Design Proposal Outline for Digital Twins Project
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Goals:

We will be developing a Digital Twin that will tell the user different readings from the place that they are located. As an example of this, if we are on a random planet then our twin will be able to model the various oxygen levels, the humidity, the temperature, etc. of the outside world. To visualize this we will be constructing a spaceship that the user will reside in that will receive the data from the sensors and send the data to the ship. This way the user inside the ship will be able to see if the world they are in is safe, or if it is not and can choose to go outside into the world they have landed in or they can choose to stay inside of their ship and continue to monitor the incoming data.

To summarize -
  - The visualization will get data on the world such as oxygen levels, humidity, temperature, etc. This will be both random and manual.
  - The visualization will also show data about the ship, such as fuel level and power consumption.
  - This data will be simulated in Python and sent to the visualization via MQTT publisher (the visualization will subscribe).
  - The user can see the data, and choose to exit the ship or stay in the ship as they see fit.

Objectives:

Our objectives will be the following -
  - We will develop a virtual ship to show the world and the ship data. This will update as it happens in "real time." All of this info will be simulated with a Python script.
  - We will develop python scripts to generate data to send to the digital twin and have the displays in the twin update as they update from the script.
  - Linking the script to the ship using MQTT for subscriber to publisher communication.
  - Making interactable with the in game player for a higher level of immersion.
  - Have animations and interactable objects in the virtual world to read the data in a better way.

Architecture:

We will be using Unreal Engine in order to develop the virtual simulation and have it interface with the publish/subscribe system of MQTT. We will have separate topics that will all be sent to the same broker bus. This will work well because of the high output capabilities of the MQTT service. This will function better then serial because it doesn't have to be serial, and comes synchronized out of the box. We will then be developing some python scripts that will allow us to generate the simulated numbers before sending them to our Digital Twin that is implemented in Unreal Unreal Engine.

Design:

Our design will consist of the above mentioned tasks that will allow us to complete our Digital Twin to the best of our capabilities. A diagram of the flow of the design will be included below -

Sensors

The sensors on this Digital Twin will be simulated in python. Some of the sensors that we will be using are listed below.

Ship Thermometer:
This will get the temperature on the inside of the ship.

Ship Status:
Tells where the ship is - In orbit, landed, moon location name, etc.

World Thermometer:
This will get the temperature of the world as you go from planet to planet.

Humidity Level:
The world humidity level, telling how humid the world is.

Oxygen Level:
This will display the oxygen level on the world telling if it is safe to enter the outside environment.

Ship Fuel:
The amount of fuel that the ship currently has.

Air Pressure:
Tells the ship what the air pressure of the outside world is.

Communications

All of the communications will be sent via MQTT connection from the sensors (Python simulated numbers) to the visualization.

Subscriber:
This keeps track of the different publishers that one thing is subscribed to. It tells the broker what information it would like to see.

Broker:
This relays the message as information is requested.

Publisher:
This gets the data from the Sensors and "publishes" their data so that other components are able to access the data that is being published.

Visualization

This will be where all of the data goes that is sent from the sensors and what is done with the data

Ship:
Various sensors and screens on the ship will read the variables that they are subscribed to and display the info on them.

VFX:
How the various components on the ship are changing. This will give a better idea of how the values are making the ship change.

Sounds:
The sounds will change based on ship values adding a better idea how the ship is working and/or the environment is working.

Database:
Keep a running track of all the data that has been collected from the sensors as time goes on. This data can then be referenced as needed if a person wants to look at a backlog of the collected data.