CECS 327 IoT End-to-End System Report

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Overview

This project implements an end-to-end IoT system that integrates IoT sensor data, a MongoDB database, and a client-server architecture to process and analyze user queries. The system uses metadata from IoT devices to enhance functionality, and all queries are processed in PST and presented in imperial units.

System Architecture

The project consists of the following components:

1. **IoT Devices**: Virtual devices simulated in Dataniz generate sensor data.
2. **MongoDB Database**: Stores IoT device data, including metadata.
3. **TCP Server**: Processes queries, interacts with the MongoDB database, and performs calculations.
4. **TCP Client**: Sends queries to the server and displays results to the user.

Features

- Processes three specific queries:
  1. **Q1**: Average moisture inside the kitchen fridge in the past three hours.
  2. **Q2**: Average water consumption per cycle in the smart dishwasher.
  3. **Q3**: Determines which device consumed more electricity (two refrigerators and a dishwasher).
- Performs unit conversions (e.g., moisture to RH%, water consumption to gallons).
- Displays results in PST and imperial units.

Tools and Libraries

- **Python 3.8.3** with:
  - pymongo
  - certifi
- **MongoDB Atlas** for database management.
- **Google Cloud** for hosting the server (optional).
- **Dataniz** for generating virtual IoT device data.

Setup Instructions and Usage

View README file.

System Details

Metadata Usage:

- Each IoT device has unique metadata, including:
  - "asset_uid": Unique identifier for the device.
  - "board_name": Identifies the type of device (e.g., fridge or dishwasher).

- "sensor type": The type of data being measured (e.g., moisture, water consumption, electricity).
- Metadata is used to:
  - Match devices in the database.
  - Filter and process queries.

Queries and Calculations:
1. **Q1**: Uses the "Moisture Meter - moistureMeter1" field in the fridge metadata to calculate the average moisture over the past 3 hours.
2. **Q2**: Uses the "WaterConsumptionSensor" field in the dishwasher metadata to calculate the average water consumption.
3. **Q3**: Compares "DishwasherAmmeter" (dishwasher) and "Ammeter" (fridge) to determine the device with the highest electricity usage.

Challenges and Solutions

Challenges:
- Field name inconsistencies in IoT data.
- Ensuring proper type conversions (e.g., strings to doubles).
- Handling cases where no data matches the query criteria.

Solutions:
- Used consistent field matching and type conversions in MongoDB queries.
- Implemented fallback responses for cases with no matching data.
- Utilized metadata for precise filtering and aggregation.

Feedback on Dataniz

Positive Aspects:
- Intuitive platform for generating realistic IoT data.
- Supports metadata-rich device simulation.

Suggested Improvements:
1. Allow bulk data export in multiple formats (e.g., CSV, JSON).
2. Provide tools to visualize sensor data over time.
3. Allow all devices to be turned on or off to generate data.
4. Removing MetaData from the website instead of having to delete it from a database.