

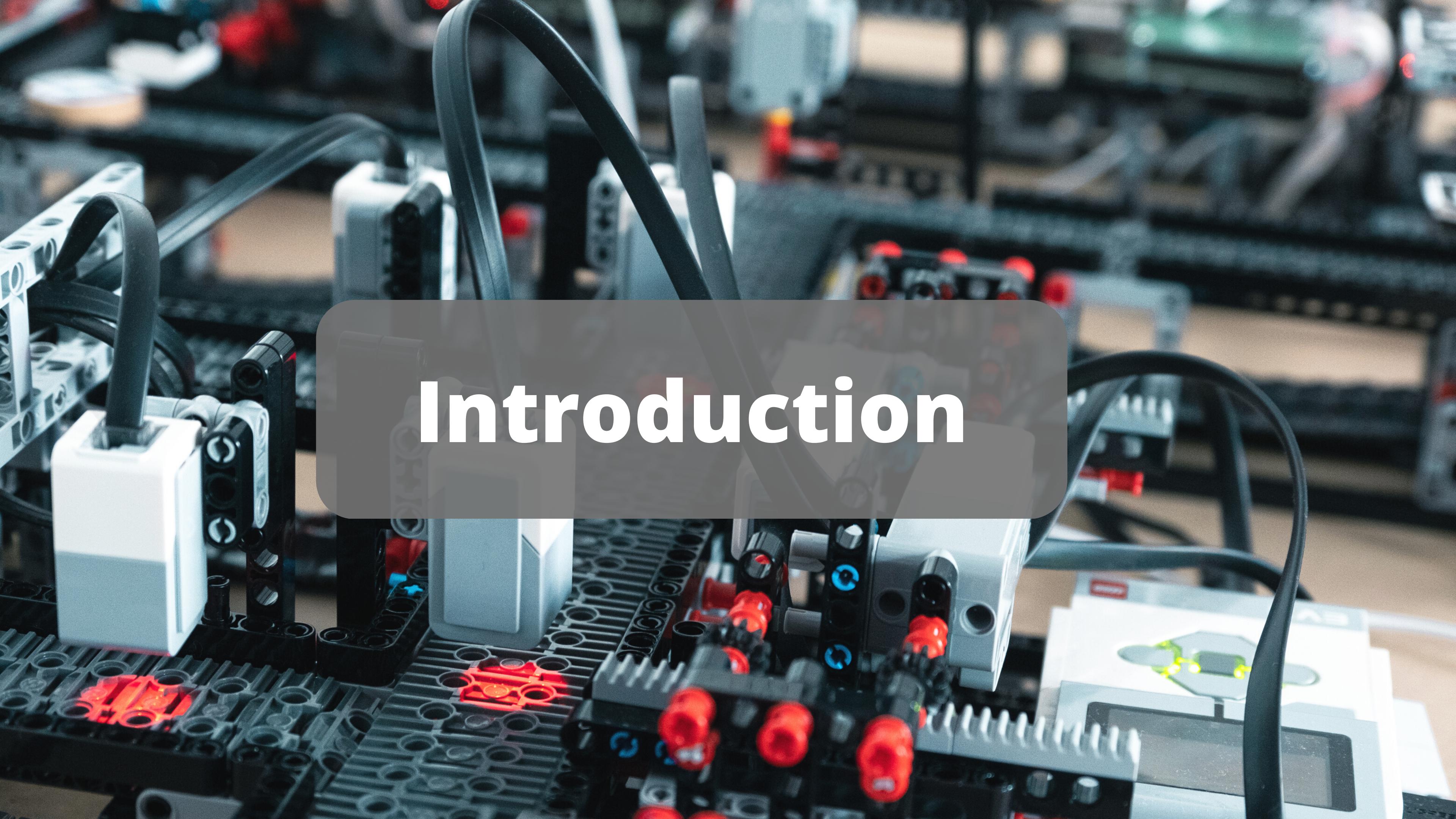
Digital Twin

Bi-Weekly 1 (11/10/2022)

Pedro Luis Bacelar dos Santos
Alex Chalissery Lona

Agenda

- Introduction
 - First impressions
 - Short-term and long-term goals
- Learnings
- POC developed with the learnings
- Next steps



Introduction

First Impressions



Pedro Luis Bacelar dos Santos



Alex Chalissery

Lona

Short-term And Long-term Goals

Long-term Goals

Develop a generic digital twin applicable in integrated manufacturing systems

Short-Term Goals

- Understand fundamentals of Digital twin framework.
- Understand the physical systems configuration available in "The Factory" lab.
- To develop a Proof-of-Concept using the previous learnings
- To conduct real time simulation and control of the existing 2-station lego model using the POC.



Learnings

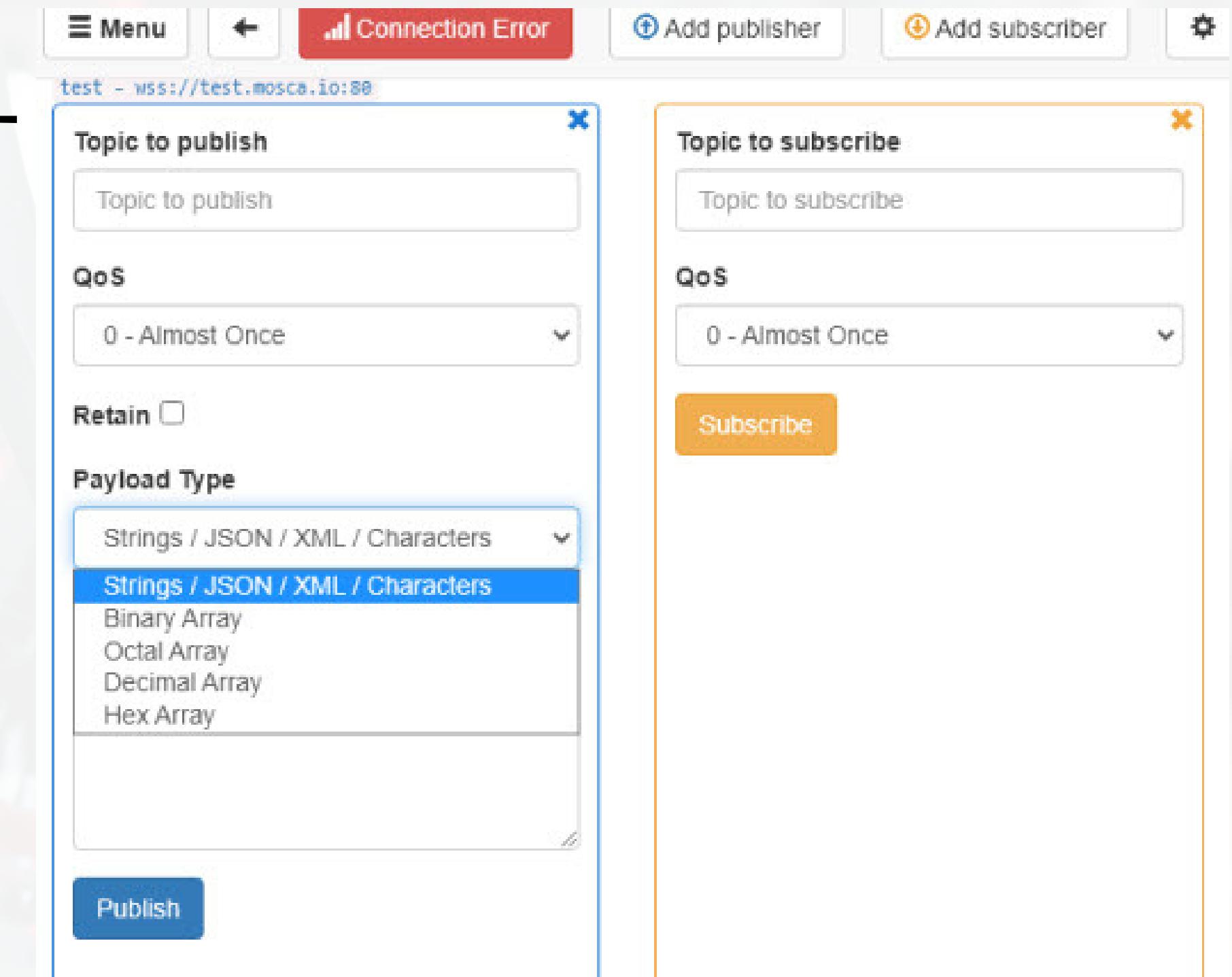
Learnings . . .

- LEGO Mindstorms EV3 KIT



Learnings . . .

- LEGO Mindstorms EV3 KIT
- Message Queuing Telemetry Transport (MQTT)

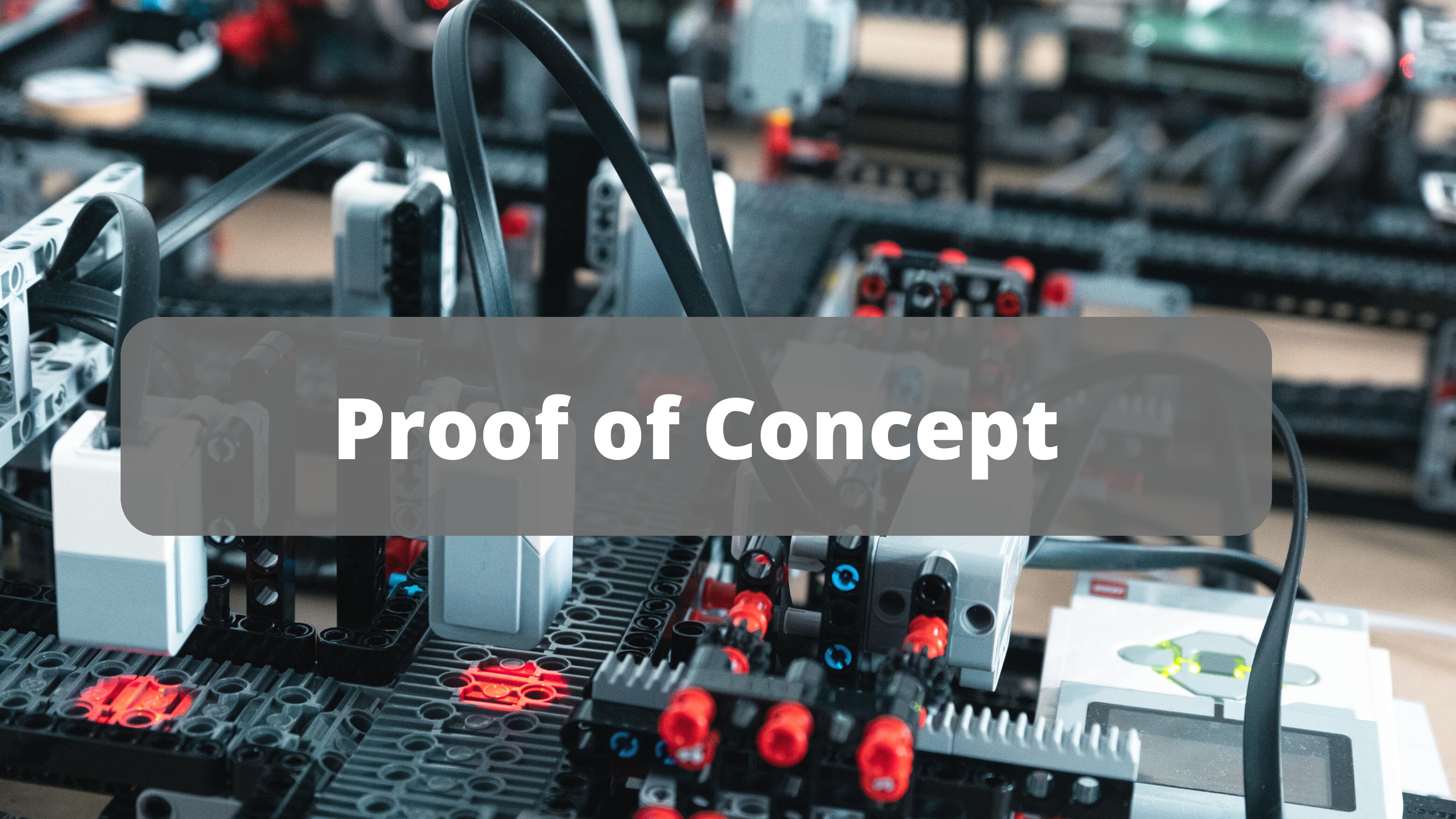


Learnings . . .

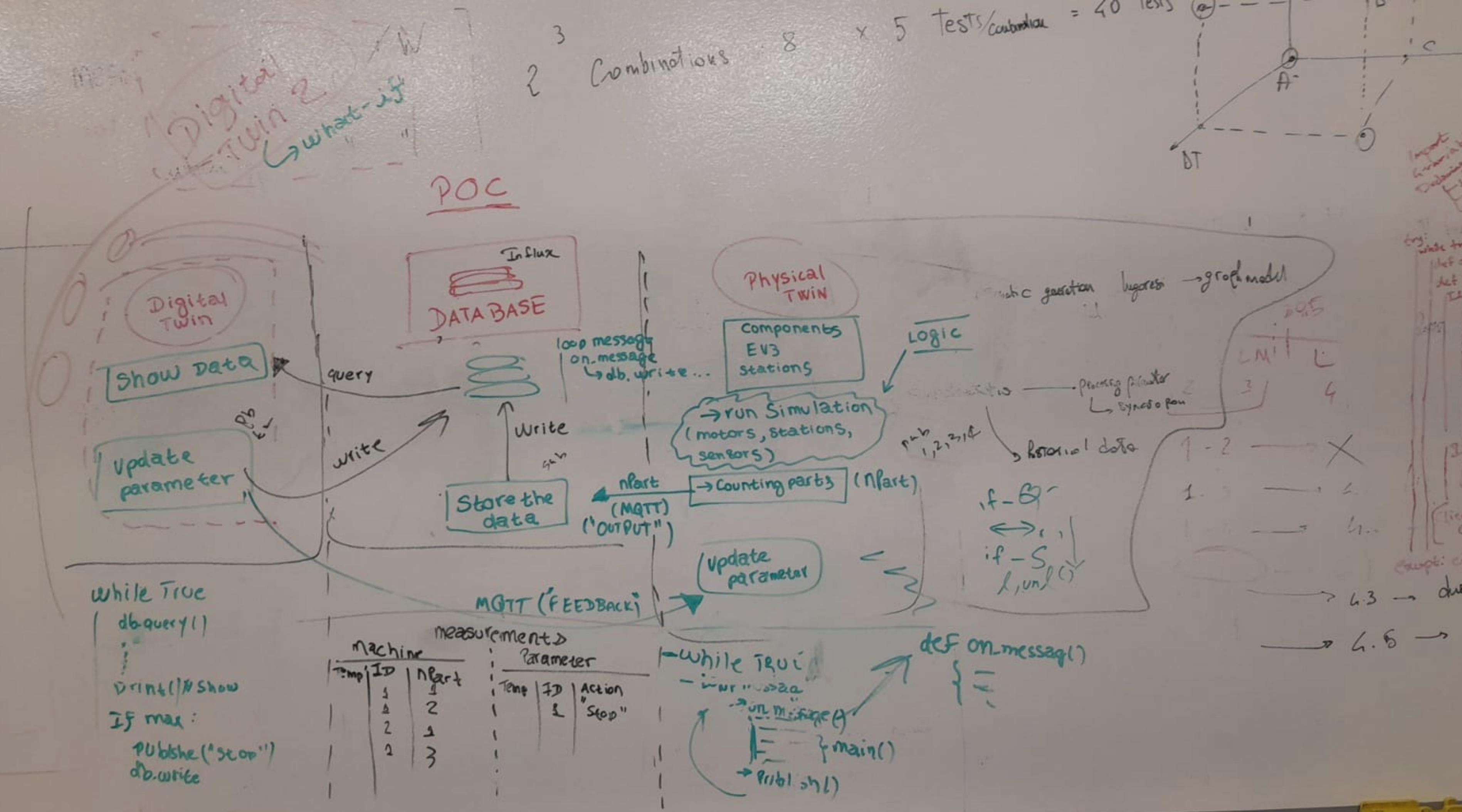
- LEGO Mindstorms EV3 KIT
- Message Queuing Telemetry Transport (MQTT)
- InfluxDB 1.7.7

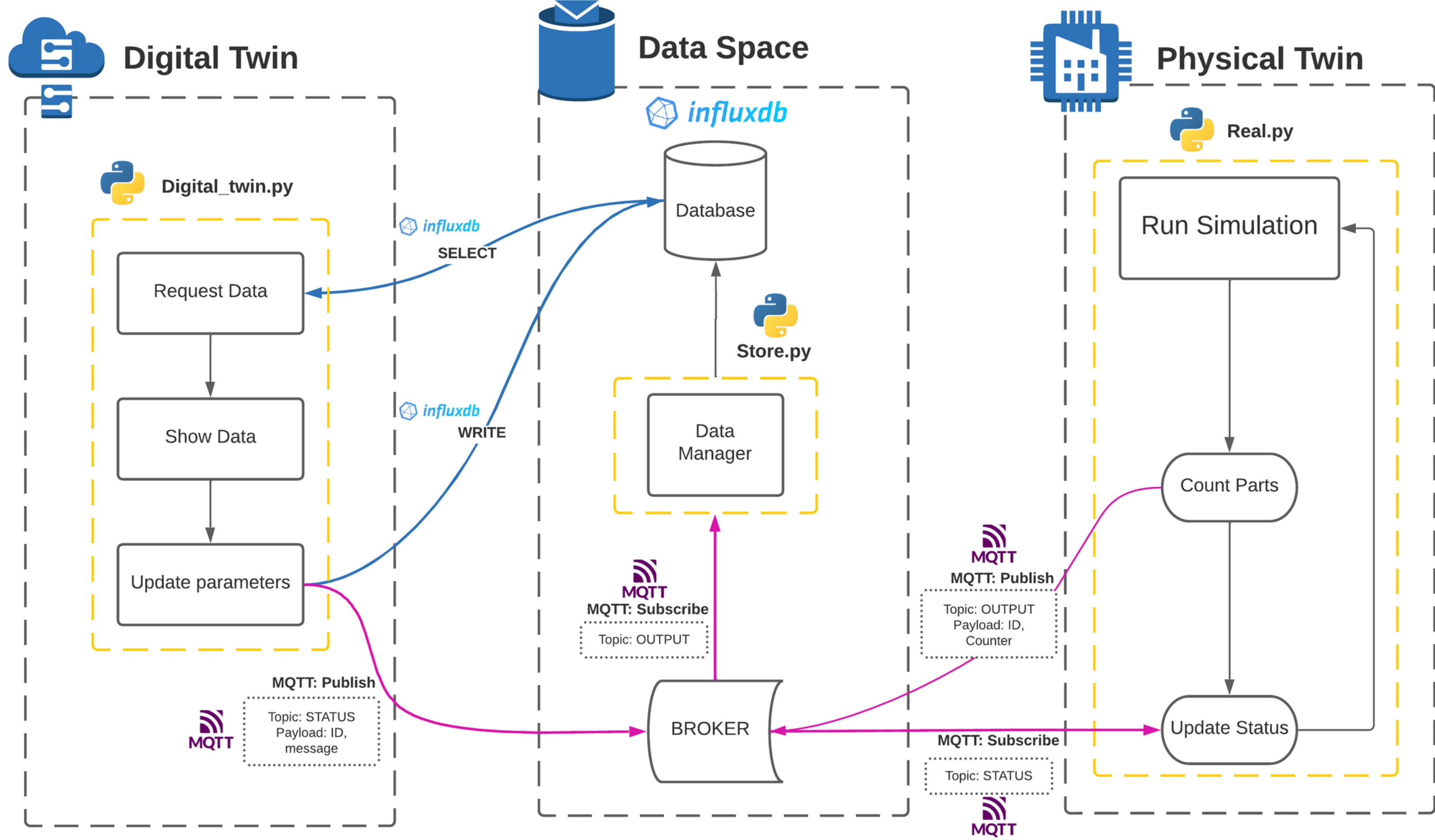


influxdb



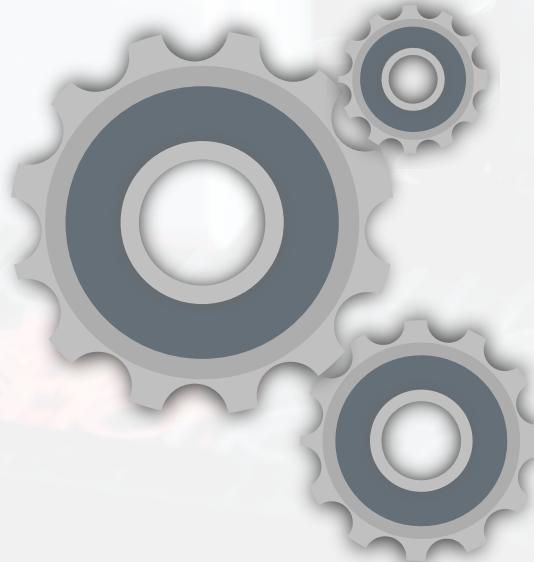
Proof of Concept





POC Developed

Physical
Twin
Configuration



Number of stations	2 (1 Buffer each)
Buffer policy	First in First out
Blocking policy	Nil
Processing time	5s
Unloading time	2s
Number of part types	1

POC Developed

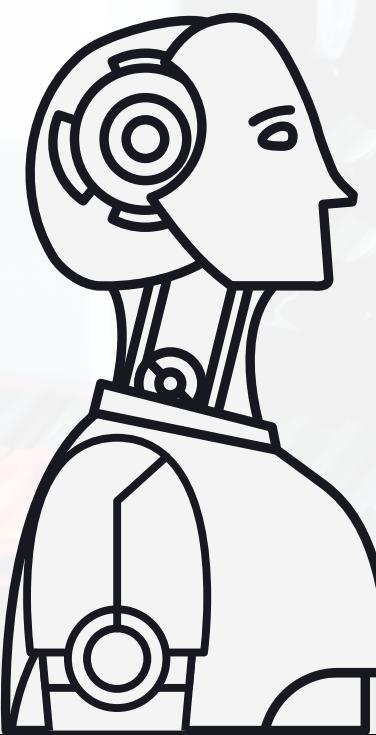
Database
Configuration



Name	poc_db
Measurements name	machine
fields	counter
tags	id

POC Developed

Digital
Twin
Configuration



capability to start and stop the physical twin	
condition based physical twin stop	based on number of parts processed
Stop condition	
Station 1	10 parts
Station 2	5 parts

POC Developed

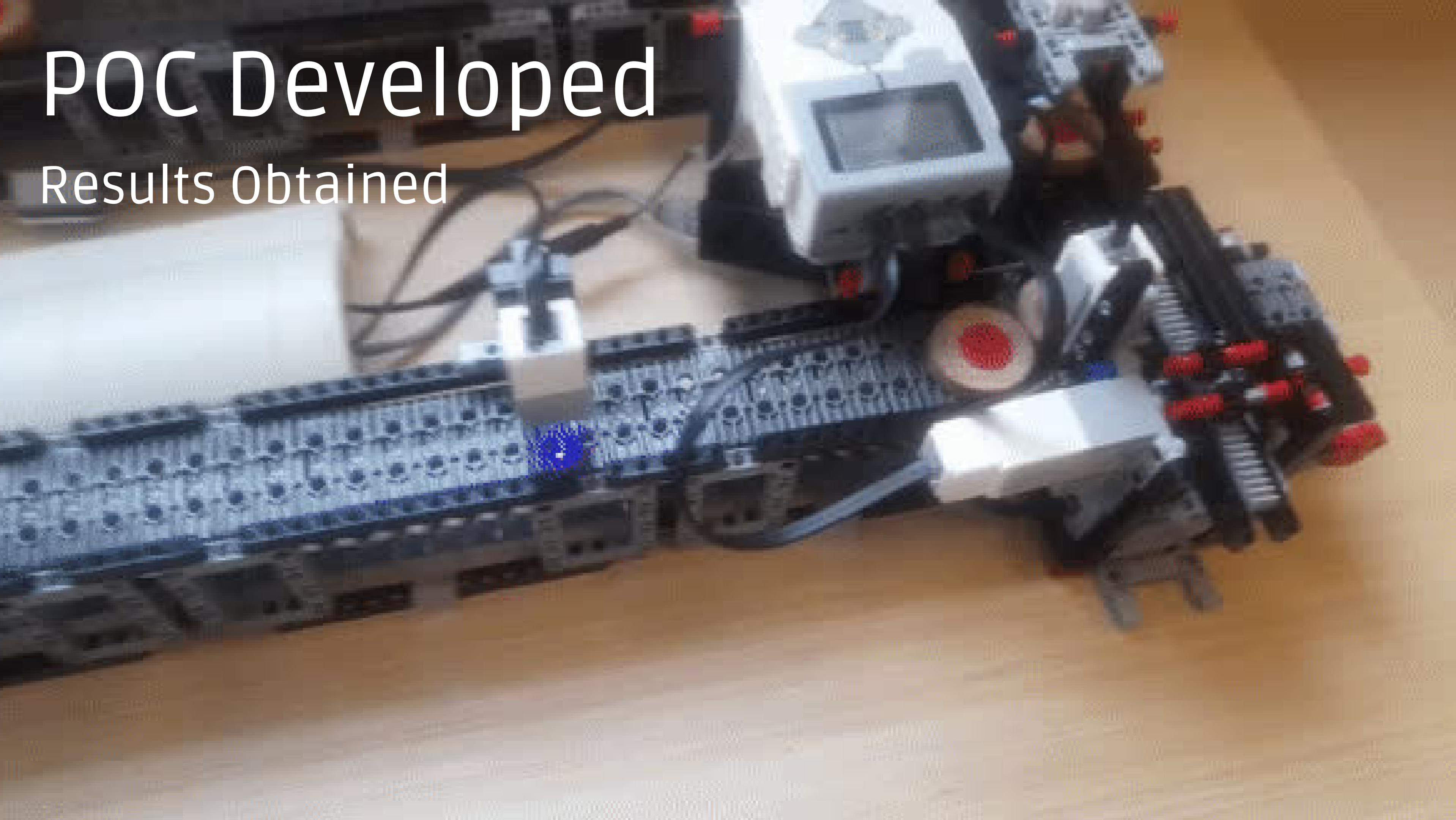
MQTT
Configuration



TOPIC	PAYLOAD
STATUS	{"message": "start", "id": machine_id}
STATUS	{"message": "stop", "id": machine_id}
STATUS	kill
OUTPUT	{"counter": counter, "id": mc_id, "ts": time.time()}

POC Developed

Results Obtained





Next Steps

Next Steps

- Refresh State-of-Art

Next Steps

- Refresh State-of-Art
- Collect existing work did by our predecessors
 - understand the work
 - organize files and modules
 - standardize and bridge the gap between the modules if any.

Next Steps

- Refresh State-of-Art
- Collect existing work did by our predecessors
 - understand the work
 - organize files and modules
 - standardize and bridge the gap between the modules if any.
- Tests on a more generic/complex model

Key: Digital
Twin

→ DI, System, etc.
→ DT and Sustainability
Quantity

DES

DES | Sync & valid.

→ Data mining;
Process mining;

→ Model generation
forecasting / Predictions

Academic
(papers)

Clustering

→ Define KPIs

Price

Quality

key words

area

No

+

dition

+

+

+

+

+

+

→ Startups

→ Industry trends

→ Big Players

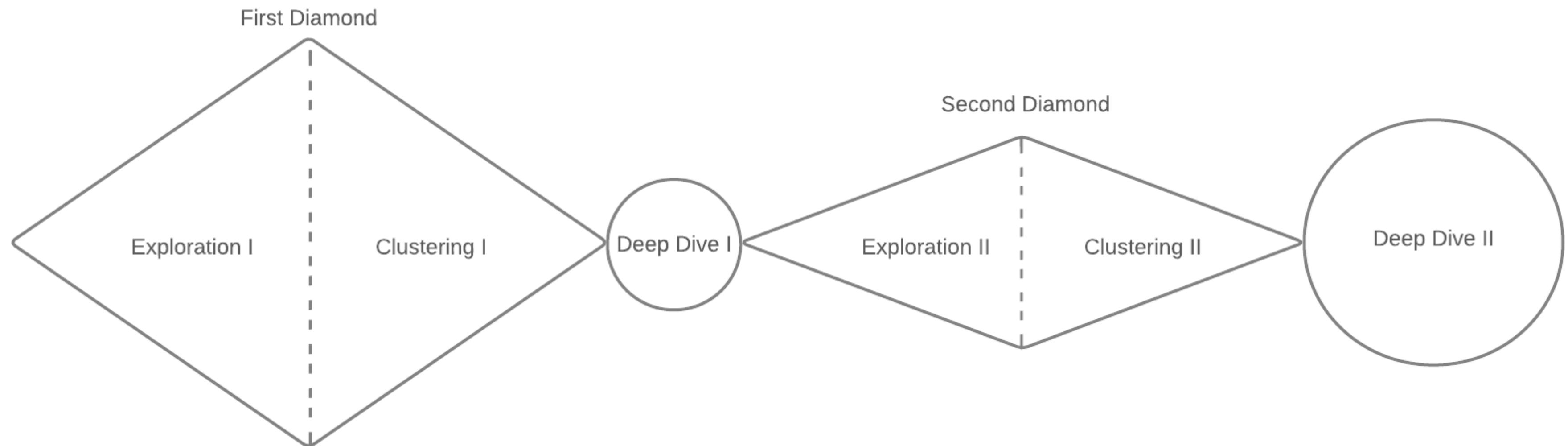
Industrial
(solutions)

→ Financial reports (investor / Shareholders)

Business → PDM, SCA
④ 6 hr

Planning

④ 18 hr → collecting
(~720 papers)



Definitions:
 Exploration: Search for content without getting in detail
 Clustering: Putting contents together and insights
 Deep Dive: Going deep with the selected content

- First Diamond**
- A broad overview of the main topics related to Digital Twin.
 - Trying to create insights from contents that are not specific for Digital Twin applications
 - Key research areas:
 - Digital Twin
 - Discrete Event Simulations
 - Data and Process mining
 - Syncro. / Validations
 - Forecasting / Predictions
 - Model Generations

Academic

- Second Diamond**
- Specific overview about the main topics related to Digital Twin and production systems
 - Trying to find what was already done in the same area of Lego Factory
 - Key research areas are the same as the key-words from previous works + new key-words from insights of the first diamond.



Thank You