Abstract
The project focuses on the Internet of Things (IoT) intertwined with Machine Learning (ML). The group continues the SenseScape Testbed, an IoT experimentation platform for indoor environments containing a variety of sensors, location-tracking nodes, and robots. The SenseScape Testbed provides an adaptable environment for labeling/testing advanced ML algorithms centered around IoT.

The Project’s Three Phases

Phase One:
- MAESTROS recognize predetermined set of activities in office
- Set in coordinate system
- Cameras capturing video data of human activity
- Automatic labeling

Phase Two:
- MAESTROS communicate with each other about what is happening in space using zero-shot or few-shot recognition.

Phase Three:
- MAESTROS communicate with each other to create a narrative of given space
- "memory" of the space
- Descriptions based on scope of time
- LLM is core of project

SERVER/DATABASE ARCHITECTURE

Here is the location of where the sensor data is being sent.

Synchronizes clocks in network
- Synchronizes Raspberry Pis with sensors or cameras attached
- Essential for connecting sensor data to the camera
- Input is same time
- Using ethernet to connect to boundary server - latency less than a wireless connection

**Hardware**

- **Raspberry Pi Model 3B+**: Microcomputer with Raspberry Pi OS Lite (Legacy)
- **MAESTRO**: a custom multi-modal sensor. Has **NINE** distinct sensors

**Website**

- **Reservation system** for robot
  - Client sends Python script for robot that will be carried out if accepted
  - **User-friendly**: easy for user to execute commands & restricts change

**HARDWARE**

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**WEBSITE**

- **Real-time information** on the sensors: Name of sensor, online status, & continuous data
- **Reservation system** for robot
  - Client sends Python script for robot that will be carried out if accepted
  - **User-friendly**: easy for user to execute commands & restricts change

**UNITY/ROBOTICS**

- **Explored Unity** for human centered design
  - Avatar mirrors webcam feed
  - VSeeFace: sends webcam data to IP address
  - Multiple users in testbed
- **Explored ROS Point Clouds**
  - LIDAR generated point clouds
  - Explore room using first person camera
  - Point cloud sent in real-time through ROS rviz (3D visualization tool)
- **VR through Meta Quest 2**
  - User can move & interact with digital twin room in headset
  - Demo: table and 3 blocks + grabbed using controllers

**COORDINATE SYSTEM**

Measurements taken of WINLAB. Focus on smaller control room. Map to be included on website.

**FUTURE WORK**

- **Hardware for PTP**: TimeCard mini Platinum Edition from OCP-TAP
- **Data Collection**: Set up MAESTROS & cameras in grid and collect data
  - **Data is uploaded on website**
  - **Cross-modal retrieval**
  - **Embedding-space arithmetic**
  - **Audio-to-image generation**

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