**Research Topic: Developing an AR Application for campus students using the Apple Vision Pro headset.**

**Introduction**

Overview: The research project is focused on developing an Augmented Reality (AR) dashboard application that integrates live Data collection from IoT sensors across CSUDH campus and presenting to the user in an AR dashboard which will be viewed using the Apple AR Vision Pro Headset.

IoT and AR (Internet of Things, Augmented Reality) have created opportunities to provide real-time, rich information to decision-makers that are working with specific devices, controls, supply chains, and more. In this research, I want to combine the integration of Augmented Reality and IOT Synthesis.

In the modern age, Augmented Reality (AR) has opened new doors in the way we view and interact with the world around us. Through the integration of IoT and AR, there lies an untapped potential for providing real-time, useful information in a visually appealing manner. This research aims to harness this potential by developing an AR dashboard application tailored for the CSUDH campus students, utilizing the Apple Vision Pro Headset as the AR viewing medium.

**Implementation**

Tools to develop the Model:

·        Game Engine: Unity3D with Ios SDK.

·        IDE: Xcode Beta – using visionOS simulator [Source: <https://developer.apple.com/news/?id=765ce4l3>]

·        Programming Language: SwiftUI, C#

·        Frameworks: RealityKit, ARKit, OpenCV [Source: <https://developer.apple.com/augmented-reality/realitykit/>]

If the Apple Vision Pro headset not available can test using the Simulator integrated in visionOS SDK.

Testing with Vision Pro headset: [Source: <https://developer.apple.com/visionos/work-with-apple/>] 

**Architecture Diagram**

A person standing in front of a black background

Description automatically generated

Step 1: 3D Model of CSUDH Campus Map

* Design a 3D Model top view of CSUDH campus map made using Blender which is a 3D Modelling Software.
* Will try to represent each campus building
* A diagram of a model of a city

  Description automatically generated Add interaction to the 3D Model in AR view. Such as description of building.

Figure 1: 3D Model building to AR View

Step 2: IOT Devices

* Install the IOT Devices to different areas of the buildings to measure the Environmental conditions such as external temperature, humidity, light levels. And measure the occupancy of the building (the number of people entering/exiting the campus building)
* Integrate the Campus wifi network
* Device driven dashboards
* Augmented Reality and IOT Synthesis. We can represent the architecture process in the Figure below.
* Pull data from the IOT Devices. Take the data based on the proximity to the device and
* Mx chip – connect to the azure cloud
* Have number of sensors: Humidity, Temperature.

Step 3: Data Collection from IoT Devices:

* Data Collection from IoT Devices: The data from the IoT devices will be sent to a centralized platform or cloud service. We could use a custom server, cloud service like AWS IoT, Azure IoT Hub, or Google IoT Core.
* Data Processing & Storage: Once the data reaches the cloud/server, the data will be stored in cloud storage, or real-time data streaming platforms.
* Backend API Development: There will be an API (Application Programming Interface) which will allow the AR application to request and retrieve this data (e.g: RESTful APIs or WebSockets for real-time data.
* Fetch live data from a chosen source for use in the AR application.
* Push the data from the device into the cloud (ex: COSMOS DB). Data architecture. External data, ingest the data. Orchestrate the data in some form of storage. Analysis of Multiple IOT devices. Pulling to an individual dashboard just for the device. Aggregate information.
* Overlay the device dashboard based on the proximity of the location. The person on site walks through. As they reach a certain location. The ability will be to overlay the data. Real time pull. Storage:

Step 4: Cleaning sensor data from IoT devices.

* This step is essential to ensure that the information you're working with is accurate, consistent, and useful.
* Verify people count data: Ensure the counts are non negative
* Ensure that timestamps from different sensors are aligned.
* Decide if outliers should be corrected (if they're errors) or removed.

Step 5: Building to Apple Vision Pro headset

* AR App Development: The AR app, developed for the Apple Vision Pro headset, should have capabilities to fetch the data from the backend API and visualize it.
* Use the visionOS SDK to retrieve the
* Design the AR Dashboards in Unity3D software
* Build the Unity project to iOS platform. Transfer the build from xcode to Apple Vision Pro headset or visionOS Simulator

Step 6: User in specific Anchor

* The AR dashboard will be anchored in specific location in front of the Cafeteria, Parking Lot, and Library. The Anchors will be used to ensure that virtual content appears in the correct position and stays there, even as a user moves around.
* Present a dashboard to the user wearing the Apple Vision Pro headset