kCloud

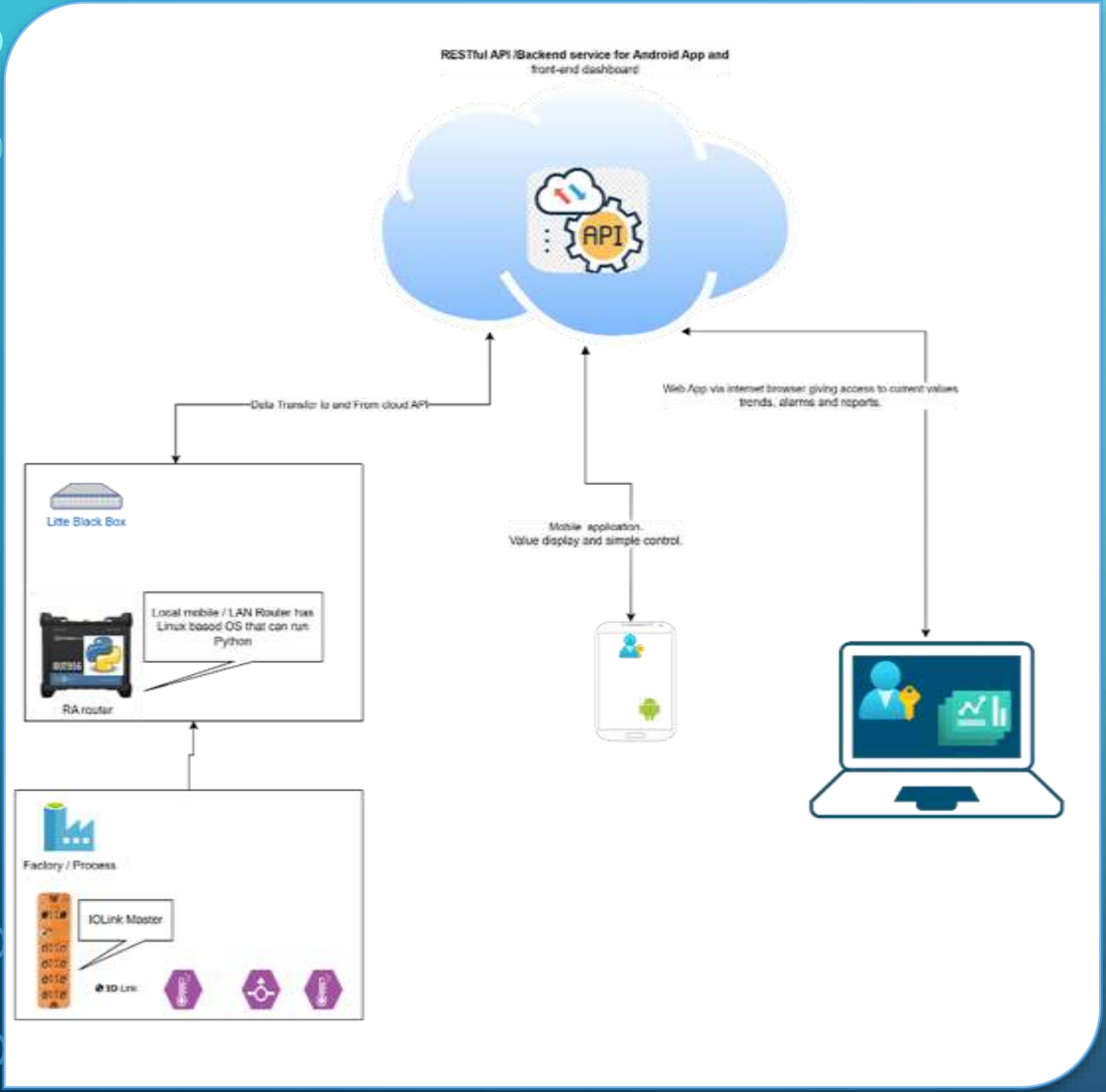
IIOT CUSTOMIZABLE SOLUTION FOR DATA TRANSFER IN SMALL TO MEDIUM INDUSTRIAL CONTROL.

HDip in Computer Science, SETU – 2022-2024

David Roche - 93521243

BACKGROUND-ME

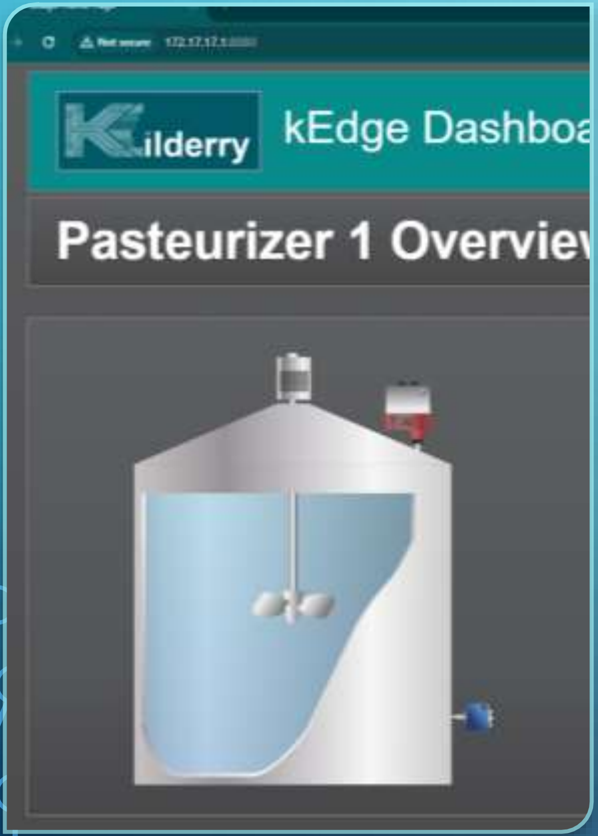
- Graduated from WIT in 1997 BTech Hons in electronic engineering.
- Working as Automation and Controls engineer since 2002.
- Undertook HDip to expand knowledge of high-end software development to maybe be a bit more elephant.


RESTful API /Backend service for Android App and front-end dashboard
API
Data Transfer to and From cloud API
Web App via internet browser giving access to current values trends, alarms and reports.
Mobile application. Value display and simple control.
Litte Black Box
Local mobile / LAN Router has Linux based OS that can run Python
RA router
Factory / Process
IOLink Master
IO-Link

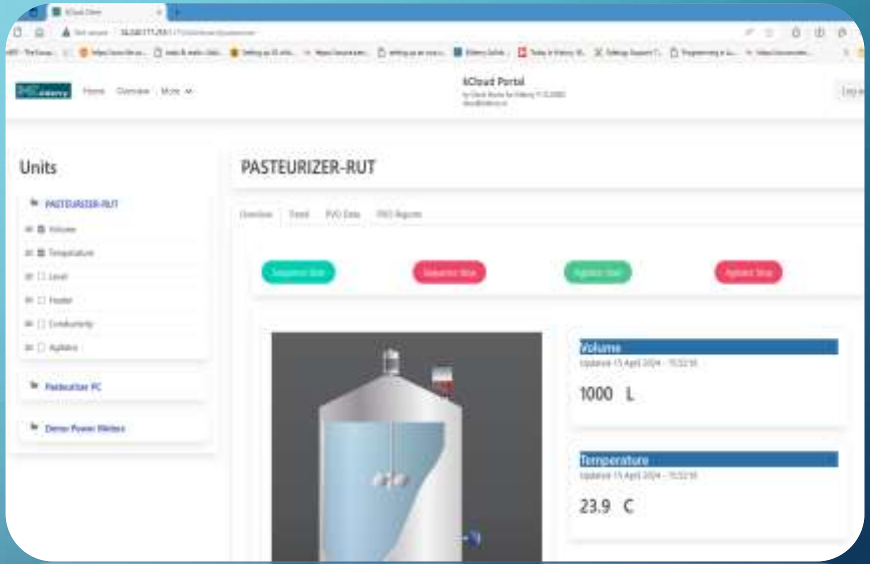
PROJECT AIMS

- Use knowledge gained from course to design a:
  - Cost effective EDGE to CLOUD solution.
  - Possible platform for R.AD. of IIOT capable solutions.
  - Workable across PLC platforms.
  - Capable of operating offline independent of cloud if desired.
  - Workable solution at the end of the project.
- Why
  - To be able to provide customers with data 1st hand. Our company can provide the OT and IT solution.

PROJECT-IMPLEMENTATION



- Simple Pasto Process in Python with local control and trending.
- Data sent to API Back End.
- Remote viewing and control.
- Repeatable without major Mods.

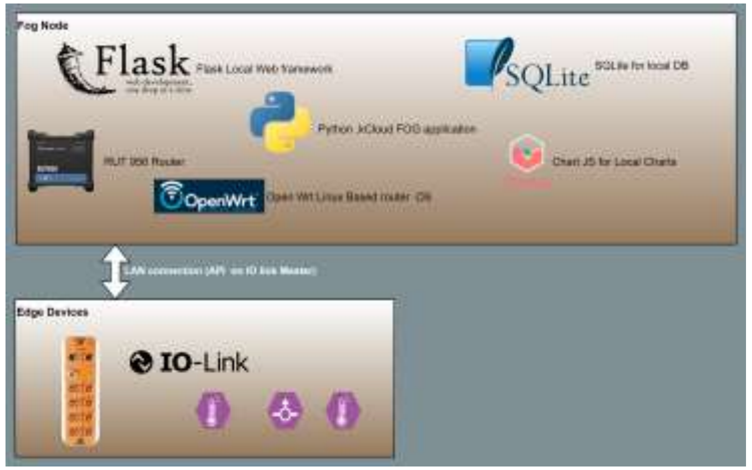


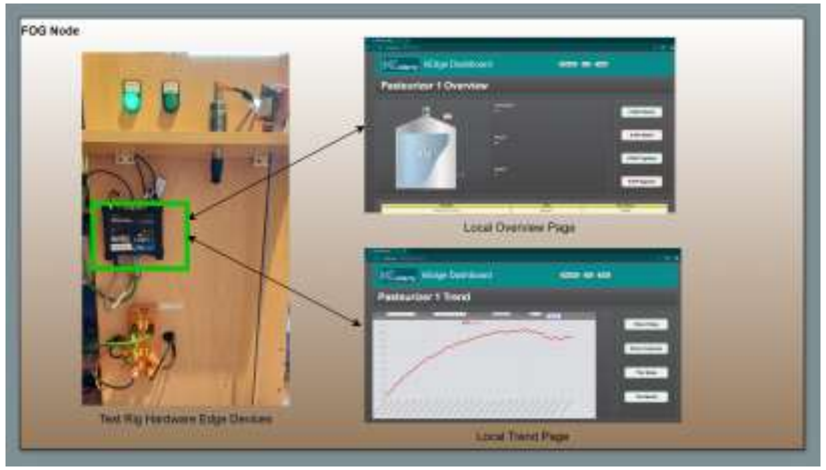
FOG NODE - FUNCTIONS

MARSHALS DATA TO THE CLOUD FROM EDGE DEVICES.

STORES DATA FOR LOCAL ACCESS AND TRENDING.

PROVIDES LOCAL USER INTERFACE.


Fog Node
Flask
Flask Local Web framework
SQLite
SQLite for local DB
Python JcCloud FOG application
RUT 956 Router
Chart JS for Local Charts
OpenWrt
Open Wrt Linux Based router OS
LAN connection (API on IO link Master)
Edge Devices
IO-Link

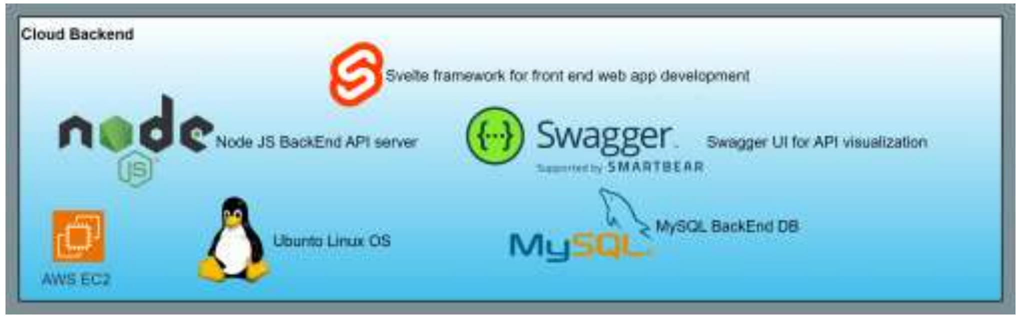


FOG NODE- TECHNOLOGIES

- Used Python to implement a simple Pasteurizer system with live instruments.
- Flask for Local browser access.
- Chart JS for Trending
- SQLite for SQL data Storage.
- Hosted on Industrial Router.

BACK-END SERVER - FUNCTION

- API interface for FOG and Front-end Devices.
- Long-Term Data Storage.
- Independent of the fog application.


Cloud Backend
Svelte framework for front end web app development
Node JS BackEnd API server
Swagger
Supported by SMARTBEAR
Swagger UI for API visualization
Ubuntu Linux OS
MySQL BackEnd DB
AWS EC2

BACK- END SERVER - TECHNOLOGIES

- Node JS Express API server.
- Development Server Ubuntu Linux on AWS.
- MySQL 8 Database.
- Swagger UI for API documentation and testing.
- Svelte kit for Front end applications.

FRONT END- FUNCTIONS

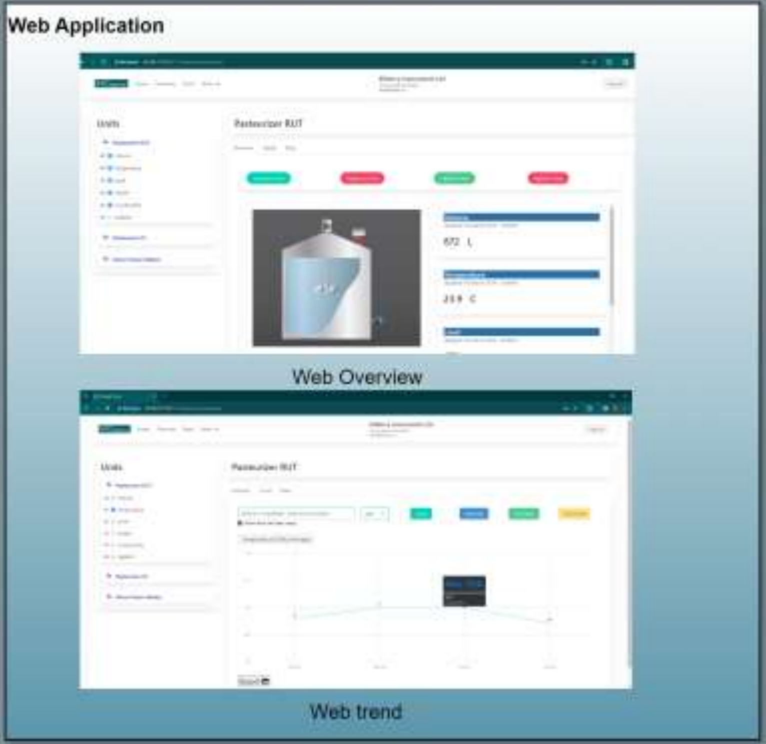
Status Review

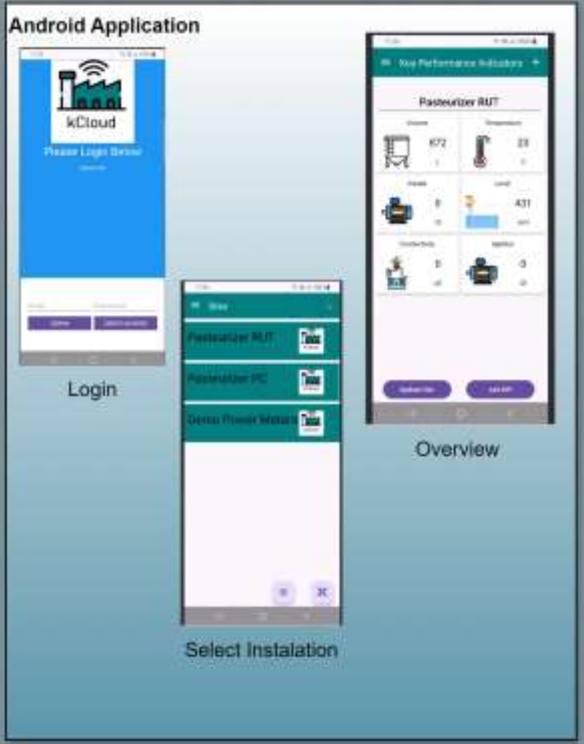
Trending

Reporting

Control

FRONT- END - TECHNOLOGIES





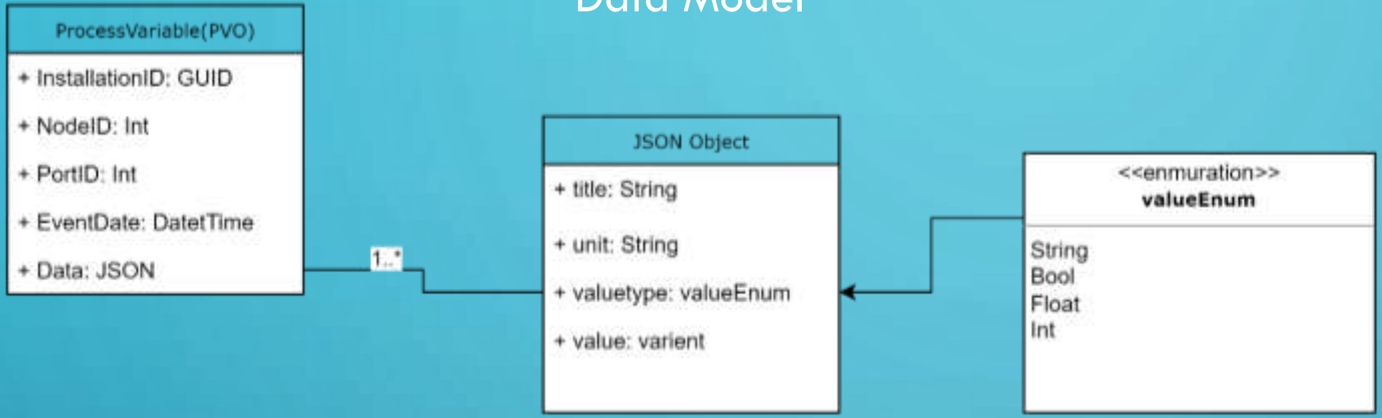
- Svelte Kit Server-Side rendering for Web.
- Frappe Charts for Trending.
- Kotlin native app for Android.

DATA MODELS - OVERVIEW

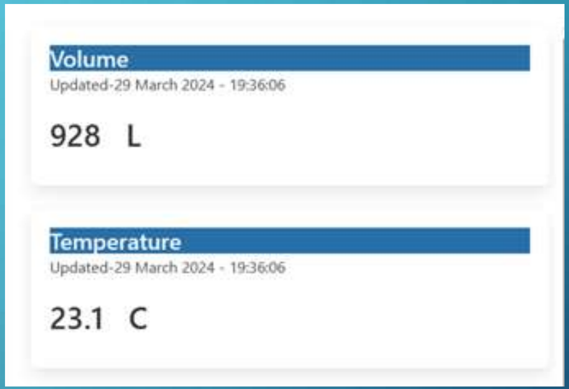
- Data Models are Critical to HOW this project Works.
- P.V.O.- Process Variable Object
  - Data from a sensor or Single Source (think MQTT)
- P.D.O. – Process Data Object
  - Data From a constructed report or batch (think End of batch report)
- C.D.O. – Control Data Object
  - Data that is used to send Control requests to the fog node.

DATA MODELS - P.V.O

Data Model



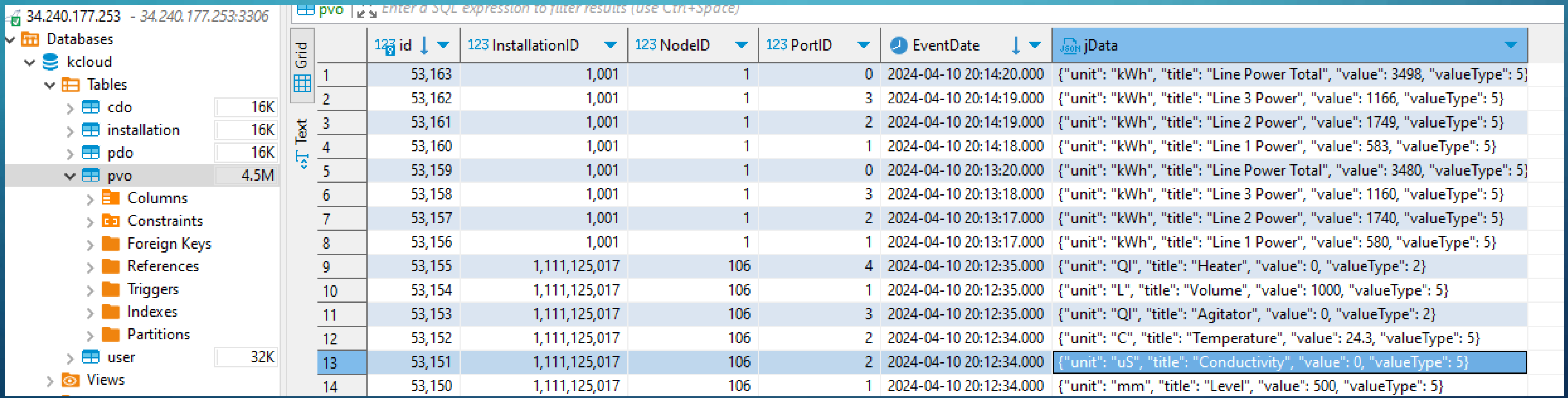
Data View



Volume
Updated-29 March 2024 - 19:36:06
928 L

Temperature
Updated-29 March 2024 - 19:36:06
23.1 C

Data Table



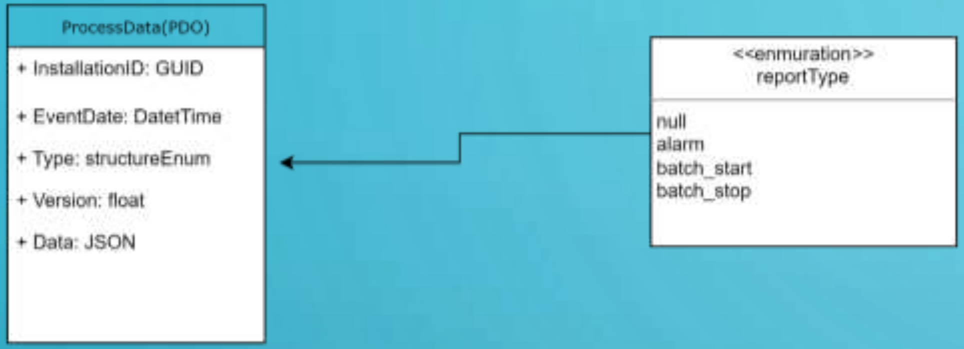
34.240.177.253 - 34.240.177.253:3306
- Databases
  - kcloud
    - Tables
      - cdo 16K
      - installation 16K
      - pdo 16K
      - pvo 4.5M
        - Columns
        - Constraints
        - Foreign Keys
        - References
        - Triggers
        - Indexes
        - Partitions
      - user 32K
    - Views

pvo | Enter a SQL expression to filter results (use Ctrl+Space)

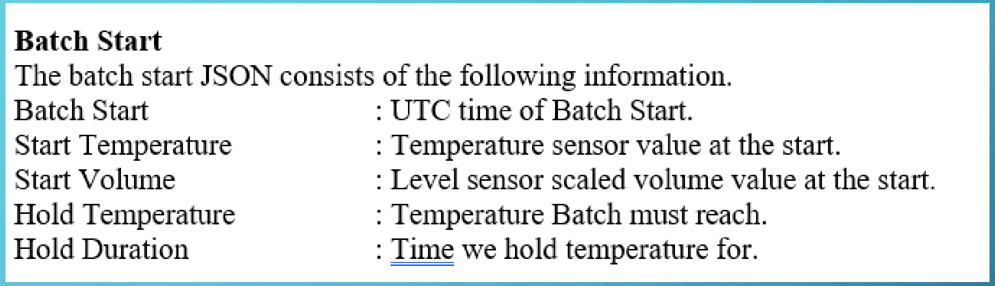
	id	InstallationID	NodeID	PortID	EventDate	jData
1	53,163	1,001	1	0	2024-04-10 20:14:20.000	{"unit": "kWh", "title": "Line Power Total", "value": 3498, "valueType": 5}
2	53,162	1,001	1	3	2024-04-10 20:14:19.000	{"unit": "kWh", "title": "Line 3 Power", "value": 1166, "valueType": 5}
3	53,161	1,001	1	2	2024-04-10 20:14:19.000	{"unit": "kWh", "title": "Line 2 Power", "value": 1749, "valueType": 5}
4	53,160	1,001	1	1	2024-04-10 20:14:18.000	{"unit": "kWh", "title": "Line 1 Power", "value": 583, "valueType": 5}
5	53,159	1,001	1	0	2024-04-10 20:13:20.000	{"unit": "kWh", "title": "Line Power Total", "value": 3480, "valueType": 5}
6	53,158	1,001	1	3	2024-04-10 20:13:18.000	{"unit": "kWh", "title": "Line 3 Power", "value": 1160, "valueType": 5}
7	53,157	1,001	1	2	2024-04-10 20:13:17.000	{"unit": "kWh", "title": "Line 2 Power", "value": 1740, "valueType": 5}
8	53,156	1,001	1	1	2024-04-10 20:13:17.000	{"unit": "kWh", "title": "Line 1 Power", "value": 580, "valueType": 5}
9	53,155	1,111,125,017	106	4	2024-04-10 20:12:35.000	{"unit": "QI", "title": "Heater", "value": 0, "valueType": 2}
10	53,154	1,111,125,017	106	1	2024-04-10 20:12:35.000	{"unit": "L", "title": "Volume", "value": 1000, "valueType": 5}
11	53,153	1,111,125,017	106	3	2024-04-10 20:12:35.000	{"unit": "QI", "title": "Agitator", "value": 0, "valueType": 2}
12	53,152	1,111,125,017	106	2	2024-04-10 20:12:34.000	{"unit": "C", "title": "Temperature", "value": 24.3, "valueType": 5}
13	53,151	1,111,125,017	106	2	2024-04-10 20:12:34.000	{"unit": "uS", "title": "Conductivity", "value": 0, "valueType": 5}
14	53,150	1,111,125,017	106	1	2024-04-10 20:12:34.000	{"unit": "mm", "title": "Level", "value": 500, "valueType": 5}

DATA MODELS – P.D.O

Data Model



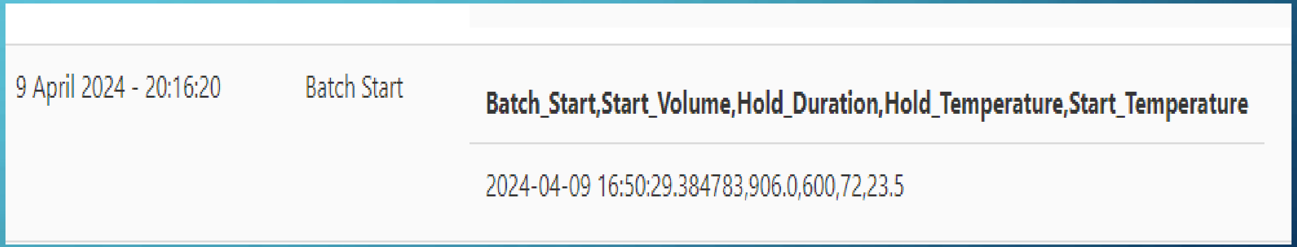
Report



Batch Start
The batch start JSON consists of the following information.

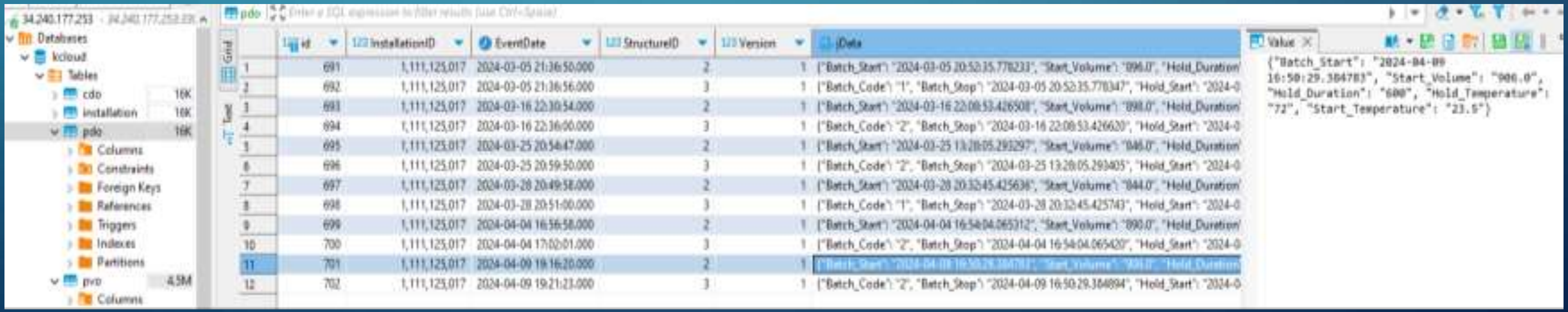
Batch Start	: UTC time of Batch Start.
Start Temperature	: Temperature sensor value at the start.
Start Volume	: Level sensor scaled volume value at the start.
Hold Temperature	: Temperature Batch must reach.
Hold Duration	: Time we hold temperature for.

Data View



9 April 2024 - 20:16:20	Batch Start	**Batch_Start,Start_Volume,Hold_Duration,Hold_Temperature,Start_Temperature**
		2024-04-09 16:50:29.384783,906.0,600,72,23.5

Data Table

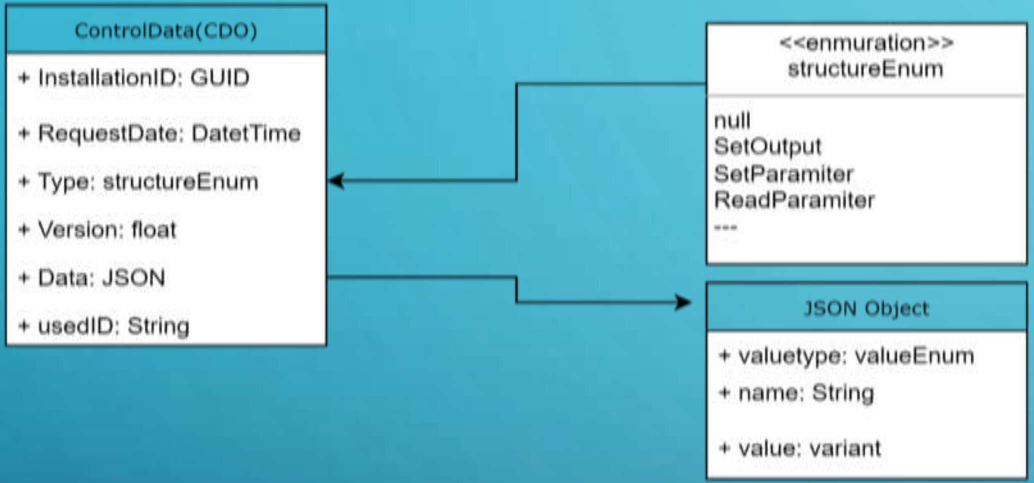


	id	InstallationID	EventDate	StructureID	Version	jData
1	691	1,111,125,017	2024-03-05 21:36:50.000	2	1	{"Batch_Start": "2024-03-05 20:52:35.778233", "Start_Volume": "896.0", "Hold_Duration'
2	692	1,111,125,017	2024-03-05 21:36:56.000	3	1	{"Batch_Code": "1", "Batch_Stop": "2024-03-05 20:52:35.778347", "Hold_Start": "2024-0
3	693	1,111,125,017	2024-03-16 22:30:54.000	2	1	{"Batch_Start": "2024-03-16 22:08:53.426508", "Start_Volume": "898.0", "Hold_Duration'
4	694	1,111,125,017	2024-03-16 22:36:00.000	3	1	{"Batch_Code": "2", "Batch_Stop": "2024-03-16 22:08:53.426620", "Hold_Start": "2024-0
5	695	1,111,125,017	2024-03-25 20:54:47.000	2	1	{"Batch_Start": "2024-03-25 13:28:05.293297", "Start_Volume": "846.0", "Hold_Duration'
6	696	1,111,125,017	2024-03-25 20:59:50.000	3	1	{"Batch_Code": "2", "Batch_Stop": "2024-03-25 13:28:05.293405", "Hold_Start": "2024-0
7	697	1,111,125,017	2024-03-28 20:49:58.000	2	1	{"Batch_Start": "2024-03-28 20:32:45.425636", "Start_Volume": "844.0", "Hold_Duration'
8	698	1,111,125,017	2024-03-28 20:51:00.000	3	1	{"Batch_Code": "1", "Batch_Stop": "2024-03-28 20:32:45.425743", "Hold_Start": "2024-0
9	699	1,111,125,017	2024-04-04 16:56:58.000	2	1	{"Batch_Start": "2024-04-04 16:54:04.065312", "Start_Volume": "890.0", "Hold_Duration'
10	700	1,111,125,017	2024-04-04 17:02:01.000	3	1	{"Batch_Code": "2", "Batch_Stop": "2024-04-04 16:54:04.065420", "Hold_Start": "2024-0
11	701	1,111,125,017	2024-04-09 19:16:20.000	2	1	{"Batch_Start": "2024-04-09 16:50:29.384783", "Start_Volume": "906.0", "Hold_Duration'
12	702	1,111,125,017	2024-04-09 19:21:23.000	3	1	{"Batch_Code": "2", "Batch_Stop": "2024-04-09 16:50:29.384894", "Hold_Start": "2024-0

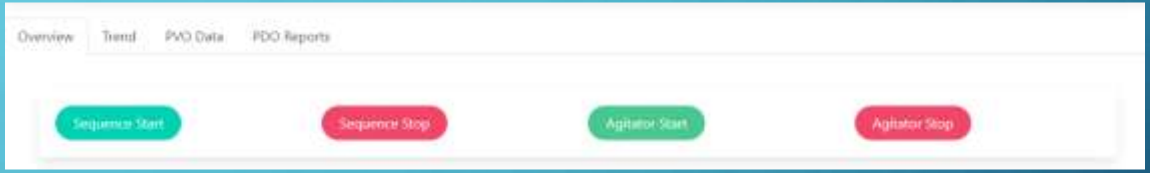
{"Batch_Start": "2024-04-09 16:50:29.384783", "Start_Volume": "906.0", "Hold_Duration": "600", "Hold_Temperature": "72", "Start_Temperature": "23.5"}

DATA MODELS - C.D.O (TRIGGER / SOFT INPUT)

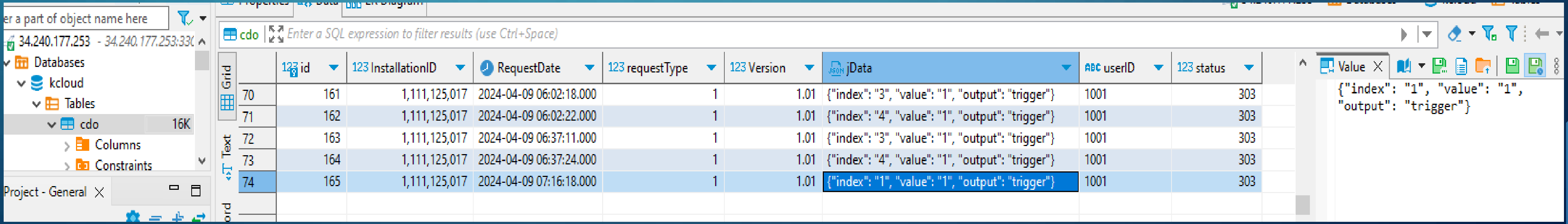
Data Model



Data View

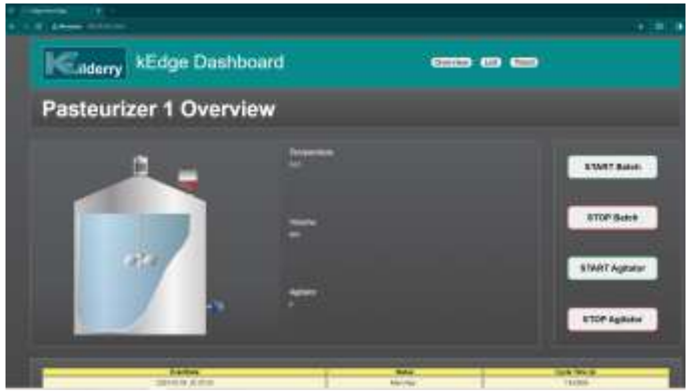


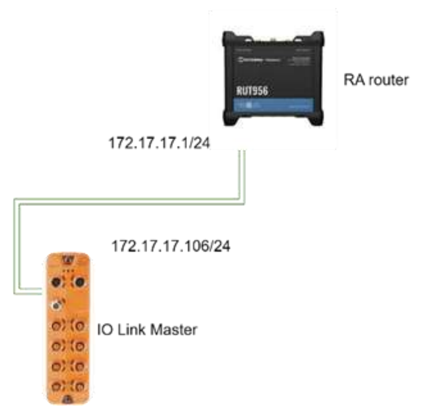
Data Table



	id	InstallationID	RequestDate	requestType	Version	jData	userID	status
70	161	1,111,125,017	2024-04-09 06:02:18.000	1	1.01	{"index": "3", "value": "1", "output": "trigger"}	1001	303
71	162	1,111,125,017	2024-04-09 06:02:22.000	1	1.01	{"index": "4", "value": "1", "output": "trigger"}	1001	303
72	163	1,111,125,017	2024-04-09 06:37:11.000	1	1.01	{"index": "3", "value": "1", "output": "trigger"}	1001	303
73	164	1,111,125,017	2024-04-09 06:37:24.000	1	1.01	{"index": "4", "value": "1", "output": "trigger"}	1001	303
74	165	1,111,125,017	2024-04-09 07:16:18.000	1	1.01	{"index": "1", "value": "1", "output": "trigger"}	1001	303

```
{"index": "1", "value": "1",
"output": "trigger"}
```





Port 1 (input)

LR2750 Level Sensor

Port 2 (input)

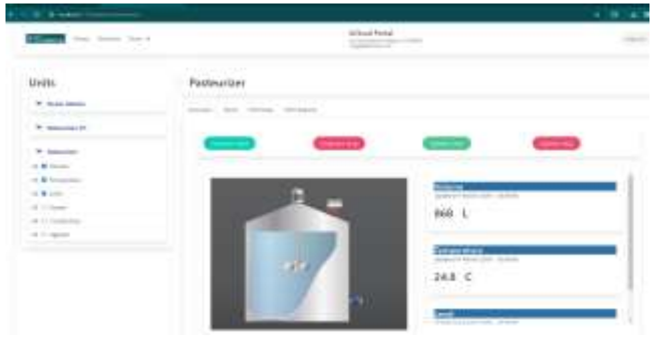
LDL 100 Temperature and Conductivity

Port 3 (Output)

DQ0 Agitator

Port 4 (Output)

DQ1 Heater



LIVE DEMO

YOU TUBE VIDEO WWW

GITHUB REPO WWW

WEB WWW

LOCAL WWW

NEW AND EXPANDED TECHNOLOGIES AND PLATFORMS.

SQLite

OpenWrt
WIRELESS FREEDOM

Flask

python
powered

Requests

Chart.js

AWS

MySQL

node JS

PM2

SVELTE

Kotlin

KEY TAKEAWAYS - GOOD

- A good footing in all the Tech used.
- Possible to use Python as a control language yes but ?
- The data design using MYSQL JSON made it possible to store and retrieve data at back end without having to modify API successful in the scope of this project.
- Fog Node is portable.
- No External subscriptions needed if locally hosted.
  - Google subscriptions, Elephant DB etc

KEY TAKEAWAYS – NOT SO GOOD BUT NOT SO BAD

RUT956 - Issues with USB storage and reverting to factory settings.

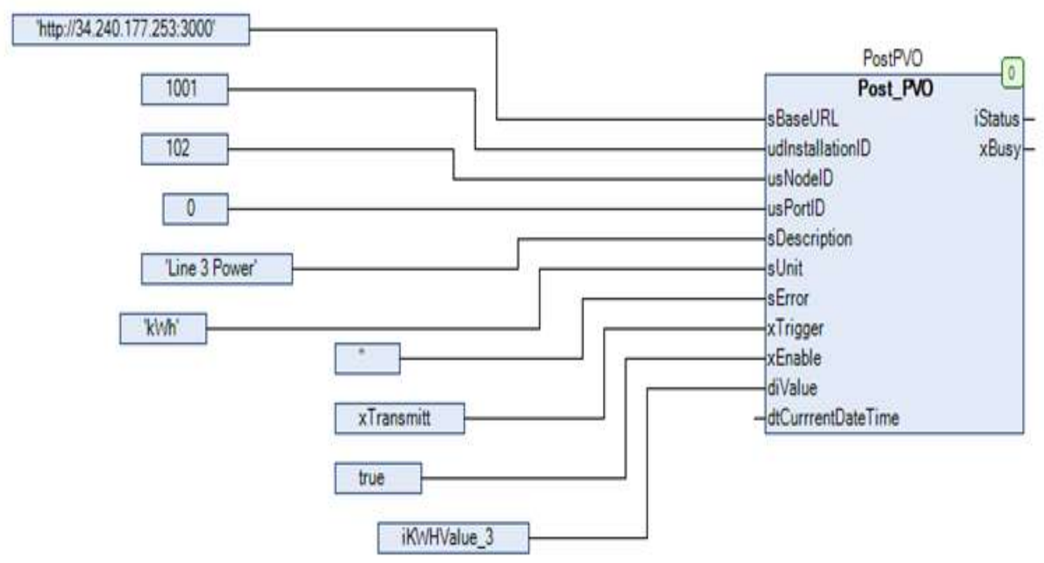
Maria DB - Issues with JSON type as Long String reverted to MySQL.

No WYSIWYG editing, needs a greater level of programming skills than standard HMI apps Godesys, Galileo etc. but no licence fees.

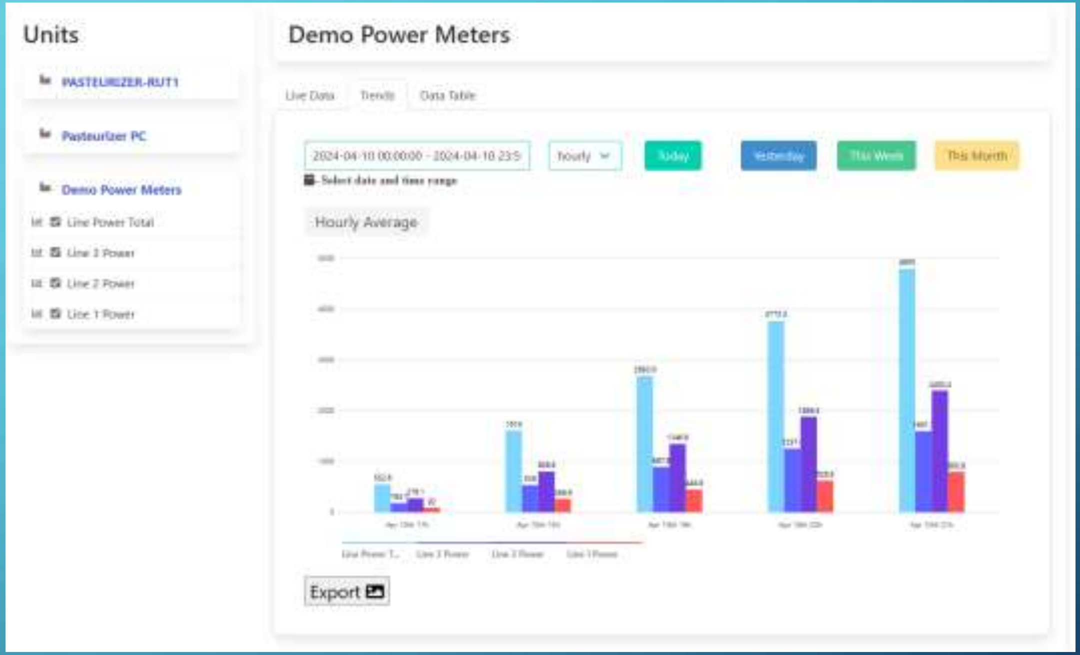
Project was foundation lots of development and testing for Production.

FUTURE DEVELOPMENTS

- Developed CODESYS FB to talk to kCloud Back-end.
- Just started working with one customer using FOG to Back end of this framework on an industrial IIOT controller.
- Another customer looking at the Codesys data upload from existing machine uploading to Back-end Web App.



QUESTIONS ?


Units
PASTEURIZER-RUT1
Pasteurizer PC
Demo Power Meters
Line Power Total
Line 3 Power
Line 2 Power
Line 1 Power
Demo Power Meters
Live Data
Trends
Data Table
2024-04-10 00:00:00 - 2024-04-10 23:5
hourly
Today
Yesterday
This Week
This Month
Select date and time range
Hourly Average
Export