eWTmqgEpQQvIL_hNa8Tqb_c2Ta4VXH3W/view?usp=sharing

For milestone1, I implemented a button, a buttongroup, and several data driven menus to control the gameplay.

I initially added a new Sprite mesh class that extends Mesh. Similar to Textmesh, I drew a single quad with width and height passed

```
namespace PE {
namespace Components {

struct SpriteMesh : public Mesh
{
    PE_DECLARE_CLASS(SpriteMesh);

    // Constructor -----
    SpriteMesh(PE::GameContext &context, PE::MemoryArena arena, Handle hMyself) : Mesh([&context, arena, hMyself])
    {
        m_loaded = false;
    }

    virtual ~SpriteMesh(){}

    virtual void addDefaultComponents();

    PE_DECLARE_IMPLEMENT_EVENT_HANDLER_WRAPPER(do_GATHER_DRAWCALLS);
    virtual void do_GATHER_DRAWCALLS(Events::Event *pEvt);

    void loadFromSource_needsRC(const char *fileName, const char *techName, int &threadOwnershipMask, float width, float height);

    PrimitiveTypes::Float32 m_width, m_height;
    PrimitiveTypes::Bool m_loaded;
    Handle m_meshCPU;
};

}namespace Components; // namespace Components
```

```
52
53     PositionBufferCPU *pVB = mcpu.m_hPositionBufferCPU.getObject<PositionBufferCPU>();
54     TexCoordBufferCPU *pTCB = mcpu.m_hTexCoordBufferCPU.getObject<TexCoordBufferCPU>();
55     // ColorBufferCPU *pCB = mcpu.m_hColorBufferCPU.getObject<ColorBufferCPU>();
56
57     NormalBufferCPU *pNB = mcpu.m_hNormalBufferCPU.getObject<NormalBufferCPU>();
58     IndexBufferCPU *pIB = mcpu.m_hIndexBufferCPU.getObject<IndexBufferCPU>();
59     pVB->m_values.reset(capacity: 4 * 3); // 4 verts * (x,y,z)
60     pTCB->m_values.reset(capacity: 4 * 2);
61     pNB->m_values.reset(capacity: 4 * 3);
62     pIB->m_values.reset(capacity: 6); // 2 tris
63     // pCB->m_values.add(1.0f, 1.0f, 0);
64
65     pIB->m_indexRanges[0].m_start = 0;
66     pIB->m_indexRanges[0].m_end = 5;
67     pIB->m_indexRanges[0].m_minVertIndex = 0;
68     pIB->m_indexRanges[0].m_maxVertIndex = 3;
69
70     pIB->m_minVertexIndex = pIB->m_indexRanges[0].m_minVertIndex;
71     pIB->m_maxVertexIndex = pIB->m_indexRanges[0].m_maxVertIndex;
72
73     m_width = width;
74     m_height = height;
75
76     // float pixSizeX = 1.0f / 1280.0f;
77     // float pixSizeY = 1.0f / 720.f;
78
79     pVB->m_values.add(0, 0, 0); // top left
80     pVB->m_values.add(width / 16, 0, 0); // top right
81     pVB->m_values.add(width / 16, -height / 16, 0);
```

I drew a single quad that has 4 vertices and 2 triangles and scaled the vertex indices.

```
77     // float pixSizeY = 1.0f / 720.f;
78
79     pVB->m_values.add(0, 0, 0); // top left
80     pVB->m_values.add(width / 16, 0, 0); // top right
81     pVB->m_values.add(width / 16, -height / 16, 0);
82     pVB->m_values.add(0, -height / 16, 0);
83
84     pIB->m_values.add(0, 1, 2);
85     pIB->m_values.add(2, 3, 0);
86
87     pTCB->m_values.add(0, 0); // top left
88     pTCB->m_values.add(1, 0); // top right
89     pTCB->m_values.add(1, 1);
90     pTCB->m_values.add(0, 1);
91
92     pNB->m_values.add(0, 0, 0);
93     pNB->m_values.add(0, 0, 0);
94     pNB->m_values.add(0, 0, 0);
95     pNB->m_values.add(0, 0, 0);
96
97     if (!m_loaded)
98     {
99         // first time creating gpu mesh
100         loadFromMeshCPU_needsRC([&mcpu, [&] threadOwnershipMask);
101     }
```

Then I created a SpriteSceneNode similar to TextSceneNode. The background texture file, width and height gets passed in.

```
ButtonGroup.cpp SpriteMesh.h SpriteMesh.cpp SpriteSceneNode.h Array.h ButtonGroup.py WayPoint.py ButtonGroup.h Button.h
22 struct SpriteSceneNode : public SceneNode
23 {
24     PE_DECLARE_CLASS(SpriteSceneNode);
25
26     // Constructor -----
27     SpriteSceneNode(PE::GameContext &context, PE::MemoryArena arena, Handle hMyself);
28
29     virtual ~SpriteSceneNode() {}
30
31     void setSelfAndMeshAssetEnabled(bool enabled);
32
33     // Component -----
34
35     virtual void addDefaultComponents();
36
37     // Individual events -----
38
39     PE_DECLARE_IMPLEMENT_EVENT_HANDLER_WRAPPER(do_PRE_GATHER_DRAWCALLS);
40     virtual void do_PRE_GATHER_DRAWCALLS(Events::Event *pEvt);
41
42     virtual void loadFromSource_needsRC(const char *filename, UIElement::DrawType drawType, int &threadOwnershipMask, float width, float height);
43
44     UIElement::DrawType m_drawType;
45
46     float m_scale;
47     Handle m_hMySpriteMesh;
48     Handle m_hMySpriteMeshInstance;
49     float m_cachedAspectRatio;
50
51     bool m_canBeRecreated;
```

```
SpriteSceneNode::SpriteSceneNode(PE::GameContext &context, PE::MemoryArena arena, Handle hMyself)
: SceneNode(&context, arena, hMyself)
{
    m_cachedAspectRatio = 1.0f;
    m_scale = 1.0f;
    if (IRenderer* pS = context.getGPUScreen())
        m_cachedAspectRatio = float(pS->getWidth()) / float(pS->getHeight());
}

void SpriteSceneNode::addDefaultComponents()
{
    SceneNode::addDefaultComponents();
    // event handlers
    PE_REGISTER_EVENT_HANDLER(Events::Event_PRE_GATHER_DRAWCALLS, SpriteSceneNode::do_PRE_GATHER_DRAWCALLS);
}

void SpriteSceneNode::setSelfAndMeshAssetEnabled(bool enabled)
{
    setEnabled(enabled);

    if (m_hMySpriteMesh.isValid())
    {
        m_hMySpriteMesh.getObject<Component>->setEnabled(enabled);
    }
}
```

```

42
43
44 void SpriteSceneNode::loadFromSource_needsRC(const char *filename, UIElement::DrawType drawType, int &threadOwnershipMask, float width, float height)
45 {
46     m_drawType = drawType;
47
48     SpriteMesh *pSpriteMesh = NULL;
49     if (m_hMySpriteMesh.isValid())
50     {
51         pSpriteMesh = m_hMySpriteMesh.getObject<SpriteMesh>();
52     }
53     else
54     {
55         m_hMySpriteMesh = PE::Handle(dbgName: "SPRITEMESH", neededSize: sizeof(SpriteMesh));
56         pSpriteMesh = new(m_hMySpriteMesh) SpriteMesh([&m_pContext, m_arena, &m_hMySpriteMesh];
57         pSpriteMesh->addDefaultComponents();
58
59         m_pContext->getMeshManager()->registerAsset(m_hMySpriteMesh);
60
61         m_hMySpriteMeshInstance = PE::Handle(dbgName: "MeshInstance", neededSize: sizeof(MeshInstance));
62         MeshInstance *pInstance = new(m_hMySpriteMeshInstance) MeshInstance([&m_pContext, m_arena, &m_hMySpriteMeshInstance];
63         pInstance->addDefaultComponents();
64         pInstance->initFromRegisteredAsset(m_hMySpriteMesh);
65
66         addComponent(&m_hMySpriteMeshInstance);
67     }
68
69     PE::IRenderer::checkForErrors(situation: "");
70
71     const char *tech = 0;

```

```

PE::IRenderer::checkForErrors(situation: "");

const char *tech = 0;
if (drawType == UIElement::Overlay2D_3DPos || drawType == UIElement::Overlay2D)
    tech = "StdMesh_2D_Diffuse_A_RGBIntensity_Tech";
if (drawType == UIElement::InWorldFacingCamera)
    tech = "StdMesh_Diffuse_Tech";

pSpriteMesh->loadFromSource_needsRC(filename, tech, [&] threadOwnershipMask, width, height);
}

void SpriteSceneNode::do_PRE_GATHER_DRAWCALLS(Events::Event *pEvt)
{
    Events::Event_PRE_GATHER_DRAWCALLS *pDrawEvent = NULL;
    pDrawEvent = (Events::Event_PRE_GATHER_DRAWCALLS *) (pEvt);

    Matrix4x4 projectionViewWorldMatrix = pDrawEvent->m_projectionViewTransform;
    Matrix4x4 worldMatrix;

    if (!m_hMySpriteMeshInstance.isValid())
        return;

    SpriteMesh *pSpriteMesh = m_hMySpriteMesh.getObject<SpriteMesh>();

    if (m_drawType == UIElement::InWorldFacingCamera)
    {
        m_worldTransform.turnTo(&pDrawEvent->m_eyePos);

```

Then I created a Button file. The button takes a string and a filepath, a name, drawtype, width, height, and an onclick function.

```
Button(PE::GameContext& context, PE::MemoryArena arena, Handle hMyself, Events::Event_CREATE_BUTTON *pEvt);

virtual ~Button(){}

virtual void addDefaultComponents();

PE_DECLARE_IMPLEMENT_EVENT_HANDLER_WRAPPER(do_PRE_GATHER_DRAWCALLS);
virtual void do_PRE_GATHER_DRAWCALLS(Events::Event *pEvt);

virtual void setSelfAndMeshAssetEnabled(bool isActive);

// void loadFromString_needsRC(const char *str, DrawType drawType, int &threadOwnershipMask);

void createTextSceneNode(const char *str, DrawType drawType, int &threadOwnershipMask);
void createSpriteSceneNode(const char *bgFile, DrawType drawType, int &threadOwnershipMask, float width, float height);

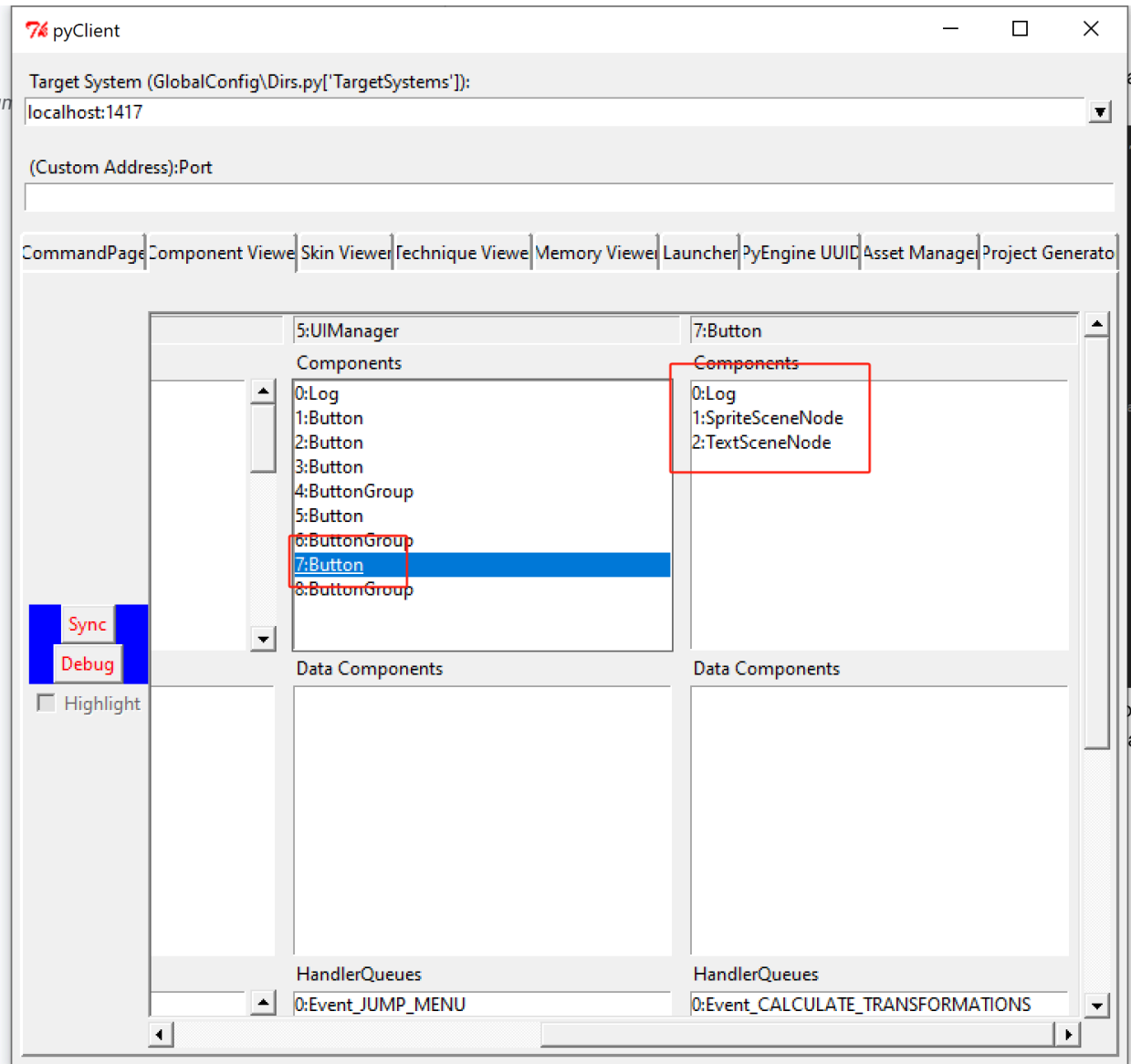
PE_DECLARE_IMPLEMENT_EVENT_HANDLER_WRAPPER(do_TEST_ONCLICK);
void do_TEST_ONCLICK(Events::Event *pEvt);

UIFunction* m_funcMap;

char* m_buttonText;
char* m_buttonImageSource;
char* m_name;

Handle m_hMySpriteSN;
Handle m_hMyTextSN;
```

In Button, it loads the background file and creates a spriteSceneNode. It then loads the text and creates a TextSceneNode. Both of these components are added under Button.



Then I added a ButtonGroup to manage different groups of buttons. The ButtonGroup takes the initial position, a layout style, a name, and a list of buttons inside, labeled by button names.

```

} namespace Components
namespace Components {

    struct ButtonGroup : UIElement
    {
        enum Layout
        {
            Vertical,
            Horizontal
        };
        PE_DECLARE_CLASS(ButtonGroup);

        ButtonGroup( PE::GameContext &context, PE::MemoryArena arena, PE::Handle hMyself, const Events::Event_CREATE_BUTTONGROUP *pEvt);
        virtual void addDefaultComponents();

        PE_DECLARE_IMPLEMENT_EVENT_HANDLER_WRAPPER(do_PRE_GATHER_DRAWCALLS);
        virtual void do_PRE_GATHER_DRAWCALLS(Events::Event *pEvt);

        const char* m_name;
        Layout m_layout;
        Array<Handle> m_ButtonList;
        char* m_buttonNames[8];
        bool m_isButtonSet = false;
    };
} namespace Components; // namespace Components
} namespace PE; // namespace CharacterControl
// namespace Components

```

```

: UIElement([&] context, arena, (* hMyself)
{
    m_ButtonList.reset(capacity: 8);
    m_name = pEvt->m_name;
    isActive = pEvt->m_active;
    if (strcmp(pEvt->m_layout, "vertical") == 0)
    {
        m_layout = Vertical;
    } else if (strcmp(pEvt->m_layout, "horizontal") == 0)
    {
        m_layout = Horizontal;
    } else
    {
        m_layout = Vertical;
    }

    for (int i = 0; i < 8; i++)
    {
        if (strlen(pEvt->m_bNames[i]) > 0)
        {
            m_buttonNames[i] = (char*)pEvt->m_bNames[i];
        }
        else
        {
            m_buttonNames[i] = "";
        }
    }
}

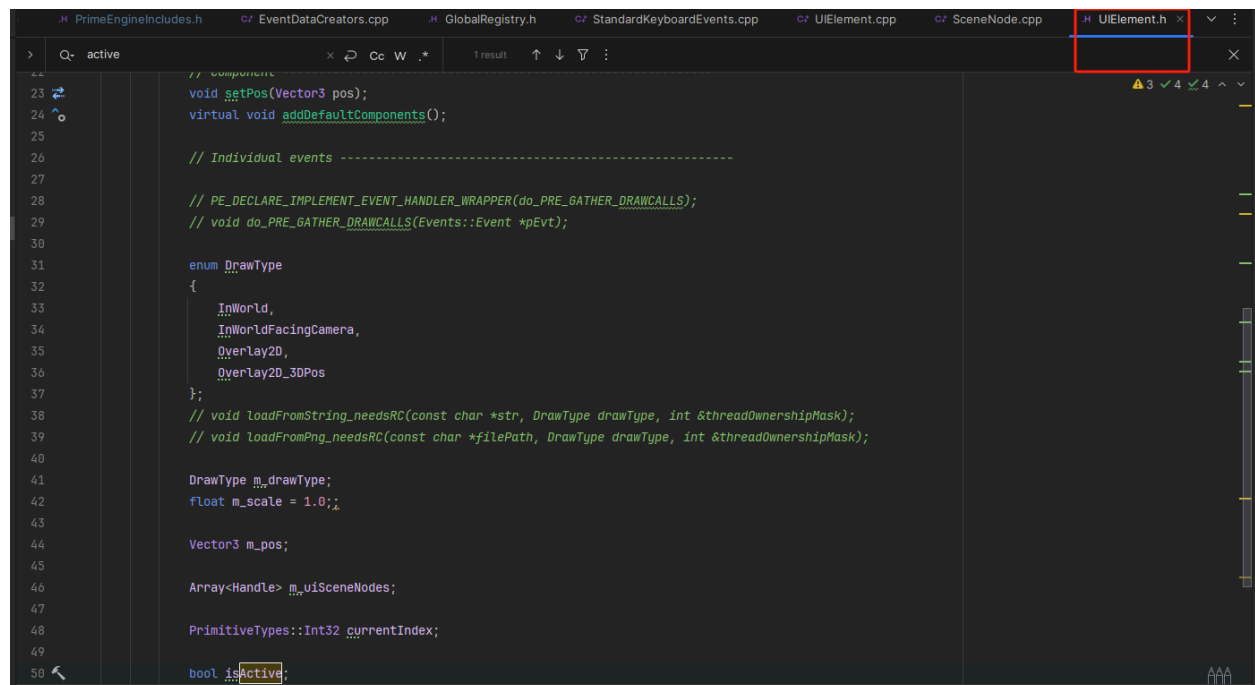
```

In ButtonGroup, I calculate the position of its child buttons based on the group's position.

```
{
    Vector3 curPos = Vector3(m_pos);

    if (m_isButtonSet)
    {
        for (int i = 0; i < m_ButtonList.m_size; i++)
        {
            Handle h = m_ButtonList[i];
            if (h.isValid())
            {
                Button* curButton = h.getObject<Button>();
                curButton->setSelfAndMeshAssetEnabled(isActive);
                if (m_layout == Vertical)
                {
                    curButton->setPos(curPos);
                    curPos.m_y -= (float)(curButton->m_height + 32) / 720.f;
                }
                if (m_layout == Horizontal)
                {
                    curButton->setPos(curPos);
                    curPos.m_x += (float)(curButton->m_width + 32) / 1280.f;
                }
            }
        }
    } else
```

I created a UIElement class so that all UI elements will extend this class.



```
// Component
void setPos(Vector3 pos);
virtual void addDefaultComponents();

// Individual events -----
// PE_DECLARE_IMPLEMENT_EVENT_HANDLER_WRAPPER(do_PRE_GATHER_DRAWCALLS);
// void do_PRE_GATHER_DRAWCALLS(Events::Event *pEvt);

enum DrawType
{
    InWorld,
    InWorldFacingCamera,
    Overlay2D,
    Overlay2D_3DPos
};

// void loadFromString_needsRC(const char *str, DrawType drawType, int &threadOwnershipMask);
// void loadFromPng_needsRC(const char *filePath, DrawType drawType, int &threadOwnershipMask);

DrawType m_drawType;
float m_scale = 1.0f;

Vector3 m_pos;

Array<Handle> m_uiSceneNodes;

PrimitiveTypes::Int32 currentIndex;

bool isActive;
```


Each UIElement will have a list of SceneNodes. Currently, it can either be a SpriteSceneNode or a TextSceneNode.

```
4
5 ✓ void UIElement::setSelfAndMeshAssetEnabled(bool enabled)
6 {
7     setEnabled(enabled);
8
9     for (int i = 0 ; i < m_uiSceneNodes.m_size; i++)
10    {
11        Handle curSceneNodeHandle = m_uiSceneNodes[i];
12        if (curSceneNodeHandle.isValid())
13        {
14            Component* curComponent = curSceneNodeHandle.getObject<Component>();
15            curComponent->setEnabled(enabled);
16        }
17    }
18 }
19
20 } namespace Components ; // namespace Components
21 } namespace PE ; // namespace PE
22
```

Then I created a UIManager. It has a list that contains all UI elements. It also handles all creation, enable and disable of all UIElements, and some events regarding UI transitions.

```
// Constructor -----
UIManager(PE::GameContext &context, PE::MemoryArena arena, Handle hMyself);
virtual ~UIManager(){}
// Methods -----

void setUIActive(Array<PrimitiveTypes::Int32> UIIndices, bool isActive);

PE_DECLARE_IMPLEMENT_EVENT_HANDLER_WRAPPER(method: do_PRE_GATHER_DRAWCALLS);
virtual void do_PRE_GATHER_DRAWCALLS(Events::Event *pEvt);

PE_DECLARE_IMPLEMENT_EVENT_HANDLER_WRAPPER(method: do_JUMP_MENU);
virtual void do_JUMP_MENU(Events::Event *pEvt);

void postPreDraw(int &threadOwnershipMask);
// Component -----

virtual void addDefaultComponents();

void createButton(Events::Event_CREATE_BUTTON* pEvt);
void createButtonGroup(Events::Event_CREATE_BUTTONGROUP* pEvt);

// Individual events -----

Array<Handle> m_UIList;

PrimitiveTypes::Int32 m_maxWidth;
```

```
62 virtual void addDefaultComponents();
63
64 void createButton(Events::Event_CREATE_BUTTON* pEvt);
65 void createButtonGroup(Events::Event_CREATE_BUTTONGROUP* pEvt);
66
67 // Individual events -----
68
69 Array<Handle> m_UIList;
70
71 PrimitiveTypes::Int32 m_maxWidth;
72 PrimitiveTypes::Int32 m_maxHeight;
73 float m_cachedAspectRatio;
74
75 private:
76 static Handle s_myHandle;
77 static const int NUM_MaxUI = 64;
78 int m_last;
79 GameContext *m_context;
80
81
82 };
83
84 }namespace Components; // namespace Components
85 }namespace PE; // namespace PE
86 #endif #ifndef __PYENGINE_2_0_UIMANAGER_H__
87
```

```

void UIManager::createButton(Event_CREATE_BUTTON *pRealEvent)
{
    if (m_UIList.m_size >= NUM_MaxUI)
    {
        return;
    }

    m_pContext->getGPUScreen()->AcquireRenderContextOwnership([&pRealEvent->m_threadOwnershipMask];
    Handle h = PE::Handle(dbgName: "BUTTON", neededSize: sizeof(Button));
    Button *pButton = new(h) Button([&m_pContext, m_arena, &h, pRealEvent);
    pButton->addDefaultComponents();
    addComponent(&h);
    Vector3 pos;
    if (pButton->m_drawType == UIElement::Overlay2D)
    {
        pos.m_x = -1.0f + 2.0f * (pRealEvent->m_pos.m_x / UIManager::Instance()->m_maxWidth);
        pos.m_y = -1.0f + 2.0f * (1.0f - (pRealEvent->m_pos.m_y / UIManager::Instance()->m_maxHeight));
    } else
    {
        pos = pRealEvent->m_pos;
    }
    pButton->setPos(&pos);
    pButton->createSpriteSceneNode(pButton->m_buttonImageSource, pButton->m_drawType, [&m_context->m_gameThreadThreadOwnershipMask, pButton->m_width, pButton->m_height];
    pButton->createTextSceneNode(pButton->m_buttonText, pButton->m_drawType, [&m_context->m_gameThreadThreadOwnershipMask];
    pButton->setSelfAndMeshAssetEnabled(pRealEvent->isActive);
    pButton->currentIndex = m_UIList.m_size;
    m_UIList.add(h);
}

```

```

void UIManager::createButtonGroup(Event_CREATE_BUTTONGROUP *pRealEvent)
{
    if (m_UIList.m_size >= NUM_MaxUI)
    {
        return;
    }

    Handle h = PE::Handle(dbgName: "BUTTONGROUP", neededSize: sizeof(ButtonGroup));
    ButtonGroup *pButtonGroup = new(h) ButtonGroup([&m_pContext, m_arena, &h, pRealEvent);
    pButtonGroup->addDefaultComponents();
    addComponent(&h);
    Vector3 pos;
    pos.m_x = -1.0f + 2.0f * (pRealEvent->m_pos.m_x / UIManager::Instance()->m_maxWidth);
    pos.m_y = -1.0f + 2.0f * (1.0f - (pRealEvent->m_pos.m_y / UIManager::Instance()->m_maxHeight));
    pButtonGroup->setPos(&pos);
    m_UIList.add(h);
}

```

```

void UIManager::setUIActive(Array<PrimitiveTypes::Int32> UIIndices, bool isActive)
{
    for (int i = 0; i < UIIndices.m_size; i++)
    {
        Handle hCurElement = m_UIList[i];
        UIElement* curUI = hCurElement.getObject<UIElement>();
        curUI->setSelfAndMeshAssetEnabled(isActive);
    }
}

```

It is constructed when Game is started.

```
30 // Singleton -----
31
32 void UIManager::Construct(PE::GameContext &context, PE::MemoryArena arena)
33 {
34     Handle handle(dbgName: "UIManager", neededSize: sizeof(UIManager));
35     UIManager *pUIManager = new(handle) UIManager([&] context, arena, & handle);
36     pUIManager->addDefaultComponents();
37     // Singleton
38     SetInstanceHandle(handle);
39     RootSceneNode::Instance()->addComponent(& handle);
40 }
41
42 // Constructor -----
43 UIManager::UIManager(PE::GameContext &context, PE::MemoryArena arena, Handle hMyself)
44 : Component([&] context, arena, & hMyself)
45 {
46     m_UIList.reset(capacity: NUM_MaxUI);
47     m_cachedAspectRatio = 1.0f;
48     m_context = &context;
49     if (IRenderer* pS = context.getGPUScreen())
50     {
51         m_maxWidth = pS->getWidth();
52         m_maxHeight = pS->getHeight();
53         m_cachedAspectRatio = float(pS->getWidth()) / float(pS->getHeight());
54     }
55 }
56 }
```

```
207
208 AnimationSetGPUManager::Construct([&] context, MemoryArena_Client);
209
210 PositionBufferCPUManager::Construct([&] context, MemoryArena_Client);
211 NormalBufferCPUManager::Construct([&] context, MemoryArena_Client);
212 TexCoordBufferCPUManager::Construct([&] context, MemoryArena_Client);
213
214 DrawList::Construct([&] context, MemoryArena_Client);
215
216 RootSceneNode::Construct([&] context, MemoryArena_Client);
217 DebugRenderer::Construct([&] context, MemoryArena_Client);
218 CameraManager::Construct([&] context, MemoryArena_Client);
219 UIManager::Construct([&] context, MemoryArena_Client);
220
221 // initialize timer functionality
222 Timer::Initialize();
223
224 context.getGameobjectManager()->addComponent(& context.getNetworkManager()->getHandle());
225
226 context.getNetworkManager()->initNetwork();
227
228 return 1;
229 }
```

Then I created a Click Event for the application

```

struct Event_LEFT_BUTTON_UP : public Event {
    PE_DECLARE_CLASS(Event_LEFT_BUTTON_UP);
    Event_LEFT_BUTTON_UP() : m_x(0), m_y(0) {}

    virtual ~Event_LEFT_BUTTON_UP(){}
    PrimitiveTypes::Int16 m_x, m_y;
};

struct Event_RIGHT_BUTTON_UP : public Event {
    PE_DECLARE_CLASS(Event_RIGHT_BUTTON_UP);
    virtual ~Event_RIGHT_BUTTON_UP(){}
    PrimitiveTypes::Int16 m_x, m_y;
};

```

Trigger the click event whenever the mouse button is released after clicking.

```

//Check for Button Down events
if ((GetKeyState(VK_LBUTTON) & 0x80) != 0)
{
    m_leftButtonPressed = true;
}
if (m_leftButtonPressed && ((GetKeyState(VK_LBUTTON) & 0x80) == 0))
{
    POINT pt;
    Handle h(dbgName: "EVENT", neededSize: sizeof(Event_LEFT_BUTTON_UP));
    Event_LEFT_BUTTON_UP * pEvt = new (h) Event_LEFT_BUTTON_UP;
    GetCursorPos(&pt);
    ScreenToClient(hWnd: pWinApp->getWindowHandle(), &pt);
    pEvt->m_x = pt.x;
    pEvt->m_y = pt.y;
    m_pQueueManager->add(h, queueType: Events::QT_INPUT);
    m_leftButtonPressed = false;
}
//Check the mouse right button is pressed or not

```

```

//Check the mouse right button is pressed or not
if ((GetKeyState(VK_RBUTTON) & 0x80) != 0)
{
    m_rightButtonPressed = true;
}
if (m_rightButtonPressed && ((GetKeyState(VK_RBUTTON) & 0x80) == 0))
{
    POINT pt;
    Handle h(dbgName: "EVENT", neededSize: sizeof(Event_RIGHT_BUTTON_UP));
    new (h) Event_RIGHT_BUTTON_UP;
    Event_RIGHT_BUTTON_UP * pEvt = new (h) Event_RIGHT_BUTTON_UP;
    GetCursorPos(&pt);
    ScreenToClient(hWnd: pWinApp->getWindowHandle(), &pt);
    pEvt->m_x = pt.x;
    pEvt->m_y = pt.y;
    m_pQueueManager->add(h, queueType: Events::QT_INPUT);
    m_rightButtonPressed = false;
}

```

Pass the event into the game queue

```
}  
if (Event_LEFT_BUTTON_UP::GetClassId() == pEvt->getClassId())  
{  
    Handle h(dbgName: "EVENT", neededSize: sizeof(Event_LEFT_BUTTON_UP));  
    Event_LEFT_BUTTON_UP *clickEvt = new(h) Event_LEFT_BUTTON_UP ;  
    Event_LEFT_BUTTON_UP *pRealEvent = (Event_LEFT_BUTTON_UP*)(pEvt);  
    clickEvt->m_x = pRealEvent->m_x;  
    clickEvt->m_y = pRealEvent->m_y;  
  
    m_pQueueManager->add(h, queueType: QT_GENERAL);  
}  
if (Event_RIGHT_BUTTON_UP::GetClassId() == pEvt->getClassId())  
{  
    Handle h(dbgName: "EVENT", neededSize: sizeof(Event_RIGHT_BUTTON_UP));  
    Event_RIGHT_BUTTON_UP *clickEvt = new(h) Event_RIGHT_BUTTON_UP ;  
    Event_RIGHT_BUTTON_UP *pRealEvent = (Event_RIGHT_BUTTON_UP*)(pEvt);  
    clickEvt->m_x = pRealEvent->m_x;  
    clickEvt->m_y = pRealEvent->m_y;  
  
    m_pQueueManager->add(h, queueType: QT_GENERAL);  
}
```

The button receives the event and text if the mouse is on the button.

```
void Button::addDefaultComponents()  
{  
    UIElement::addDefaultComponents();  
    // event handlers  
    PE_REGISTER_EVENT_HANDLER(Events::Event_PRE_GATHER_DRAWCALLS, Button::do_PRE_GATHER_DRAWCALLS);  
    PE_REGISTER_EVENT_HANDLER(Events::Event_LEFT_BUTTON_UP, Button::do_TEST_ONCLICK);  
}
```

```
void Button::do_TEST_ONCLICK(Events::Event *pEvt)  
{  
    Events::Event_LEFT_BUTTON_UP *pRealEvent = (Events::Event_LEFT_BUTTON_UP*)(pEvt);  
    float xPos = (m_pos.m_x + 1.0f) / 2 * UIManager::Instance()->m_maxWidth;  
    float yPos = (1.0f - ((m_pos.m_y + 1.0f) / 2)) * UIManager::Instance()->m_maxHeight;  
  
    if (pRealEvent->m_x > xPos && pRealEvent->m_x < xPos + m_width && pRealEvent->m_y > yPos && pRealEvent->m_y < yPos + m_height)  
    {  
        onClick();  
    }  
}
```

I then created a data driven lua element that can pass data into button and buttongroup, which will auto generate UI based on what we created in maya. For Button,

```
2
3  outputDebugString("Executing Button.lua (note: this will probably just define functions like runScript(args)\n")
4
5  function runScript(args)
6      outputDebugString("PE: Progress: Button.lua runScript() Entry...\n")
7
8      -- local pos = args['base']['pos']
9      local pos = args['base']['pos']
10     local u = args['base']['u']
11     local v = args['base']['v']
12     local n = args['base']['n']
13
14     outputDebugString("PE: Progress: about to call root.CharacterControl.Events.Event_CREATE_BUTTON.Construct\n")
15     handler = getGameobjectManagerHandle(L_getGameContext())
16
17     evt = root.PE.Events.Event_CREATE_BUTTON.Construct(
18         L_getGameContext(),
19         args['name'],
20         args['width'],
21         args['height'],
22         args['btext'],
23         args['background'],
24         args['drawType'],
25         args['funcName'],
26         pos[1], pos[2], pos[3],
27         args['peuuid']
28     )
29     outputDebugString("PE: Progress: about to call root.PE.Components.Component.SendEventToHandle(handler, evt)\n")
30
31     root.PE.Components.Component.SendEventToHandle(handler, evt)
32 end
```

```
1  t = {}
2  t["mayaRep"] = "Maya/Meshes/Weapons/Grenade/Grenade.ma"
3
4  t["callerScript"] = ''
5  -- this script is in lua format
6  -- this is a meta script that fills in data that is passed to 'myScript' that in turn calls C++ function
7  -- some of the data can be set by default, some of the data might be required to be edited from maya
8  function fillMetaInfoTable(args) -- the script fromat requires existence of this function
9
10     -- user modified data
11     args['myScript']="Button.lua"
12     args['myScriptPackage']="Default"
13
14     args['name'] = "0"
15     args['width'] = 160
16     args['height'] = 32
17     args['btext'] = "Start Game"
18     args['background'] = "cobble2_color.dds"
19     args['drawType'] = "Overlay2D"
20     args['funcName'] = "UIFunction.pauseGame"
21
22     end -- required
23     ''
24
```

We also need a createButton lua event to pass data into our code.


```

namespace PE
{
    namespace Events{
        struct Event_CREATE_BUTTON : Event_CREATE_MESH
        {
            PE_DECLARE_CLASS(Event_CREATE_BUTTON);
            Event_CREATE_BUTTON(int &threadOwnershipMask): Event_CREATE_MESH([& threadOwnershipMask){}

            // override SetLuaFunctions() since we are adding custom Lua interface
            static void SetLuaFunctions(PE::Components::LuaEnvironment *pLuaEnv, lua_State *luaVM);

            // Lua interface prefixed with L_
            static int L_Construct(lua_State* luaVM);

            char m_name[32];
            int m_width, m_height;
            char m_text[256];
            char m_background[256];
            char m_drawType[32];
            char m_funcName[64];

            Vector3 m_pos;

            bool isActive;

            PEUID m_peuuid; // unique object id
        };
    } namespace Events
}

```

```

namespace PE {
    namespace Events
    {
        PE_IMPLEMENT_CLASS1(Event_CREATE_BUTTON, PE::Events::Event);

        void Events::Event_CREATE_BUTTON::SetLuaFunctions(PE::Components::LuaEnvironment *pLuaEnv, lua_State *luaVM)
        {
            static const struct luaL_Reg l_Event_CREATE_BUTTON[] = {
                {name: "Construct", func: L_Construct},
                {name: NULL, func: NULL} // sentinel
            };

            // register the functions in current lua table which is the table for Event_CreateButton
            luaL_register(luaVM, libname: 0, l_Event_CREATE_BUTTON);
        }

        int Events::Event_CREATE_BUTTON::L_Construct(lua_State* luaVM)
        {
            PE::Handle h(dbgName: "CREATE_BUTTON_EVENT", neededSize: sizeof(Events::Event_CREATE_BUTTON));

            // get arguments from stack

```

```

30
31 // get arguments from stack
32 int numArgs, numArgsConst;
33 numArgs = numArgsConst = 12;
34
35 PE::GameContext *pContext = (PE::GameContext*)(lua_touserdata(luaVM, -numArgs--));
36
37 Event_CREATE_BUTTON *pEvt = new(h) Event_CREATE_BUTTON([&pContext->m_gameThreadThreadOwnershipMask);
38
39 const char* name = lua_tostring(luaVM, -numArgs--);
40 float width = (float)lua_tonumber(luaVM, -numArgs--);
41 float height = (float)lua_tonumber(luaVM, -numArgs--);
42 const char* text = lua_tostring(luaVM, -numArgs--);
43 const char* bgFile = lua_tostring(luaVM, -numArgs--);
44 const char* drawType = lua_tostring(luaVM, -numArgs--);
45 const char* funcName = lua_tostring(luaVM, -numArgs--);
46
47 Vector3 buttonPos;
48 buttonPos.m_x = (float)lua_tonumber(luaVM, -numArgs--);
49 buttonPos.m_y = (float)lua_tonumber(luaVM, -numArgs--);
50 buttonPos.m_z = (float)lua_tonumber(luaVM, -numArgs--);
51
52 pEvt->m_peuuid = Lua64ue::readPEUUID(luaVM, -numArgs--);
53 StringOps::writeToString(name, pEvt->m_name, maxSize: 255);
54 StringOps::writeToString(drawType, pEvt->m_drawType, maxSize: 255);
55 pEvt->m_width = width;
56 pEvt->m_height = height;
57 StringOps::writeToString(text, pEvt->m_text, maxSize: 255);
58 StringOps::writeToString(bgFile, pEvt->m_background, maxSize: 255);
59 StringOps::writeToString(funcName, pEvt->m_funcName, maxSize: 255);
60
61 pEvt->m_pos = buttonPos;
62
63 lua_pop(luaVM, numArgsConst);

```


For ButtonGroup,

```

1 -- expected arguments:
2
3 outputDebugString("Executing ButtonGroup.lua \n")
4
5 function runScript(args)
6     outputDebugString("PE: Progress: ButtonGroup.lua runScript() Entry...\n")
7
8     -- local pos = args['base']['pos']
9     local pos = args['base']['pos']
10    local list = args['list']
11
12    outputDebugString("PE: Progress: about to call root.CharacterControl.Events.Event_CREATE_BUTTONGROUP.Construct\n")
13    handler = getGameobjectManagerHandle(l_getGameContext())
14
15    evt = root.PE.Events.Event_CREATE_BUTTONGROUP.Construct(
16        l_getGameContext(),
17        args['name'],
18        args['buttonlayout'],
19        pos[1], pos[2], pos[3],
20        args['isActive'],
21        args['peuuid'],
22        list[1], list[2], list[3]
23    )
24    outputDebugString("PE: Progress: about to call root.PE.Components.Component.SendEventToHandle(handler, evt)\n")
25
26    root.PE.Components.Component.SendEventToHandle(handler, evt)
27 end
28



```

```

1  t = {}
2  t["mayaRep"] = "Maya/Meshes/Arrow/arrow.mb"
3
4  t["callerScript"] = ''
5  -- this script is in lua format
6  -- this is a meta script that fills in data that is passed to 'myScript' that in turn calls C++ function
7  -- some of the data can be set by default, some of the data might be required to be edited from maya
8  function fillMetaInfoTable(args) -- the script fromat requires existence of this function
9
10 -- user modified data
11 args['myScript']="ButtonGroup.lua"
12 args['myScriptPackage']="Default"
13
14 args['name'] = "0"
15 args['buttonlayout'] = "vertical"
16 args['list'] = {"0", "2", "3"}
17  args['isActive'] = 1
18
19 end -- required
20 ''
21

```

```

9
10 namespace PE{
11     namespace Events{
12         struct Event_CREATE_BUTTONGROUP : Event_CREATE_MESH
13         {
14             PE_DECLARE_CLASS(Event_CREATE_BUTTONGROUP);
15
16             Event_CREATE_BUTTONGROUP(int &threadOwnershipMask): Event_CREATE_MESH(&threadOwnershipMask)
17             {
18
19             }
20
21             // override SetLuaFunctions() since we are adding custom Lua interface
22  static void SetLuaFunctions(PE::Components::LuaEnvironment *pLuaEnv, lua_State *luaVM);
23
24             // Lua interface prefixed with l_
25  static int l_Construct(lua_State* luaVM);
26
27             char m_name[32];
28             char m_layout[32];
29             const char* m_bNames[8];
30             PrimitiveTypes::Int16 m_active;
31
32             PEUUID m_peuuid; // unique object id
33         };
34     } namespace Events
35     namespace Components {
36
37         struct ButtonGroup : UIElement

```

```

1 PE_IMPLEMENT_CLASS1(Event_CREATE_BUTTONGROUP, PE::Events::Event);
2 void Events::Event_CREATE_BUTTONGROUP::SetLuaFunctions(PE::Components::LuaEnvironment *pLuaEnv, lua_State *luaVM)
3 {
4     static const struct luaL_Reg l_Event_CREATE_BUTTONGROUP[] = {
5         {_name: "Construct", _func: l_Construct},
6         {_name: NULL, _func: NULL} // sentinel
7     };
8
9     // register the functions in current lua table which is the table for Event_CreateButton
10    luaL_register(luaVM, _libname: 0, l_Event_CREATE_BUTTONGROUP);
11 }
12 int Events::Event_CREATE_BUTTONGROUP::l_Construct(lua_State* luaVM)
13 {
14     PE::Handle h(dbgName: "CREATE_BUTTON_EVENT", neededSize: sizeof(Events::Event_CREATE_BUTTONGROUP));
15
16     // get arguments from stack
17     int numArgs, numArgsConst;
18     numArgs = numArgsConst = 11;
19
20     PE::GameContext *pContext = (PE::GameContext*)(lua_touserdata(luaVM, -numArgs--));
21
22     Event_CREATE_BUTTONGROUP *pEvt = new(h) Event_CREATE_BUTTONGROUP(&pContext->m_gameThreadThreadOwnershipMask);
23
24     const char* name = lua_tostring(luaVM, -numArgs--);
25     const char* layout = lua_tostring(luaVM, -numArgs--);
26
27     Vector3 buttonGroupPos;
28     buttonGroupPos.m_x = (float)lua_tonumber(luaVM, -numArgs--);
29     buttonGroupPos.m_y = (float)lua_tonumber(luaVM, -numArgs--);

```

```

42     pEvt->m_active = isActive;
43
44     pEvt->m_peuid = LuaGlue::readPEUID(luaVM, -numArgs--);
45     pEvt->m_pos = buttonGroupPos;
46
47     StringOps::writeToString(name, pEvt->m_name, maxSize: 255);
48     StringOps::writeToString(layout, pEvt->m_layout, maxSize: 255);
49
50     int i = 0;
51     while (i < 8)
52     {
53         if (!lua_isnil(luaVM, -numArgs) && numArgs > 0)
54         {
55             const char* curButtonName = lua_tostring(luaVM, -numArgs--);
56             pEvt->m_bNames[i] = curButtonName;
57         }
58         else
59         {
60             pEvt->m_bNames[i] = "";
61         }
62         i++;
63     }
64
65     lua_pop(luaVM, numArgsConst);
66     LuaGlue::pushTableBuiltFromHandle(luaVM, h);
67
68     return 1;
69 }

```

Then I added the function mapping for button because in Maya we can only specify a string.

```
{
    namespace Components
    {
        struct UIFunction: Component
        {
            PE_DECLARE_CLASS(UIFunction);

            UIFunction(PE::GameContext& context, PE::MemoryArena arena, Handle hMyself):Component(&context, arena, hMyself){}
            virtual ~UIFunction() {}

            virtual void addDefaultComponents();

            std::function<void()> findFunction(const char* funcName);

            void pauseGame();

            void resumeGame();

            void jumpMenu(char* menuName);

            void exitGame();

            void defaultFunc();

        };
    } namespace Components ;
} namespace PE
```

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```

```

void UIFunction::resumeGame()
{
    PE::Handle h(dbgName: "Event_RESUME", neededSize: sizeof(Events::Event_RESUME));
    Events::Event_RESUME *pEvt = new (h) Events::Event_RESUME;
    Events::EventManager::Instance()->add(h, queueType: Events::QT_GENERAL);
    jumpMenu("0");
}

void UIFunction::jumpMenu(char* menuName)
{
    PE::Handle h(dbgName: "Event_PAUSE", neededSize: sizeof(Events::Event_JUMP_MENU));
    Events::Event_JUMP_MENU *pEvt = new (h) Events::Event_JUMP_MENU;
    pEvt->m_name = menuName;
    Events::EventManager::Instance()->add(h, queueType: Events::QT_GENERAL);
}

void UIFunction::exitGame()
{
    PE::Handle h(dbgName: "Event_EXIT_GAME", neededSize: sizeof(Events::Event_EXIT_GAME));
    Events::Event_EXIT_GAME *pEvt = new (h) Events::Event_EXIT_GAME;
    Events::EventManager::Instance()->add(h, queueType: Events::QT_GENERAL);
}

void UIFunction::defaultFunc()
{
    OutputDebugStringA("UIFunction::findFunction: function not implemented");
}

```

```

} namespace Components :

```

I created an event respectively,

```
8
9         PE_IMPLEMENT_CLASS1(Event_FLY_CAMERA, Event);
10        PE_IMPLEMENT_CLASS1(Event_ROTATE_CAMERA, Event);
11    +    PE_IMPLEMENT_CLASS1(Event_PAUSE, Event);
12    +    PE_IMPLEMENT_CLASS1(Event_RESUME, Event);
13    +    PE_IMPLEMENT_CLASS1(Event_EXIT_GAME, Event);
14    +    PE_IMPLEMENT_CLASS1(Event_JUMP_MENU, Event);
15    +
16    };
17    };
```

```

34         Vector3 m_relativeRotate; //2D screenspace rotate
35     };
36 +
37 + struct Event_PAUSE : public Event {
38 +     PE_DECLARE_CLASS(Event_PAUSE);
39
40 +     Event_PAUSE() {}
41 +     virtual ~Event_PAUSE(){}
42 + };
43 +
44 + struct Event_RESUME : public Event {
45 +     PE_DECLARE_CLASS(Event_RESUME);
46 +
47 +     Event_RESUME() {}
48 +     virtual ~Event_RESUME(){}
49 + };
50 +
51 + struct Event_EXIT_GAME : public Event {
52 +     PE_DECLARE_CLASS(Event_EXIT_GAME);
53 +
54 +     Event_EXIT_GAME() {}
55 +     virtual ~Event_EXIT_GAME(){}
56 + };
57 +
58 + struct Event_JUMP_MENU : public PE::Events::Event {
59 +     PE_DECLARE_CLASS(Event_JUMP_MENU);
60 +
61 +     Event_JUMP_MENU(){}
62 +     virtual ~Event_JUMP_MENU(){}
63 +
64 +     PrimitiveTypes::Int16 m_index;
65 + };
66 }; // namespace Events
67 }; // namespace PE
68

```


In GameObjectManager, I passed all creation event into it, and let it pass it to the handling component

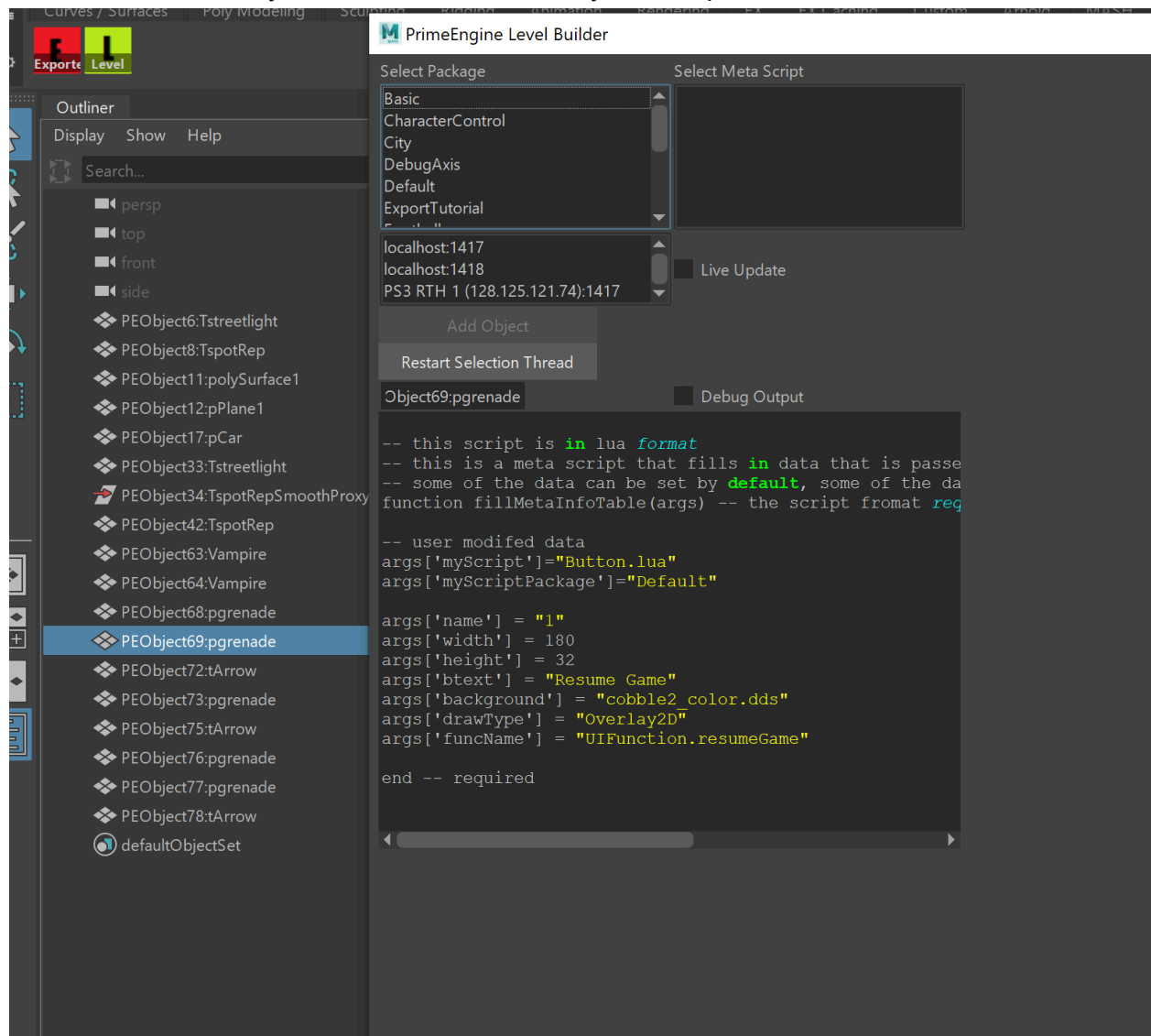
```
56         m_pContext->getLuaEnvironment()->pop();
57     }
58 + void GameObjectManager::do_CREATE_BUTTON(Event *pEvt)
59 + {
60 +     Event_CREATE_BUTTON *pRealEvent = (Event_CREATE_BUTTON*) pEvt;
61 +     UIManager::Instance()->createButton(pRealEvent);
62 +     m_pContext->getGPUScreen()->ReleaseRenderContextOwnership(pRealEvent->m_threadOwnershipMask);
63 + }
```

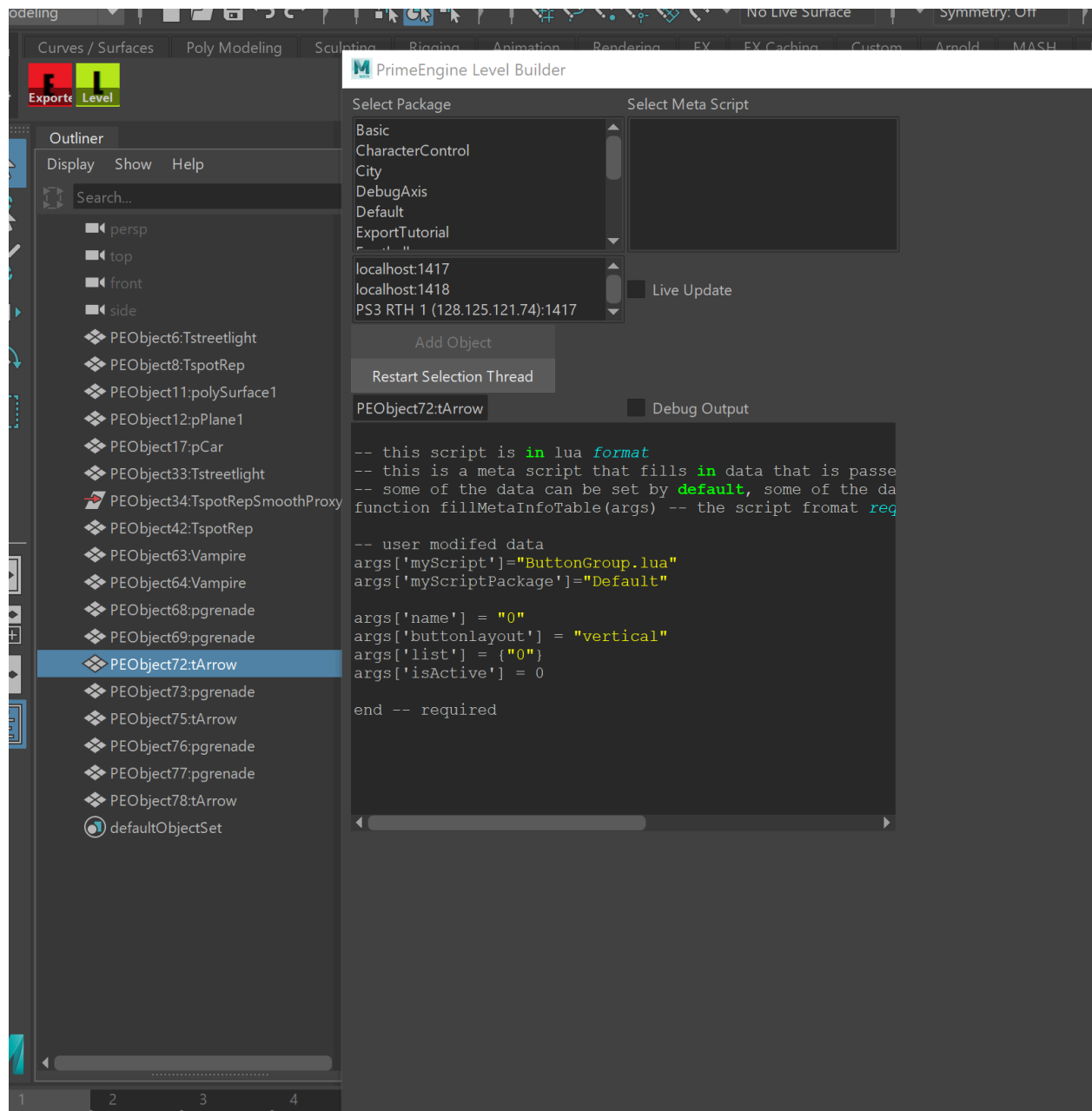
```
64
65     void GameObjectManager::do_CREATE_MESH(Events::Event *pEvt)
66     {
```

For pausing and resuming event, I simply added a variable to stop framerate from increasing

```
44         {
45             // physics kick off
46             m_pContext->getPhysicsManager()->handleEvent(pGeneralEvt);
47 +         }
48 +         else if (Event_PAUSE::GetClassId() == pGeneralEvt->getClassId())
49 +         {
50 +             isPaused = true;
51 +         }
52 +         else if (Event_RESUME::GetClassId() == pGeneralEvt->getClassId())
53 +         {
54 +             isPaused = false;
55 +         }
56 +         else
57 +         {
58 +             // do nothing
59 +         }
60 +     }
61 + }
62 +
63 + void GameObjectManager::do_PAUSE(Event *pEvt)
64 + {
65 +     Event_PAUSE *pRealEvent = (Event_PAUSE*) pEvt;
66 +     m_pContext->getPhysicsManager()->handleEvent(pGeneralEvt);
67 +     isPaused = true;
68 + }
69 +
70 + void GameObjectManager::do_RESUME(Event *pEvt)
71 + {
72 +     Event_RESUME *pRealEvent = (Event_RESUME*) pEvt;
73 +     m_pContext->getPhysicsManager()->handleEvent(pGeneralEvt);
74 +     isPaused = false;
75 + }
76 +
77 + void GameObjectManager::do_FRAME_TIME(Event *pEvt)
78 + {
79 +     Event_FRAME_TIME *pRealEvent = (Event_FRAME_TIME*) pEvt;
80 +     m_pContext->getLog()->m_isActivated = false;
81 +     float gameThreadPostDrawFrameTime = m_hTimer.getObject<Timer>()->TickAndGetTimeDeltaInSeconds();
82 +     if (isPaused)
83 +     {
84 +         m_frameTime = 0;
85 +     } else
86 +     {
87 +         m_frameTime = gameTimeBetweenFrames + gameThreadPreDrawFrameTime + gameThreadDrawWaitFrameTime +
88 +             gameThreadDrawFrameTime + gameThreadPostDrawFrameTime;
89 +     }
90 + }
91 +
92 + void GameObjectManager::do_FRAME_TIME_UPDATE(Event *pEvt)
93 + {
94 +     Event_FRAME_TIME_UPDATE *pRealEvent = (Event_FRAME_TIME_UPDATE*) pEvt;
95 +     m_frameTime = 0.1f;
96 + }
```

Last, I added the newly created elements into Maya and exported a new level file.





Loading this file gives the video. Although the video looks simple, there is an extendable architecture behind this. If there could be more time, I will add a scalable and alignable text for the background. A more flexible button group with scalability and alignability. Also there could be a customized single color background behind each element.