Agri-Tech

Farm Water Management

IITM & GL – ACSE Oct’21

Final Capstone Demo and Presentation - Oct 2022

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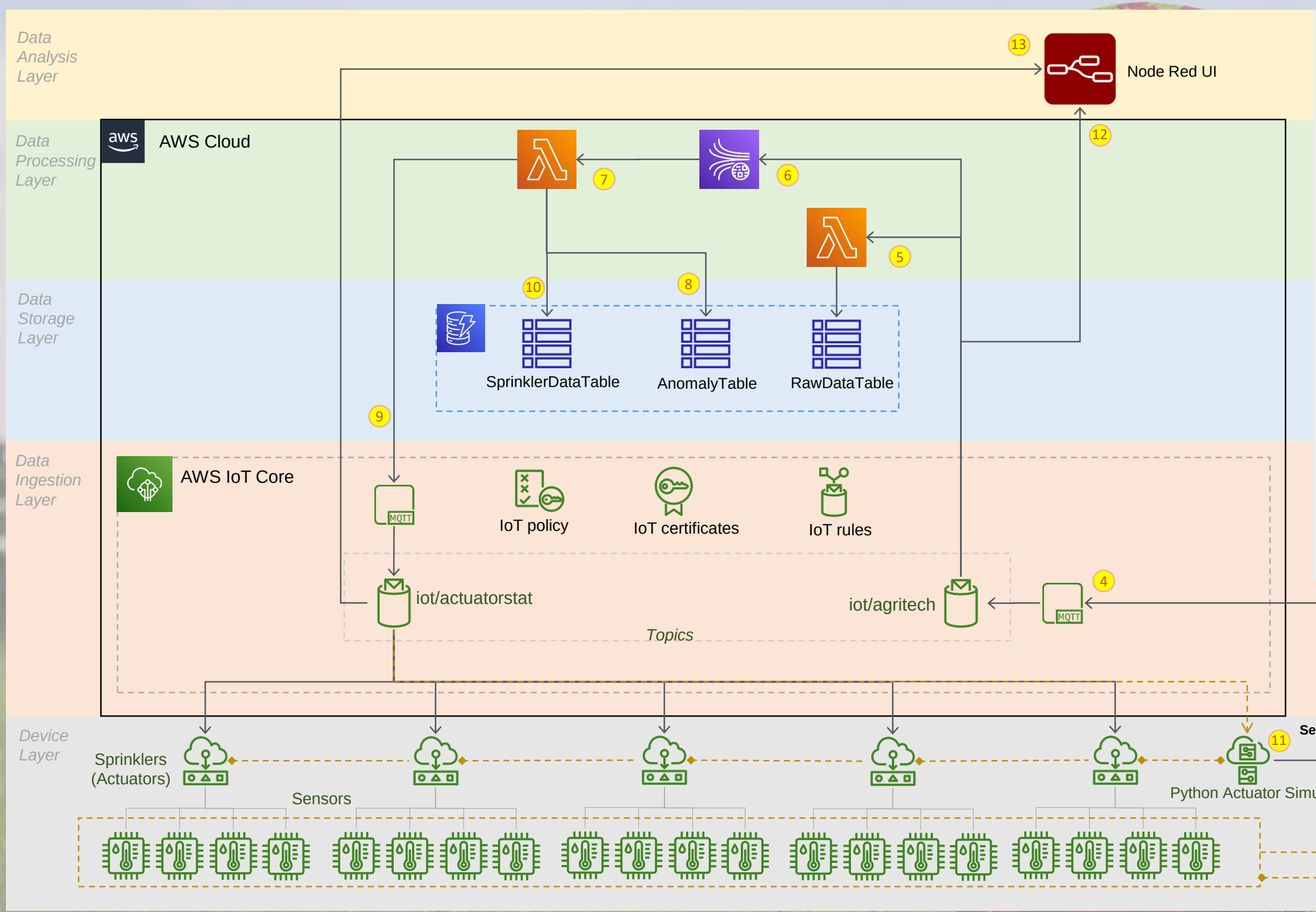
Agenda

- Architecture
- Components used in this Project
- Data Model
- Edge Computing
- Solution Files
- Project Structure
- Thresholds
- Business Logic
- Graphical Dashboard
- Questions?

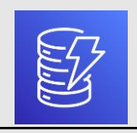
Architecture



END to END FLOW

1. Update sensor group config with initial setting (one-time).
2. Read sensor config.
3. Send sensor Latitude & Longitude and get Air Temperature, Air Humidity & Rain data from Open Weather API.
4. Send this raw data Soil Temperature, Soil Moisture, Air Temperature, Air Humidity and Rain data to Topic iot/agritech.
5. Push Raw Data to RawDataTable.
6. Push Raw Data to Kinesis Data Stream.
7. Get Raw Data and execute Lambda function.
8. Log Anomaly State, Actuator State and Rain forecast for sensor group (each of four sensors) in Anomaly Table.
9. Once all four sensors for an actuator have logged anomalies , determine if sprinkler has to be turned on(1) or off(0), send payload to iot/actuatorstat topic for actuator simulator to receive command to turn sprinkler on or off.
10. Store data from step 9 in SprinklerDataTable.
11. Update sensor config with new setting.
12. Send Raw Data for analytics and for Graphical Representation of Sensor Data to Node-Red
13. Send Place, Severity Levels and Actuator State for display on Dashboard (UI)

Components Used in this Project

	AWS IAM	To Create **AgriTechRole** and **LambdaRole**. AgriTechRole is used for S3 and IoT. LambdaRole is used for Lambda Function execution.
	Amazon S3	S3 bucket **sniotg2** for auto-provisioning of devices on the cloud. Provisioning template is used and bulk registration done.
	AWS IoT Core	During bulk-registration, IoT things, groups, thing types (Actuator, Sensor) are created. Certificates & Policies are attached. Simulator code for sensor publishes to MQTT topic **iot/agritech** & Lambda function publishes to MQTT topic **iot/actuatorstat**. Rules are also configured for lambda functions execution.
	Kinesis Data Stream	**AgriTechDataStream** Streams Raw Data to **AnomalyFunction**. Sensor data is a large stream of real time data which needs to tracked and processed for detecting anomalies near real time
	AWS Lambda Functions	Two Lambda functions are used, one to store raw data to **RawDataTable** and other to process sensor group anomalies and publish actuator command to MQTT topic **iot/actuatorstat**.
	Dynamo DB Tables	Three tables used. Data Model on next slide.
	Node-Red	Node-Red UI is used for Graphical representation of Sensor Status, Senor Group Anomaly State and Sprinkler Status on the UI.
	SQLite DB	SQLite DB is used to store Sensor Group Config data. SQLite is a lightweight disk-based database that doesn't require a separate server process and allows accessing the database using a nonstandard variant of the SQL query language

Data Model

RawDataTable	
Partition Key	deviceid
Sort Key	timestamp
	actuatorStat
	airMoisture
	airTemperature
	groupid
	latitude
	longitude
	place
	rainForecast
	soilMoisture
	soilTemperature

AnomalyTable	
Partition Key	sensorId
Sort Key	sensortimestamp
	actReqtimestamp
	actuatorId
	groupId
	grpAnolamyState
	soilMoisture
	soilTemperature
	latitude
	longitude
	place

SprinklerDataTable	
Partition Key	actuatorId
Sort Key	ActCmdtimestamp
	actuatorCmd
	groupId
	grpAnomalyState
	rainForecast
	latitude
	longitude
	place

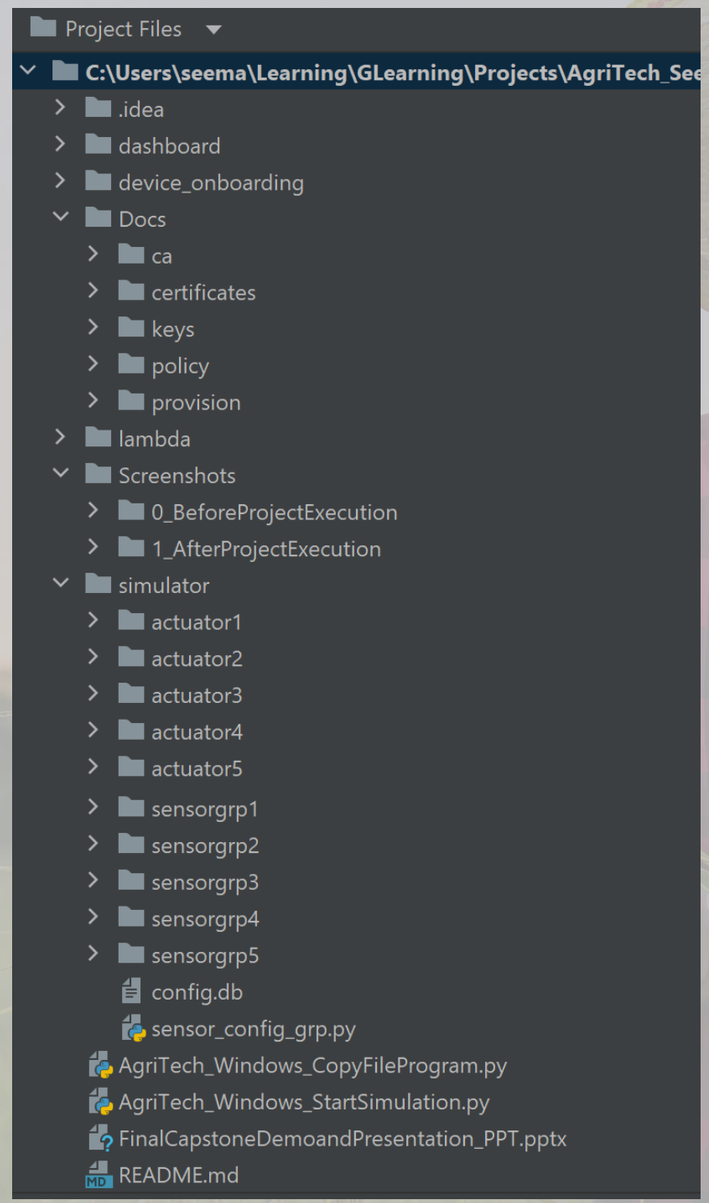
Edge Computing

Components and External Integrations			
 sensor_group_config	Sensor Group Configuration Database	Column	Description
		DEVICE ID	Id of the Sensor device
		GROUP ID	Sensor Group Id
		LAT	Latitude value for sensor group
		LONG	Longitude value for sensor group
		LOCATION	Place value for sensor group
		CONTROL ID	Group Anomaly State (Severity level)
		ACTUATOR STATUS	Actuator Status ON (1) or OFF (0)
OpenWeather	Open Weather Map API Integration	Returns the Weather data for given sensor group latitude and longitude values.	

Solution Files

Code File	Notes
bulkregistration.py config.py **main.py** general-policy.json provisioning-data.json provisioning-template.json	Device onboarding (bulk registration process)
senor_grp_config.py	Generates the initial SQLite config database
soil_sensor_grp_publish.py	Sensor Simulator. (Publisher) Also fetches Air Temperature, Air Moisture and Rain forecast from Open Weather Map.
actuator_stat_subscribe_grp.py	Sprinkler Simulator. (Subscriber) Subscribes to the topic iot/actuatorstat and updates the sensor group config (SQLite db).
AnomalyFunction.py	Lambda Function - code to be added to code section after creating AWS Lambda function.
RawDataStorageFunction.py	Lambda Function - code to be added to code section after creating AWS Lambda function.
node_red_dashboard_ui.json	JSON file that can be imported into a Node-Red UI
AgriTech_Windows_CopyFileProgram.py AgriTech_Windows_StartSimulation.py	Utility Files for Windows OS to make copying of certificates and running of simulators faster.
README.md	Readme file with step by step explanation of the project setup and execution.

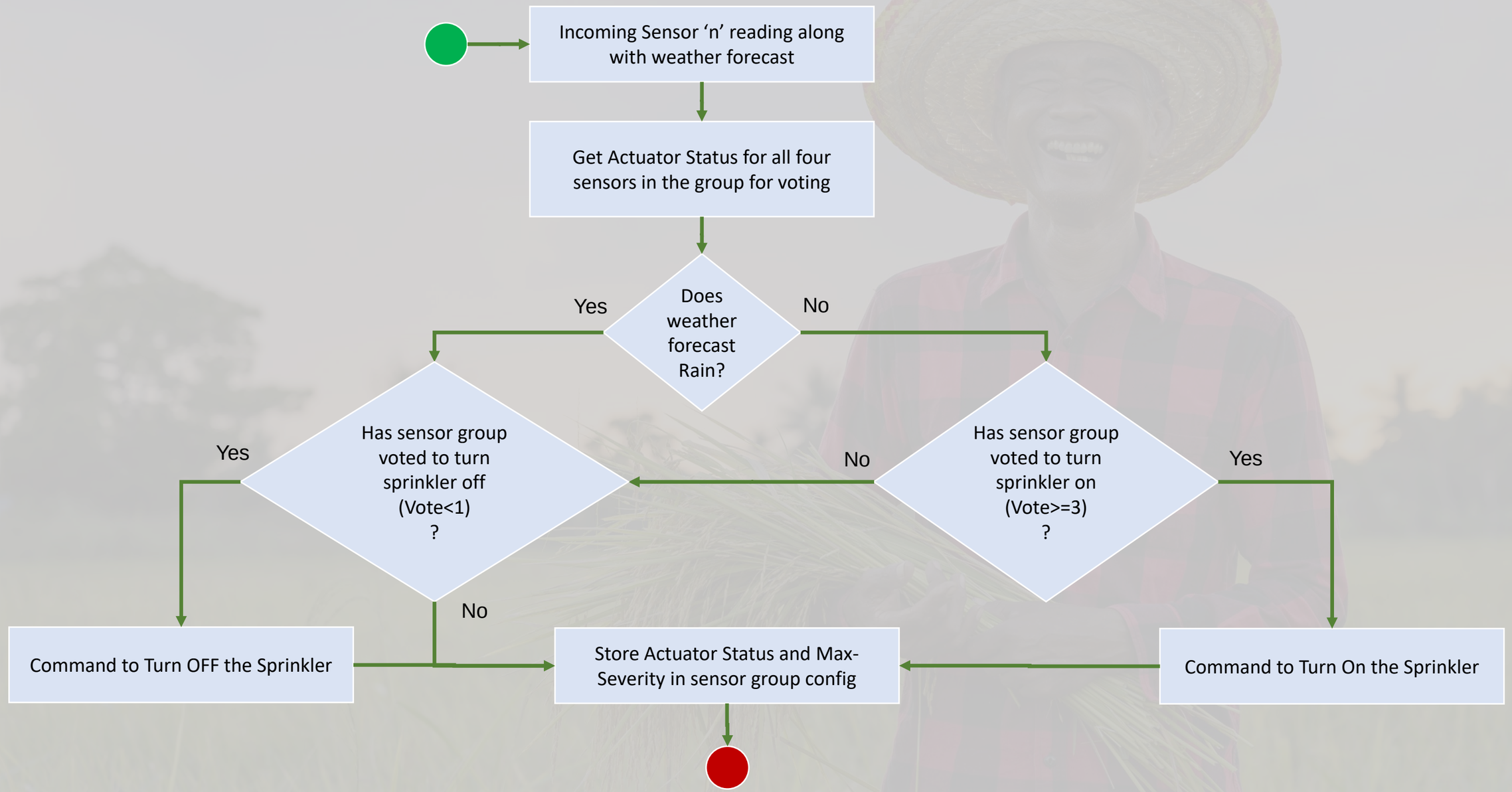
Project Structure



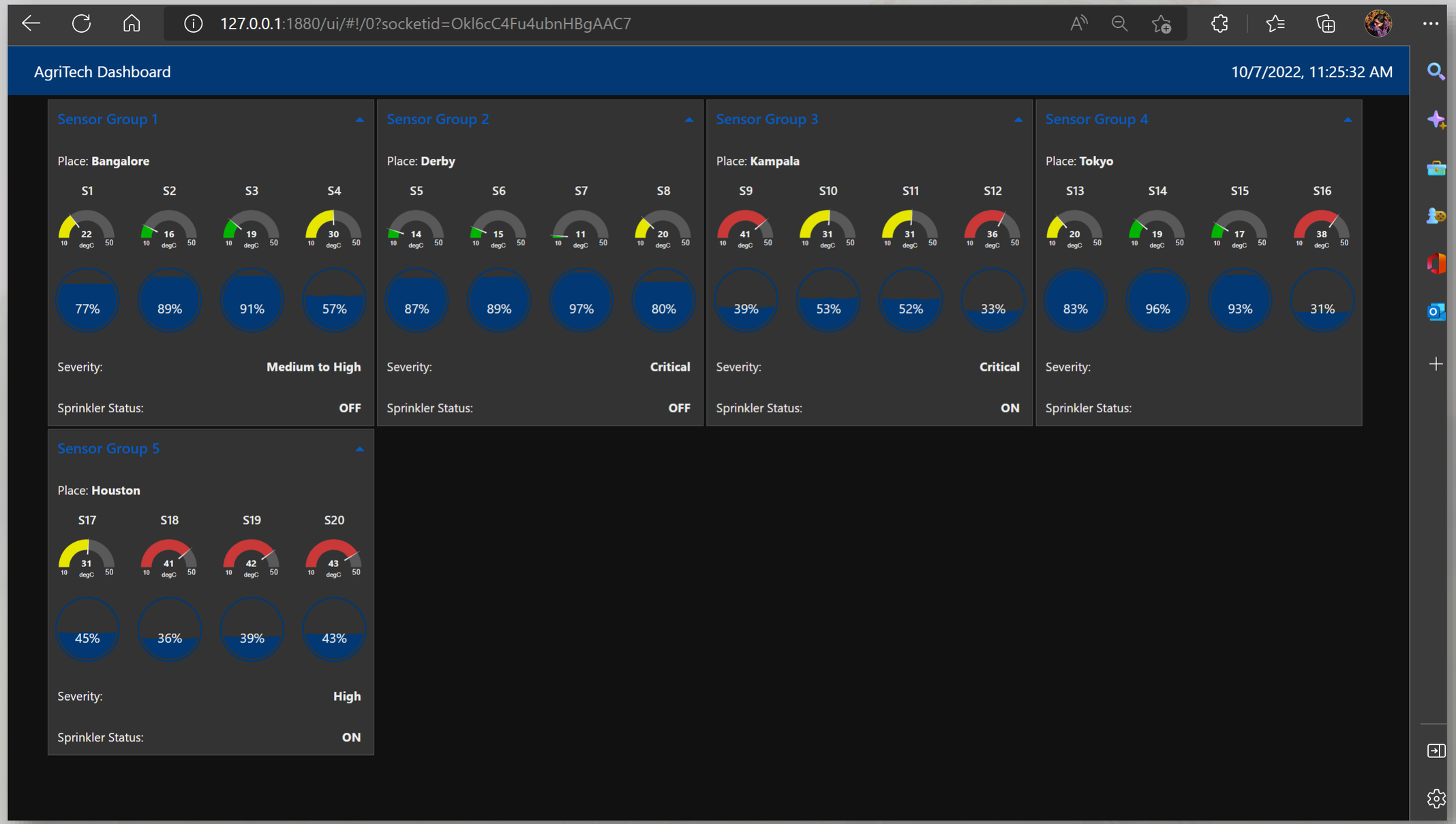
Thresholds

Soil Temperature	Soil Moisture	Weather Forecast	Severity Level	Sprinkler Command
< 20	86-100		0-Normal	OFF
< 20	86-100	No Rain	0-Normal	OFF
20-25	75-86		4-Low	OFF
20-25	75-86	No Rain	4-Low	ON
25-30	60-74		3-Medium	OFF
25-30	60-74	No Rain	3-Medium	ON
30-35	45-49		2-High	OFF
30-35	45-49	No Rain	2-High	ON
>=35	30-44		1-Critical	OFF
>=35	30-44	No Rain	1-Critical	ON

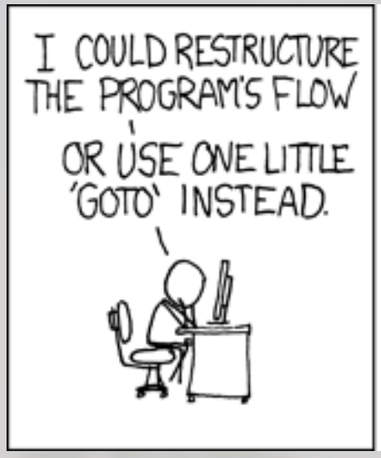
Business Logic

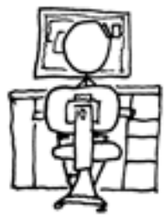


Graphical Dashboard (Node-Red UI)



Questions?





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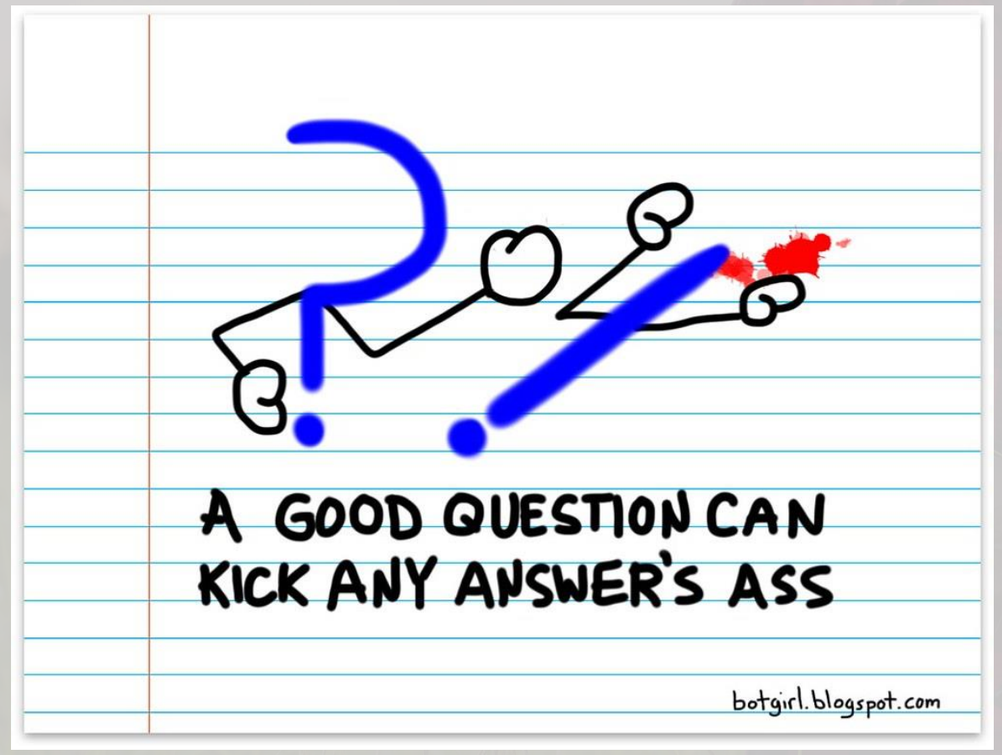

Thank You.