

Machine Learning for IoT (Maestro)

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Introduction

- Imagine yourself in a crowded auditorium setting. In the event of emergence, how could you find the most efficient, and reliable escape path? How could you help others to achieve the same goal? We should take following questions into consideration.
 - How to measure hallway capacity?
 - How to calculate occupancy distribution?
 - How to find a quick but not intrusive way to disseminate useful information to people?



Project Overview

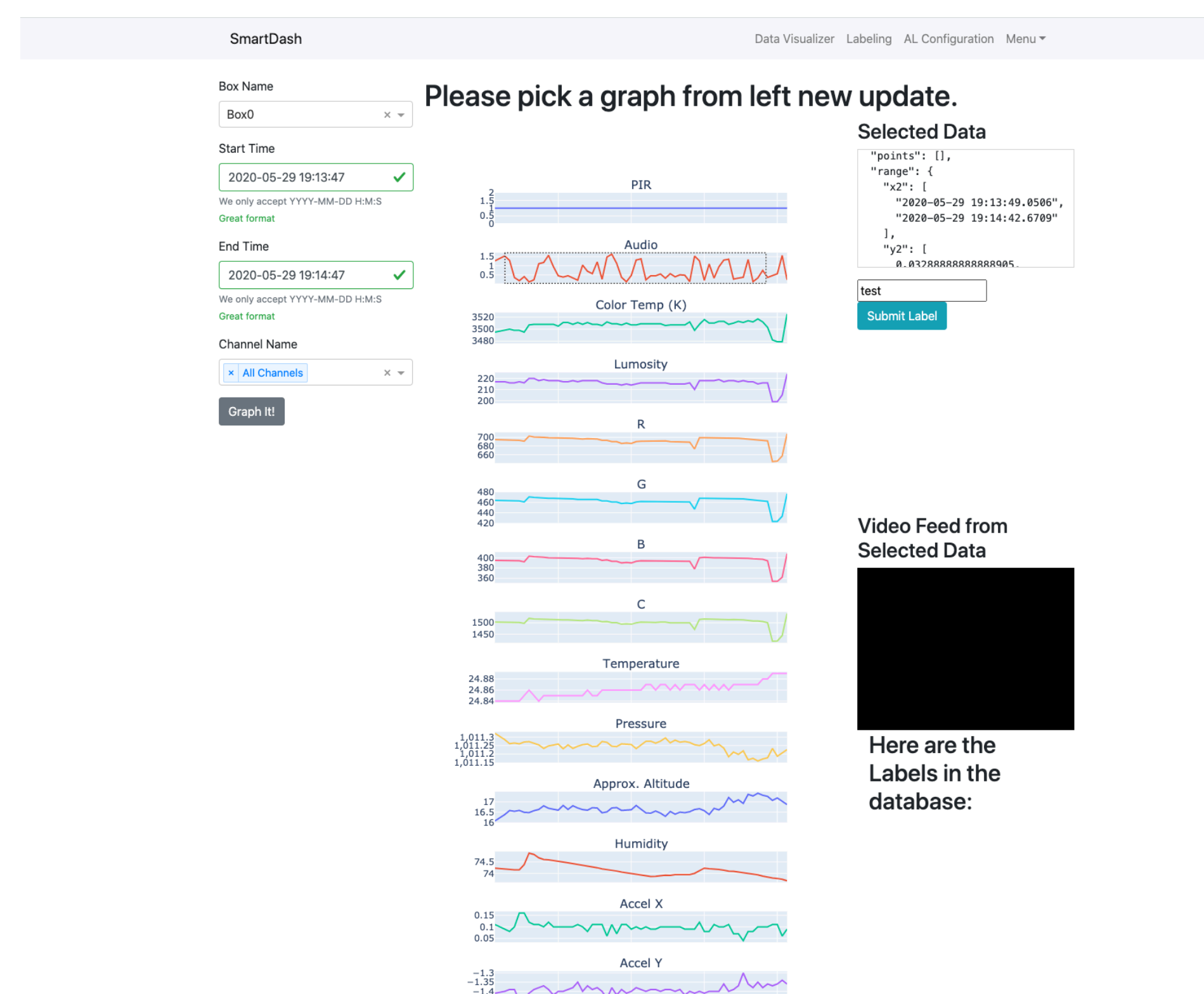
- The objective of this project is to build a framework for building intelligent environment applications through ambient sensing and machine learning.
- To achieve the goal of an “intelligent environment”. We need to find solutions to the previous questions
 - How to measure hallway capacity?
 - We can measure the speed of human movement in the auditorium**
 - How to calculate occupancy distribution?
 - Deploy sensors that can accurately read and collect data**
 - How to find a quick but not intrusive way to disseminate useful information to people?
 - Allow smartphone apps to connect to the sensor system**

Smart Box + Smart Dash

- Smart box:
 - has multiple sensors attached to an Arduino which connects to a python backend and uploads data every 10 seconds to a MongoDB database.



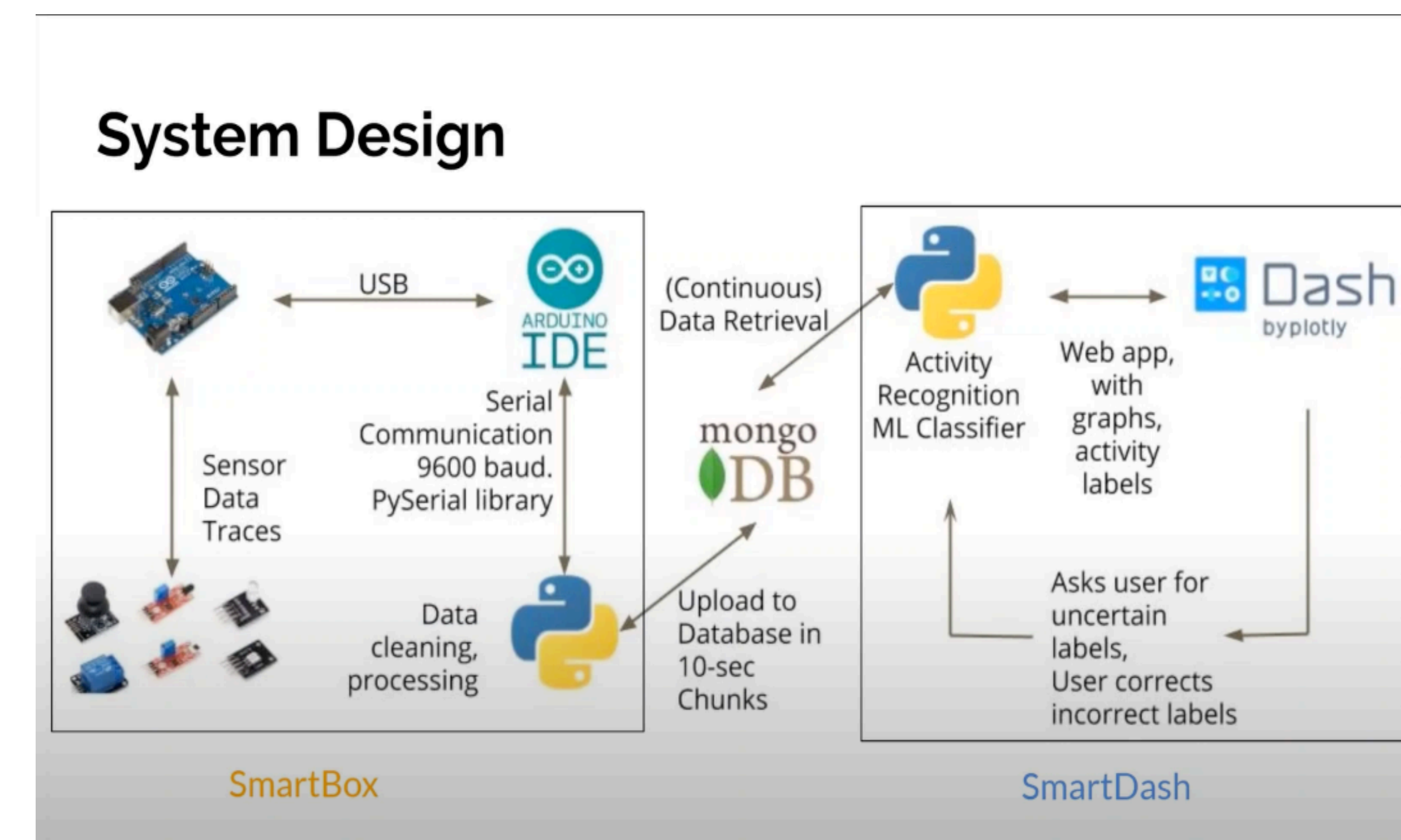
- Smart Dash:
 - is a full stack framework where users could query the data they need and generate graphs based on their time inputs.



Reference

Project repository:
<https://github.com/shantanu/smart-box>

System Design



SmartBox:

- The Smart Box hardware is currently in the prototype phase. It is powered by a Raspberry Pi 3, and the data collection is enabled through an Arduino Uno connected to various sensors listed in the following
 - Passive infrared motion detection
 - Magnetometer
 - Color and Illumination
 - Audio Sensor
 - Temperature/Humidity/Barometer
 - Geophone
 - WIFI Transceiver
- It includes a configuration feature that allows the user to specify what sensors are plugged into the SmartBox (and in which order). Every 10 seconds, the SmartBox issues a POST request in JSON with 180 total sensor readings,

SmartDash:

- is an active learning framework with two main functions: data visualization, and user querying for active learning.
- The visualizer allows users to visualize the data based on start time, end time, and channel name.
- The Active Learning portion of SmartDash takes the latest user query from the active learning application, and displays a GIF of the corresponding video feed and a small graph of the data to the user. The user is then able to submit their label for that data, which feeds back into the active learning system.

Future Application

For the future direction of this project, there are a couple of areas where we could dive into

- Activities of Daily Life Monitoring
 - Set up smart-boxes in homes of elderly people allows us to monitor their health
 - Classify what they are doing e.g. using stove, walking



- HVAC System Fine-Tuning
 - Active learning can help understand occupancy schedules and comfort preferences of occupants
 - Allows energy savings by keeping occupants comfortable, turning off HVAC when no occupants.

