IOT - A TOOL FOR BETTER FACILITY MANAGEMENT AT SHOPPING MALL

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The Institution of Engineers, Malaysia

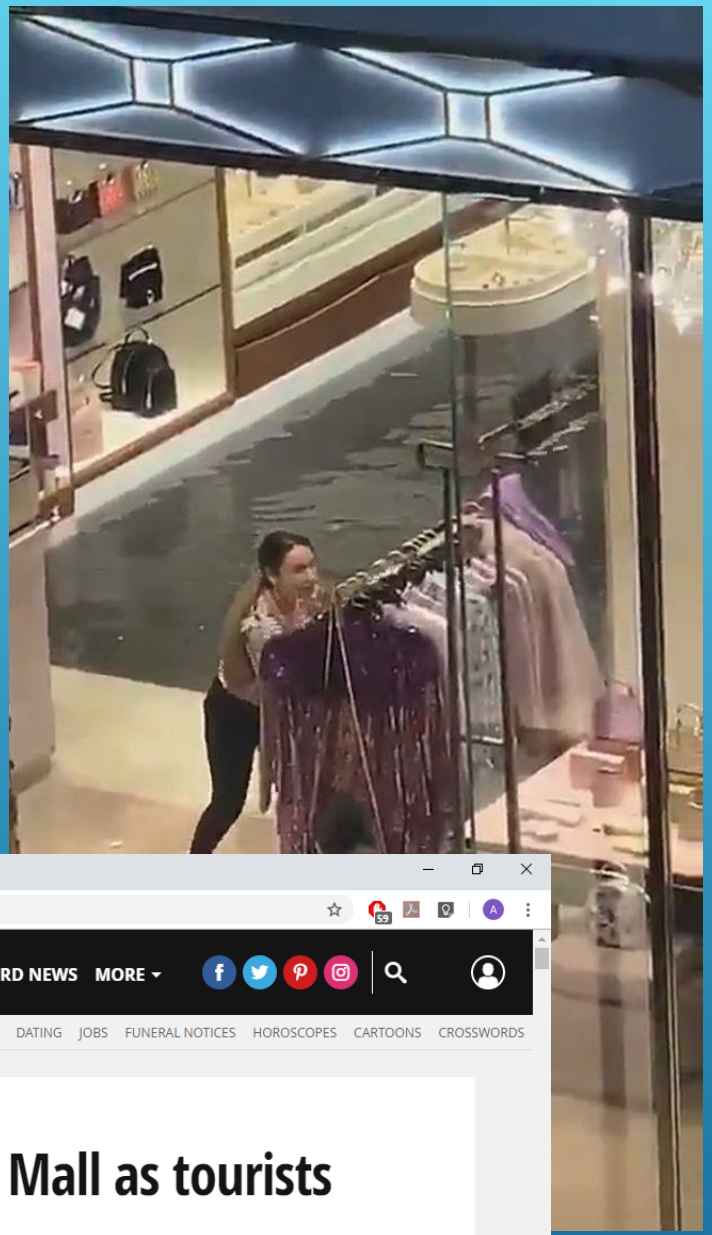
27 November 2019

PPK Malaysia
Malaysia Shopping Malls Association

IEM
The Institution of Engineers, Malaysia


SWAROVSKI

5 June 2011
Tanglin Mall, Orchard Road



12 Nov 2019
Dubai Mall

Torrent of water floods through

mirror.co.uk/news/weird-news/dubai-water-flood-shopping-mall-20867184

Mirror

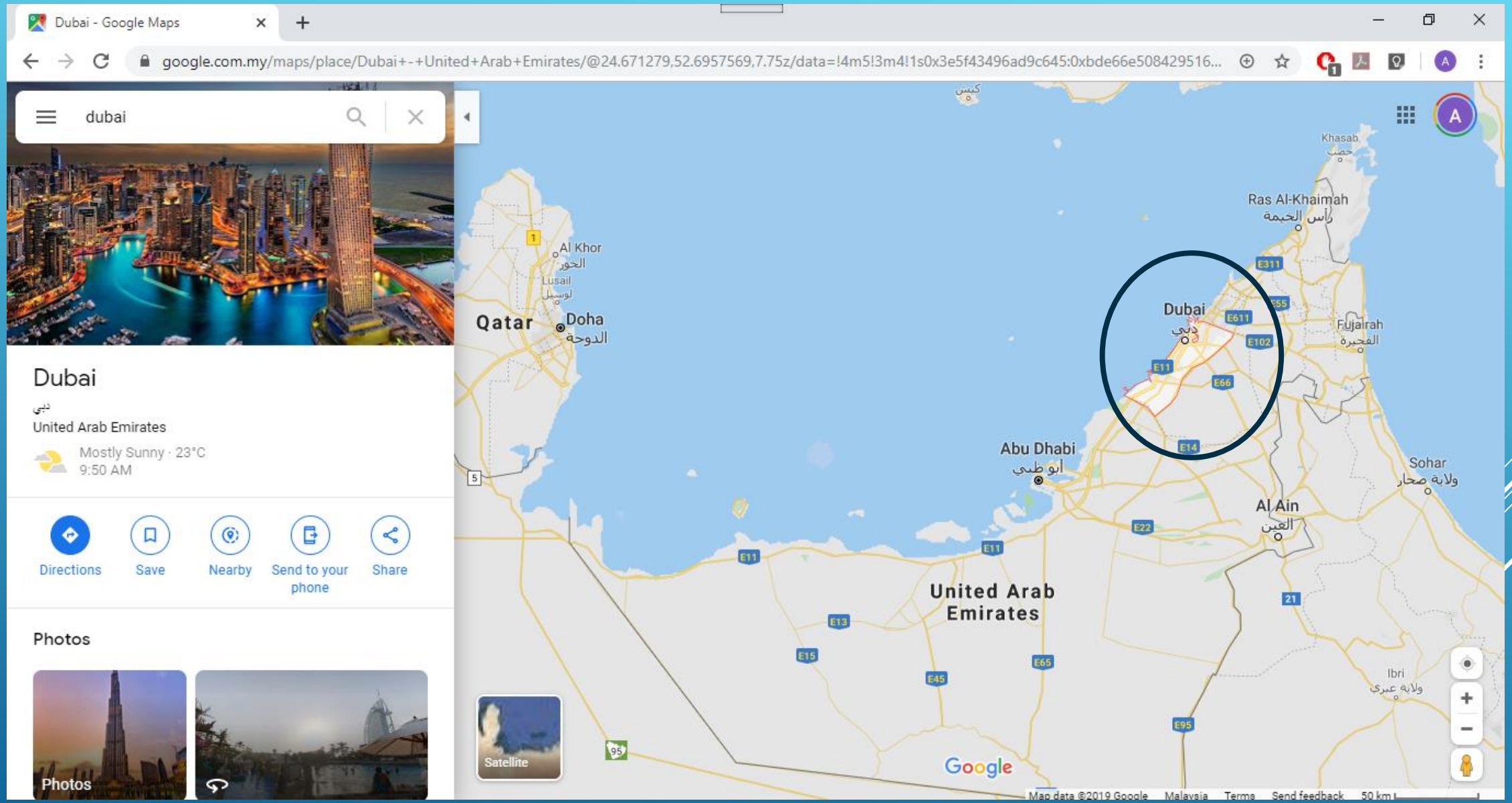
NEWS POLITICS SPORT FOOTBALL CELEBS TV FILM ROYALS WEIRD NEWS MORE

SHOP VOUCHER CODES OFFERS BINGO DATING JOBS FUNERAL NOTICES HOROSCOPES CARTOONS CROSSWORDS

News › Weird News › Floods

Torrent of water floods through Dubai Mall as tourists carry on shopping

The heavy downpour in the UAE caused leakage in the world's second-largest shopping centre as rainwater gushed down through the ceiling


Dubai - Google Maps
google.com.my/maps/place/Dubai+-+United+Arab+Emirates/@24.671279,52.6957569,7.75z/data=!4m5!3m4!1s0x3e5f43496ad9c645:0xbde66e508429516...
dubai
Dubai
دبي
United Arab Emirates
Mostly Sunny · 23°C
9:50 AM
Directions
Save
Nearby
Send to your phone
Share
Photos
Photos
Qatar
Doha
الدوحة
Al Khor
الخور
Lusail
لوسيل
Dubai
دبي
Abu Dhabi
أبو ظبي
United Arab Emirates
Ras Al-Khaimah
رأس الخيمة
Khasab
خصب
Fujairah
الفجيرة
Sohar
ولاية صحار
Al Ain
العين
Ibri
ولاية عبري
Satellite
Google
Map data ©2019 Google
Malaysia
Terms
Send feedback
50 km

PUMPS AT SHOPPING MALL

INTERNET-OF-THINGS

Gartner

- The network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment.
- The convergence of machine and intelligent data is known as the Industrial Internet, and it's changing the way we work.
- Embedded with increasingly sophisticated software instrumentation, able to connect to other devices and fully capable of responding intelligently to user needs.

INTERNET-OF-THINGS (IOT)

- The term was first mentioned by Kevin Ashton of P&G in 1999.
- IoT is the network of physical devices, embedded with electronics, software, sensors, actuators, and network that enables the devices to exchange data.
- Each device can operate on its own but still can work with other devices.
- By 2020, IoT will consist of about 30 billion devices, with estimated value of $7.1 trillion.

INTERNET-OF-THINGS (IOT)

Devices

Network

Platform

Microsoft Azure

amazon web services

IBM BlueMix

Alibaba Cloud
aliyun.com

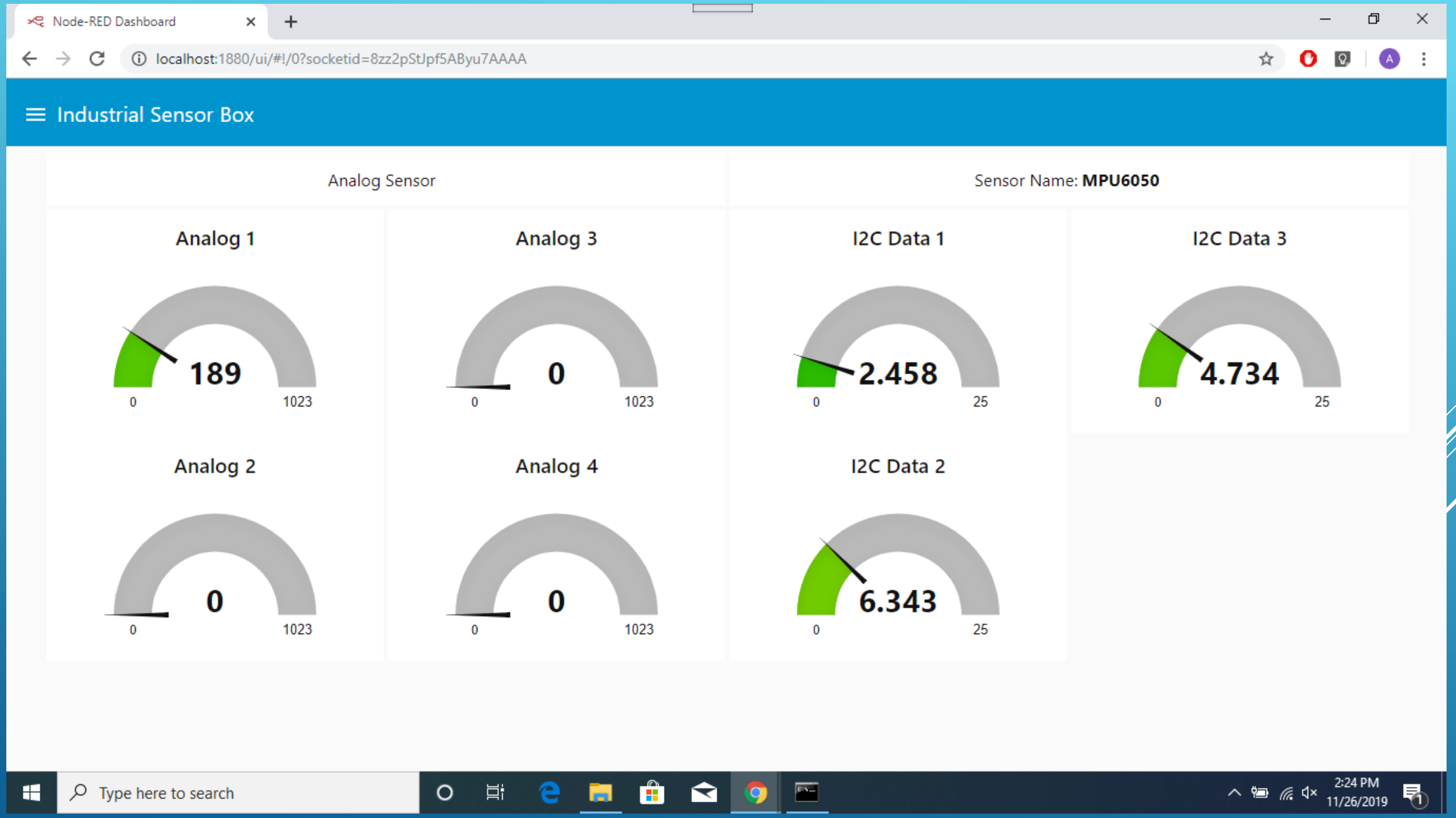
Project 1: Industrial Sensor Box

- To make ease of the data analyzing of the industrial machine condition and the industrial environment.

  To develop low cost solution for the data analyzing in industry.

  To develop multi function system integration for the industrial use.

  All in one solution for the entire system with single integration.


Node-RED Dashboard
localhost:1880/ui/#!/0?socketid=8zz2pStJpf5AByu7AAAA
Industrial Sensor Box
Analog Sensor
Sensor Name: MPU6050
Analog 1
189
0
1023
Analog 3
0
0
1023
I2C Data 1
2.458
0
25
I2C Data 3
4.734
0
25
Analog 2
0
0
1023
Analog 4
0
0
1023
I2C Data 2
6.343
0
25
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11/26/2019

PROJECT 2: PUMP FAILURE PREDICTION WITH MACHINE LEARNING AND IOT

Presentation Contents

- Aim and objectives
- Problem statement
- What is cavitation?
- Proposed methodology
- Investigation on materials and components
- Concept design derived from fundamental engineering principles
- Testing
- Results
- IoT Platform and Alerts

Aims and objectives

AIM

The aim of the project is to design a cavitation identification method via Machine Learning for Predictive Maintenance

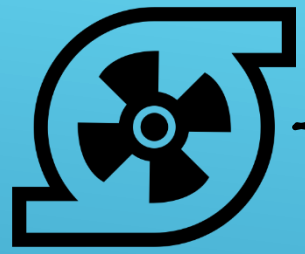
Objectives

- **To construct a mechanism for variables measurement on pump for predictive maintenance.**
- **To design a data acquisition system and Predictive Maintenance algorithm.**
- **To develop an IoT platform to perform automated scheduling system via data analytics.**
- **To analyse and evaluate the performance of the variables measurement, data acquisition system, Predictive Maintenance algorithm, IoT platform, and the automated scheduling system.**

Problem statement

***current problems with system in placed**

Current process



Cavitation detection

- Uses sensor for monitoring purposes only (Aivaliotis, Georgoulias & Chryssolouris, 2017).
- Contains no predictive capability

Time wasting

- Wait-and-see approach , reactive maintenance
- ↑ Time spent repairing due to pump breaking during odd hours
- Disruption in water distribution operations

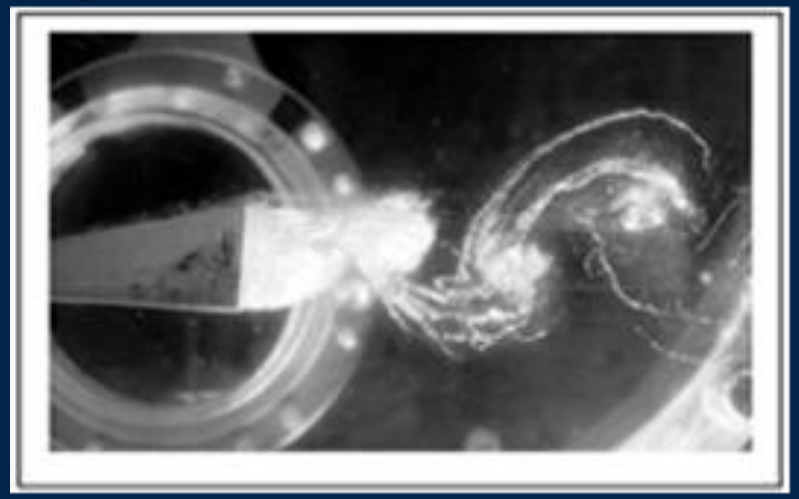
Lack of Automated scheduling

- Manual scheduling for pump repair
- ↑ Time spent preparing repair SOP

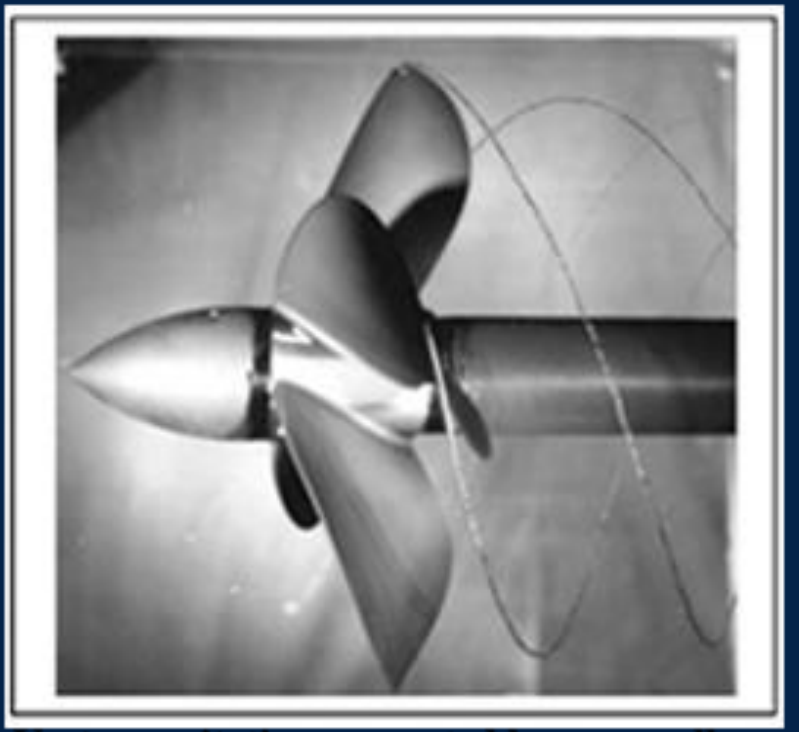
What is Cavitation?

Traveling Bubble Cavitation on the Hydrofoil Suction Side

Attached cavitation on a foil suction side



Shear cavitation in the wake of a bluff body



Vortex cavitation generated by a propeller (Courtesy of DGA/BEC)

Investigation of materials and components

Data acquisition software and controllers

Software	TwinCAT2	TwinCAT3	MathWorks	LabVIEW
Real time capability	n/a	Available	Available	Available
Programming language	IEC 61131	IEC 61131	MATLAB	G-language
3rd party programming interface	n/a	Available	Available	Available
Core activation	n/a	Available	n/a	n/a
IoT	n/a	Available	Available	Available
Cycle time	50µs (max)	50µs (max)	n/a	n/a

Data Acquisition controller						
Sensor	Flow-rate sensor (PWM)			Vibration (Analogue)		
Model	C6015	CX2020	CX5010	Arduino Mega	Raspberry Pi 3B	ESP 32
Processor	Intel Atom	Intel Celeron	Intel Atom	ATmega2560	BCM2387	L6
Memory	160Gb	8Gb	512Mb	2560kb	1GB	448 KB
Persistent memory	∞	128kb	1000kb	4kb	n/a	0.512kb
Form factor	Small	Medium	Medium	Medium	Medium	Small
IoT	Yes	Yes	Yes	n/a	Yes	Yes

Investigation of materials and components

Data acquisition sensors

Flow rate sensors comparison

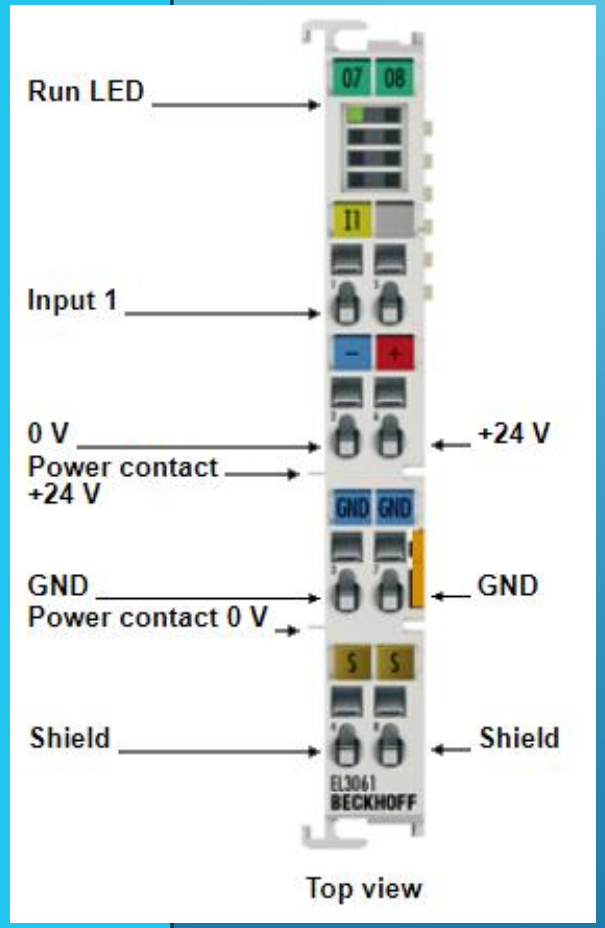
Specification	Sensors	
	YF-B2	YF-DN50
Working Voltage	5-18v	5v
Flow rate	0-60L/min	5-200L/min
Output	PWM	PWM
permissible pressure	1.75Mpa	1.75Mpa

Vibration sensors comparison

Specification	Sensors		
	ADXL 180	ADXL 313	ADXL 335
Voltage (v)	5	2	3.6
Signal type	HV	I^2C	Analog
Form factor	Small	Small	Small
Sensing axis	x	x,y,z	x,y,z
Range (g)	50	2	3

Investigation of materials and components

Data acquisition IO cards (Beckhoff)



Hardware Model	EL3061	EL3014	EL3054
Number of input pin	1	4	4
Technology	Single-ended	Differential	Single-ended
Signal type	-10v…+10v	0mA……20mA	4mA……20mA
Operating temperature (°C)	-25…+60	-25…+60	-25…+60

Investigation of materials and components

Predictive maintenance and IoT platform

Comparison of dataset training and testing time

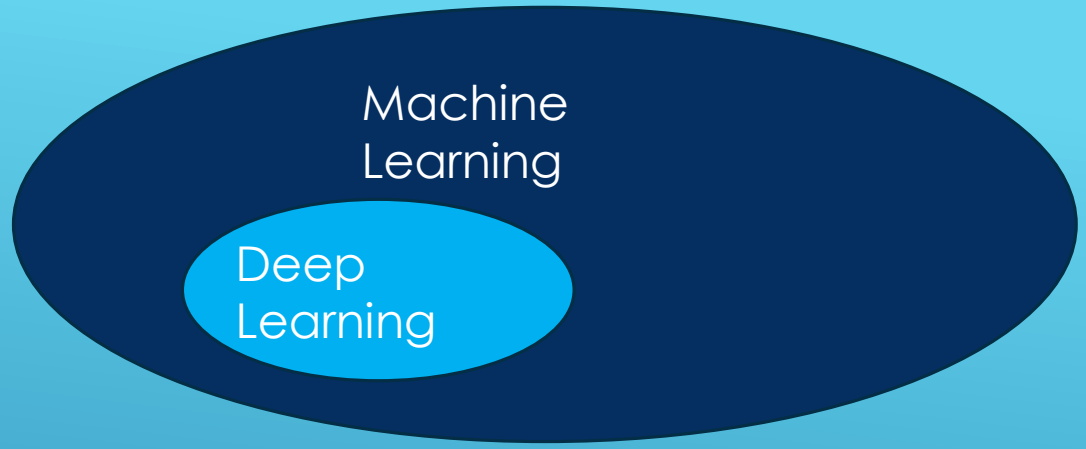
(Bucurica et al, 2015)

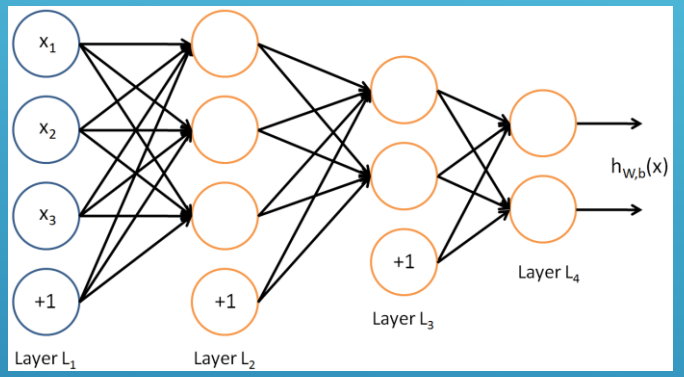
Dataset	Algorithm	Training time (s)	Testing time (s)	Accuracy (%)	Resources
Diabetes	ELM	0.2	0.11	100	64
	SVM	0.128	0.087	98.86	17
Heart	ELM	0.215	0.07	90	27
	SVM	0.103	0.043	94	38

Dashboard GUI	Node-Red	Ubidots	Microsoft Azure	Things Board
Pricing (RM/month)	0	65	80	0
Scripting	Available	n/a	Available	n/a
Scheduler	Available	n/a	Available	n/a

Investigation of materials and components

Machine Learning vs Deep Learning



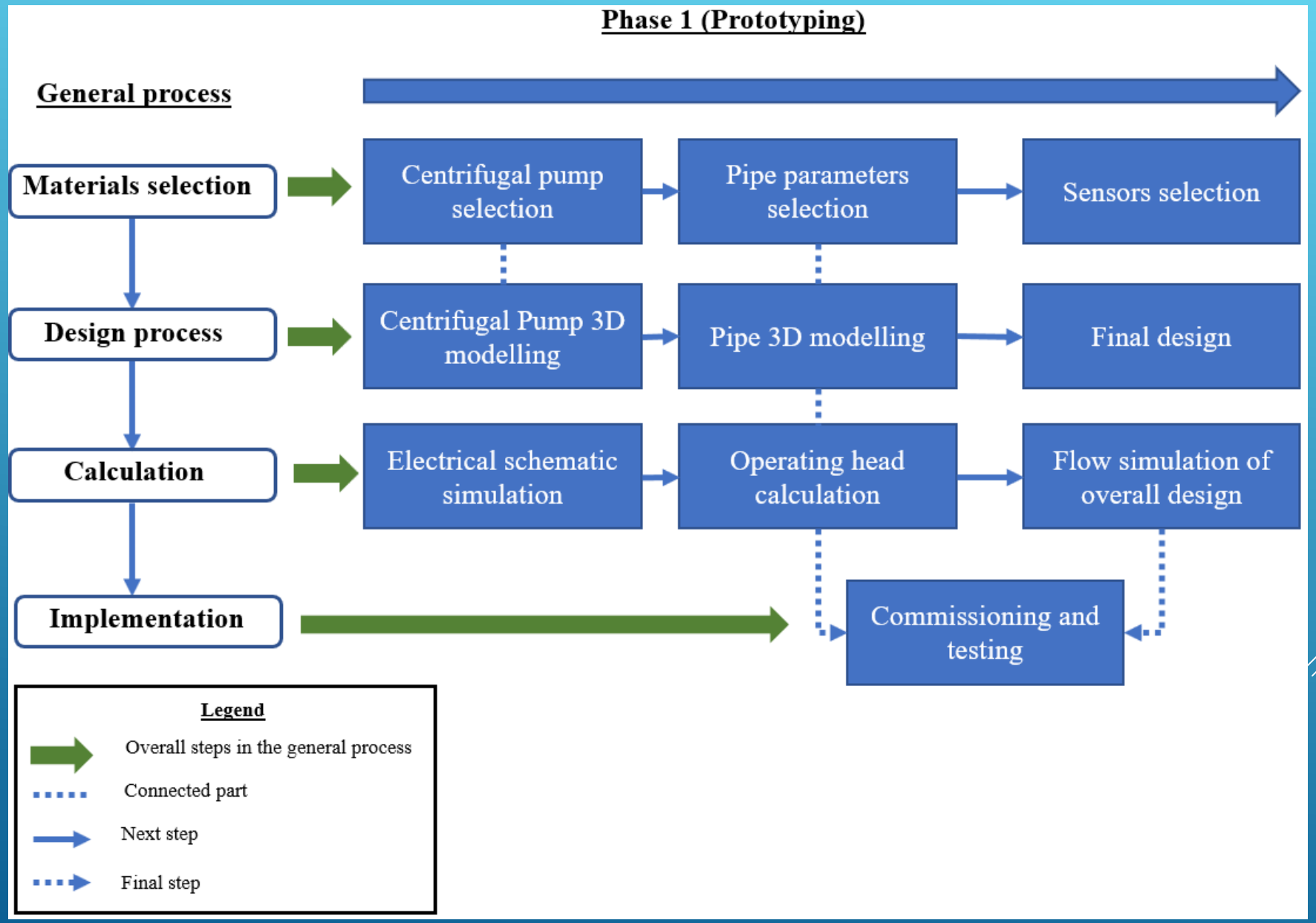


Machine Learning

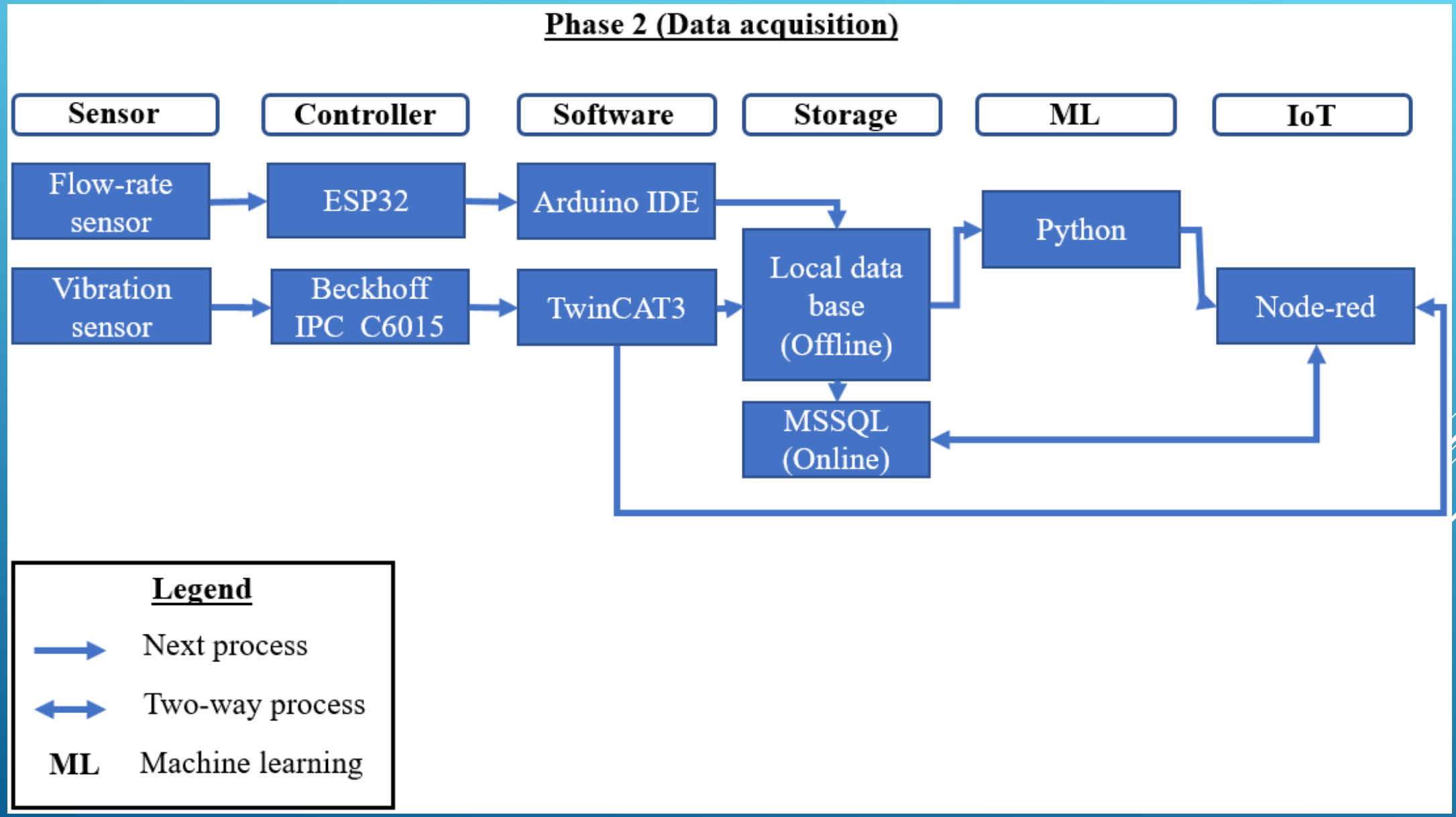
SVM – Support Vector Machine – model with learning algorithms that analyzes data used for classification and regression analysis.

ELM - Extreme Learning Machine – model for classification and regression where the parameters of hidden nodes can stay constant.

Methodology Phase 1

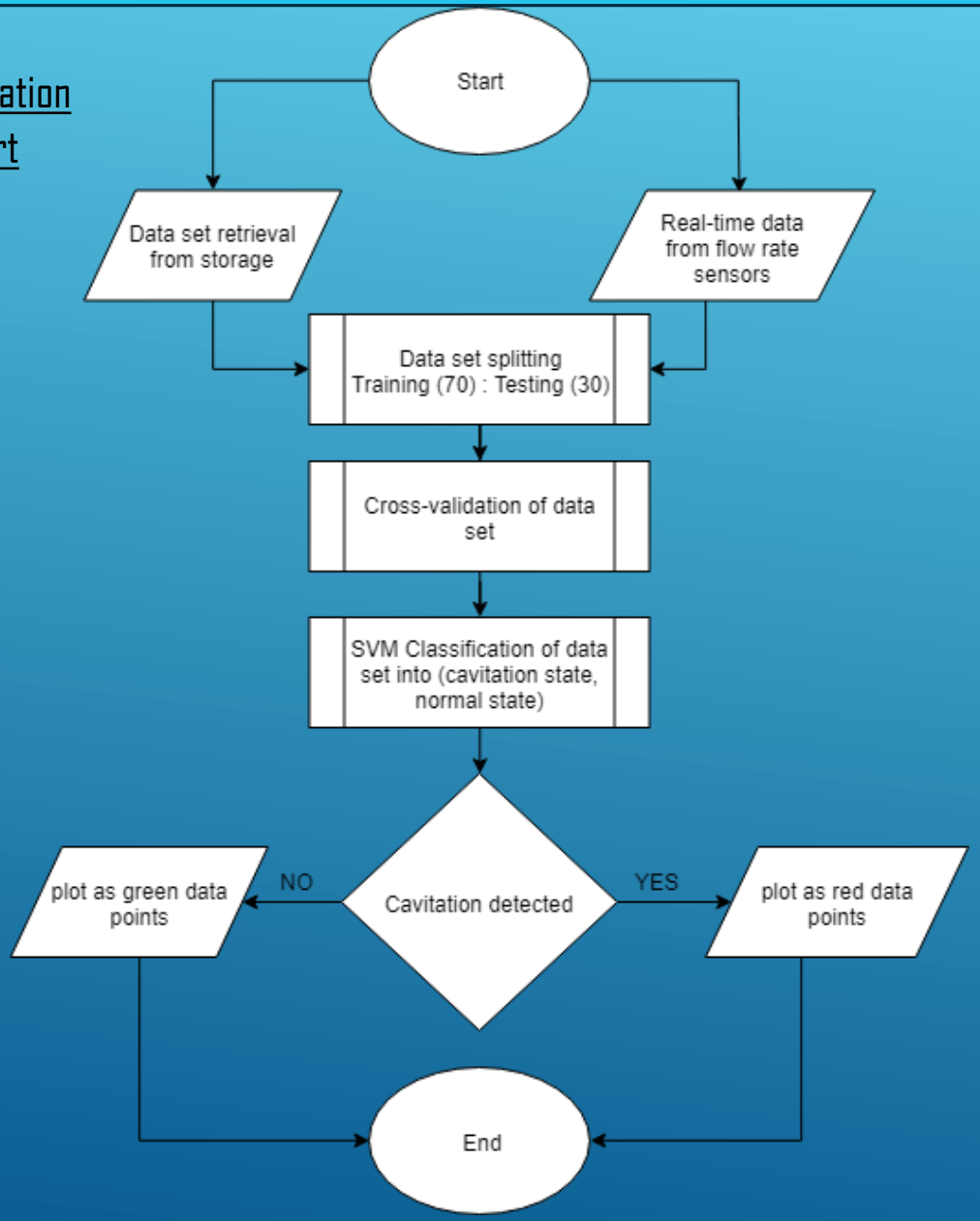


Methodology Phase 2

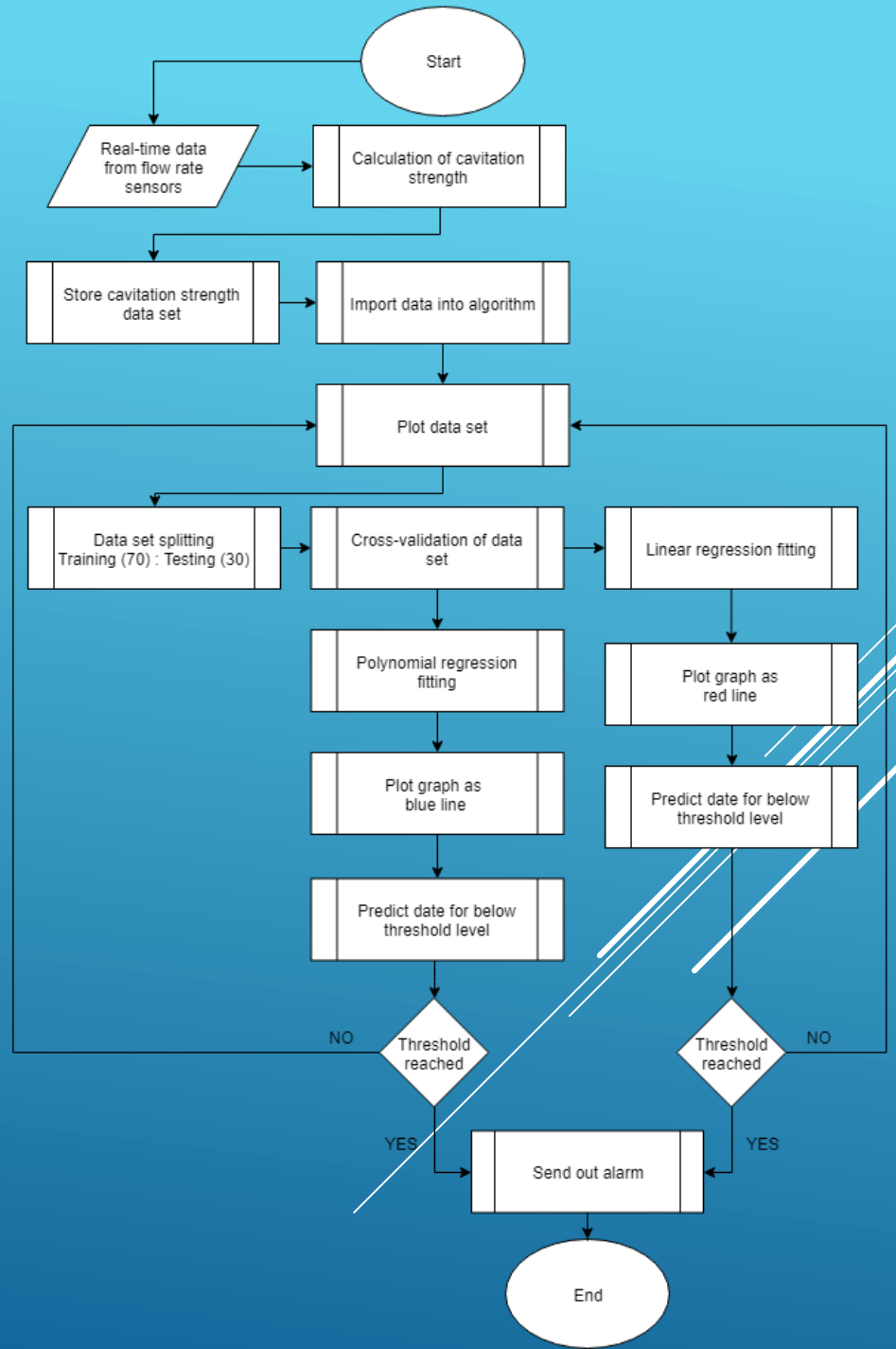


Methodology Phase 3

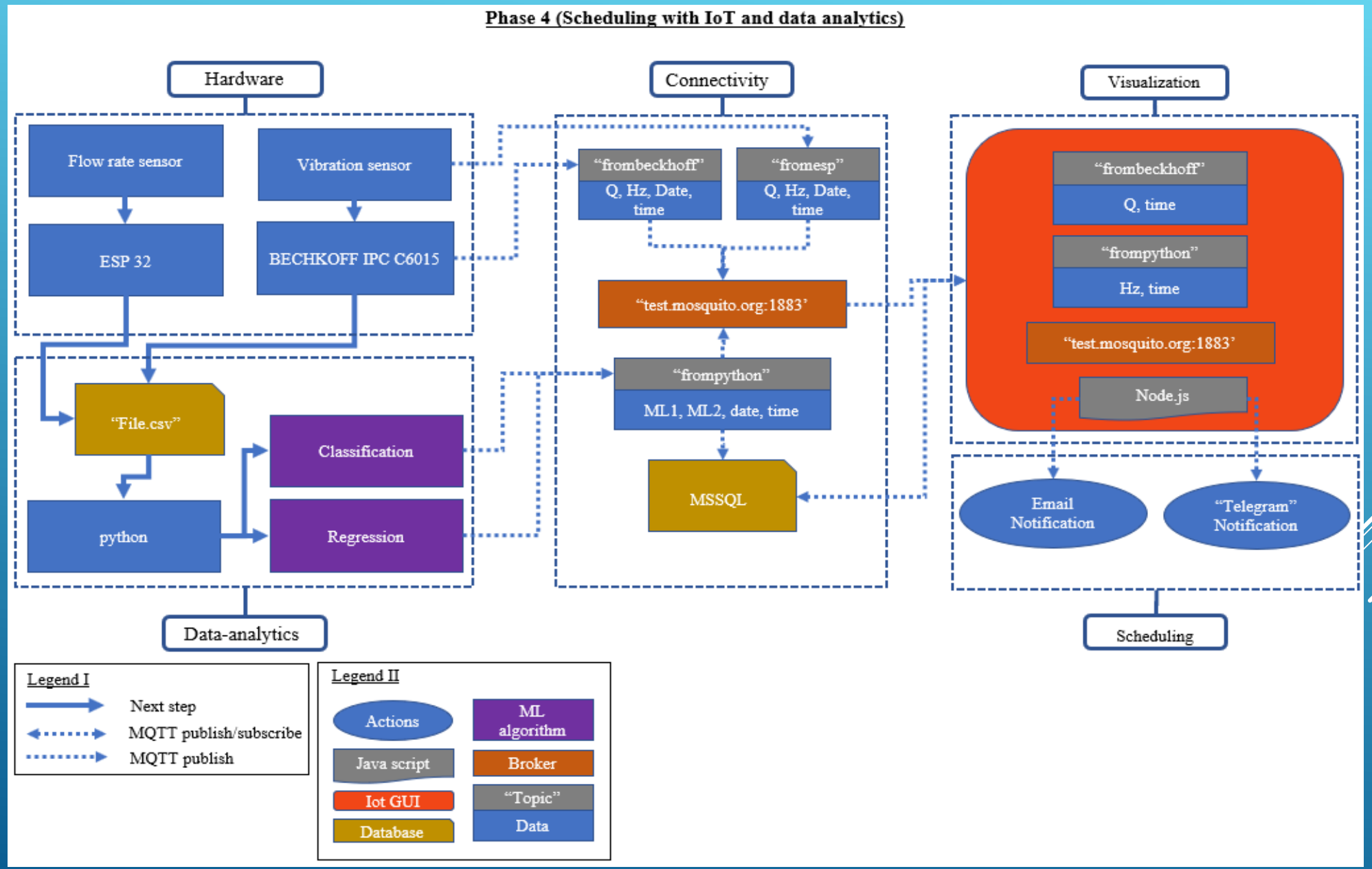
Classification Flowchart



Prediction algorithm Flowchart



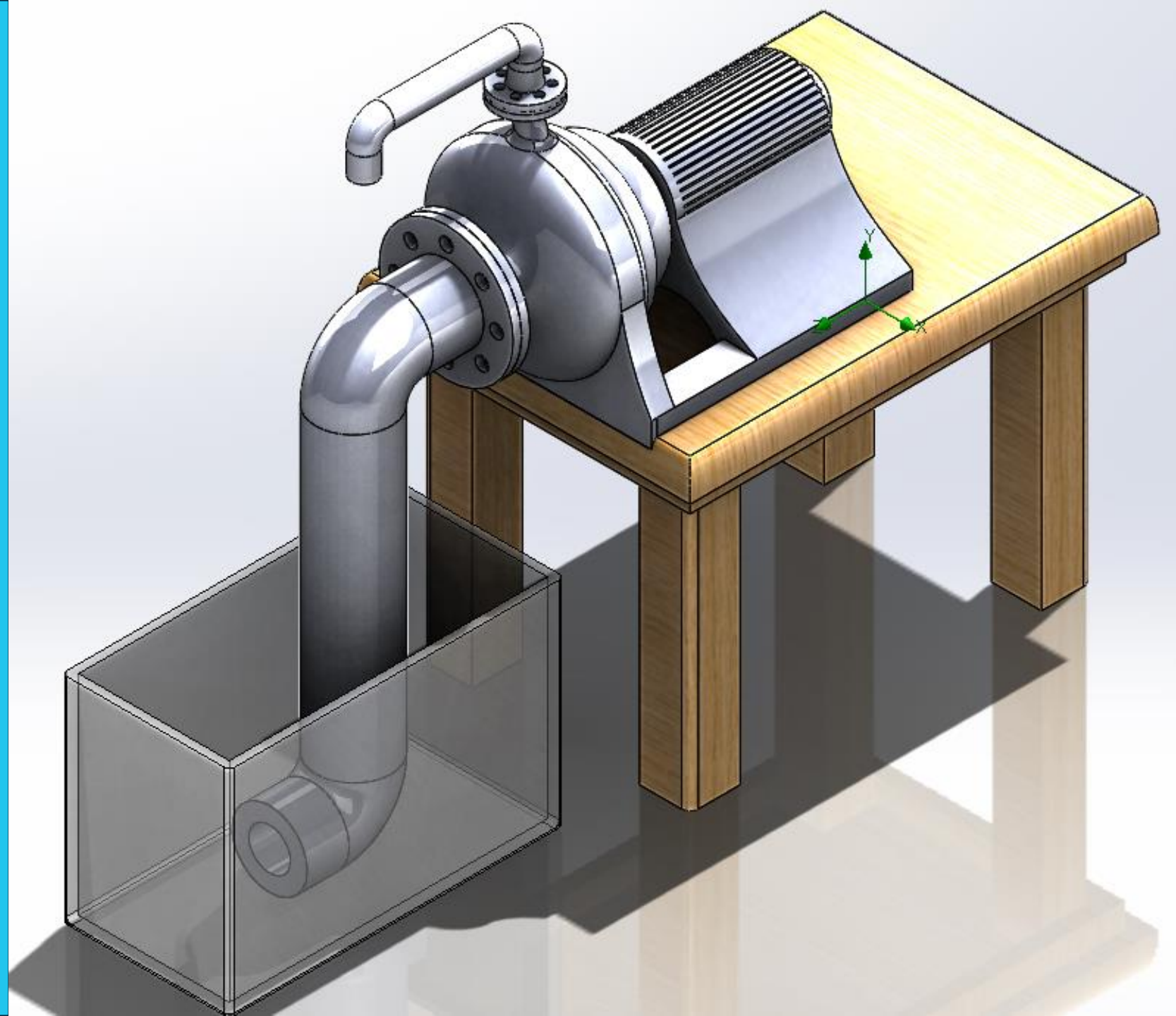
Methodology Phase 4



Concept design derived from fundamental engineering principles

3D design of prototype

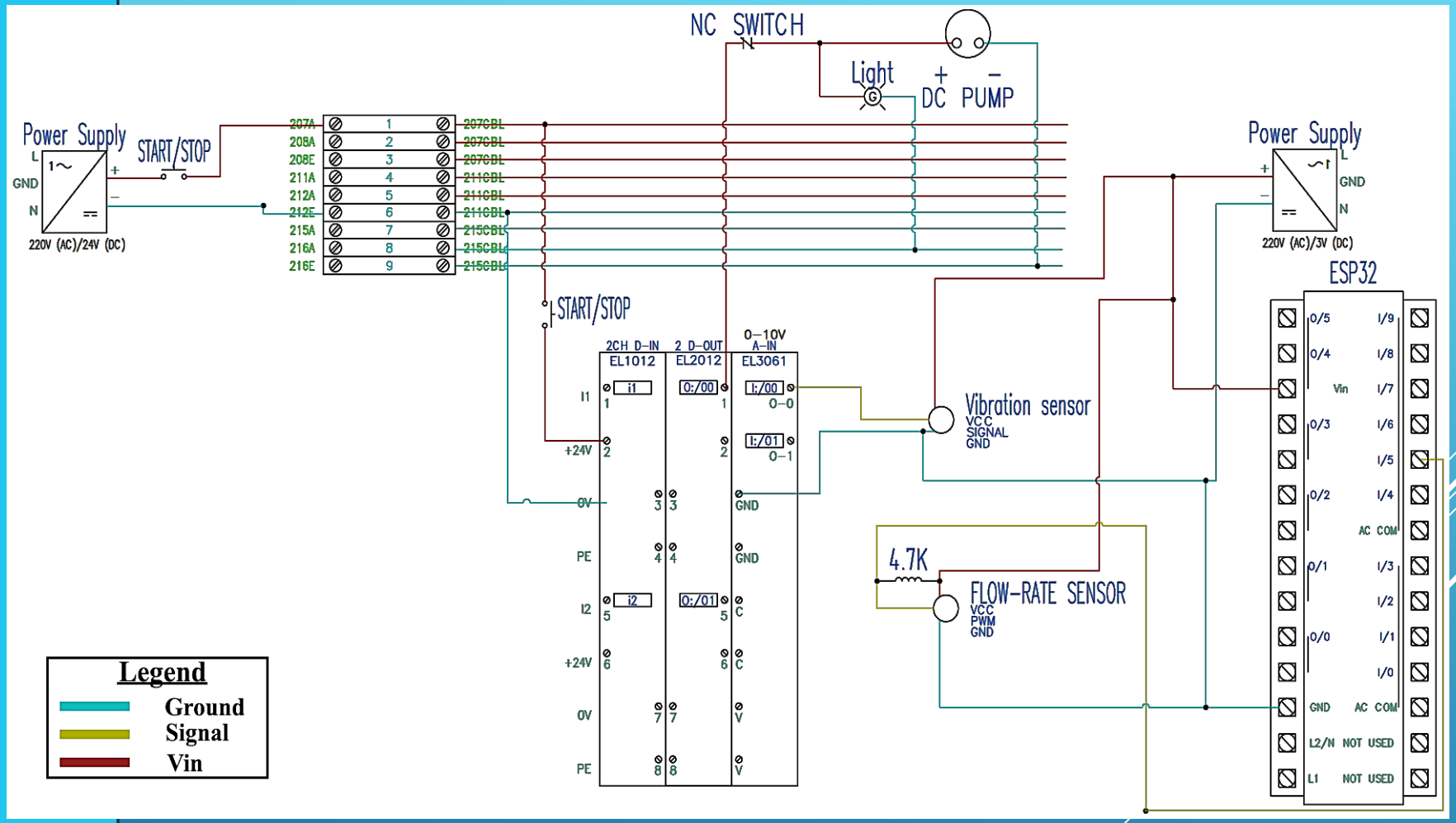
Phase 1



Concept design derived from fundamental engineering principles

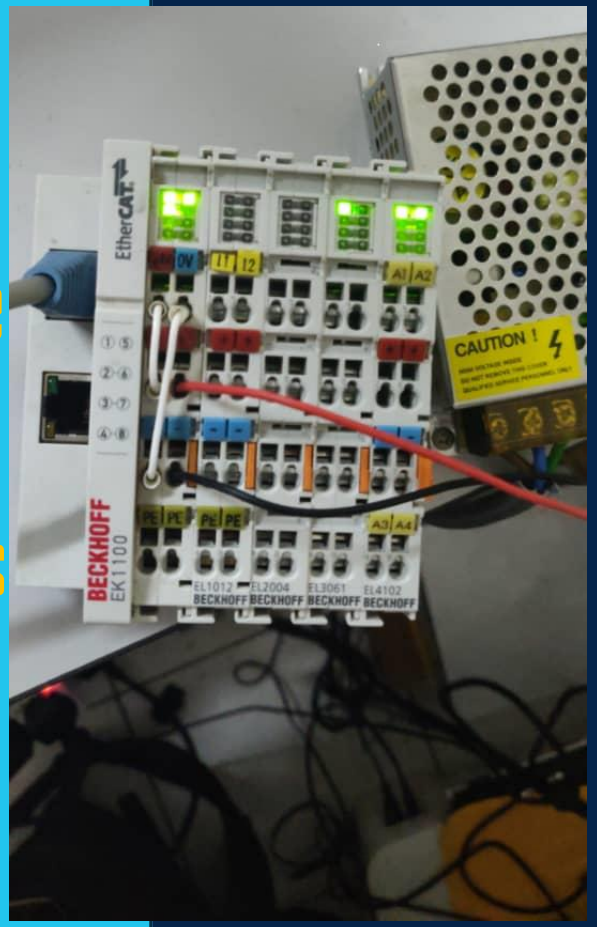
Electrical schematic

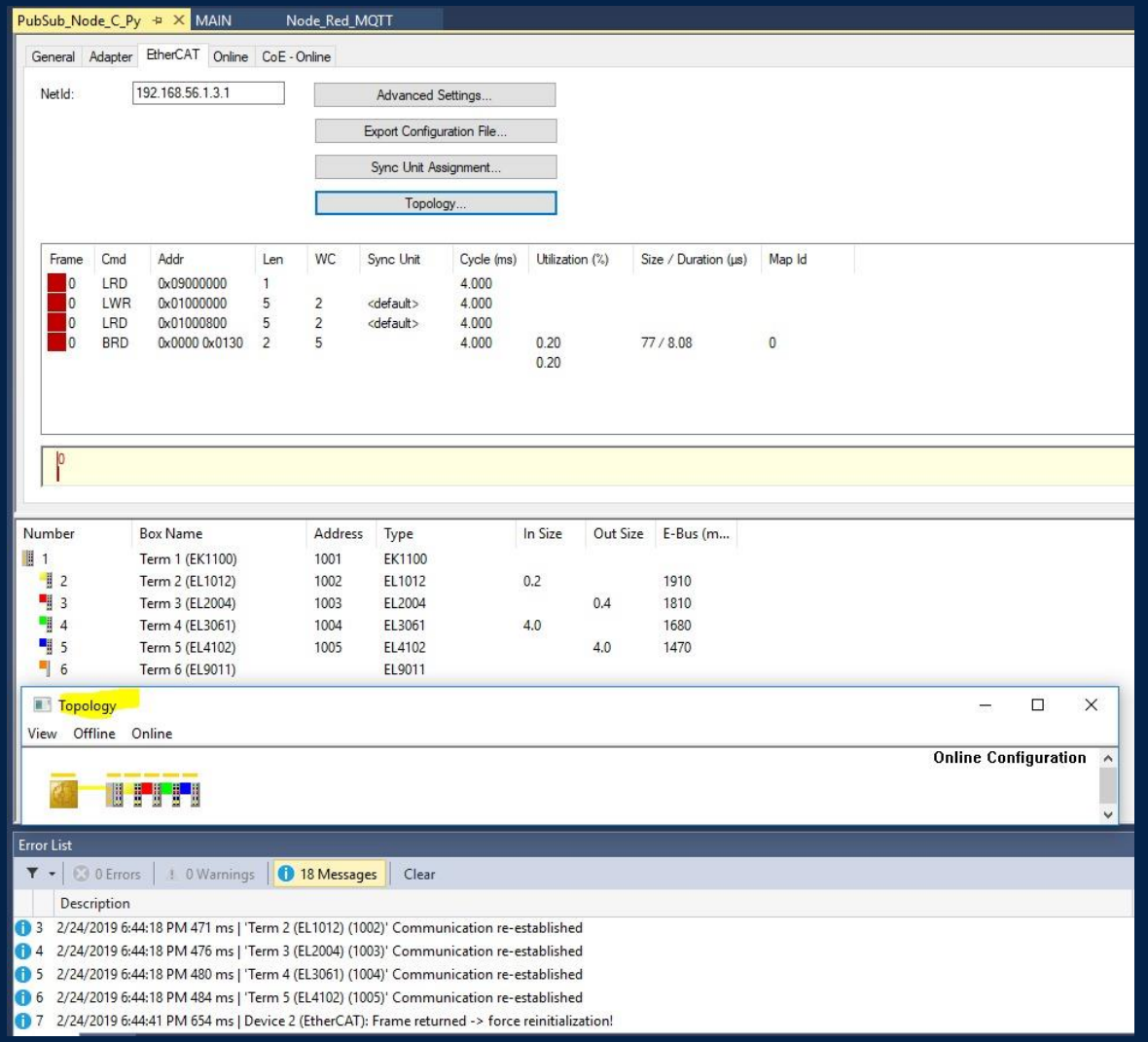
Phase 2



Concept design derive from fundamental engineering principles

Phase 2



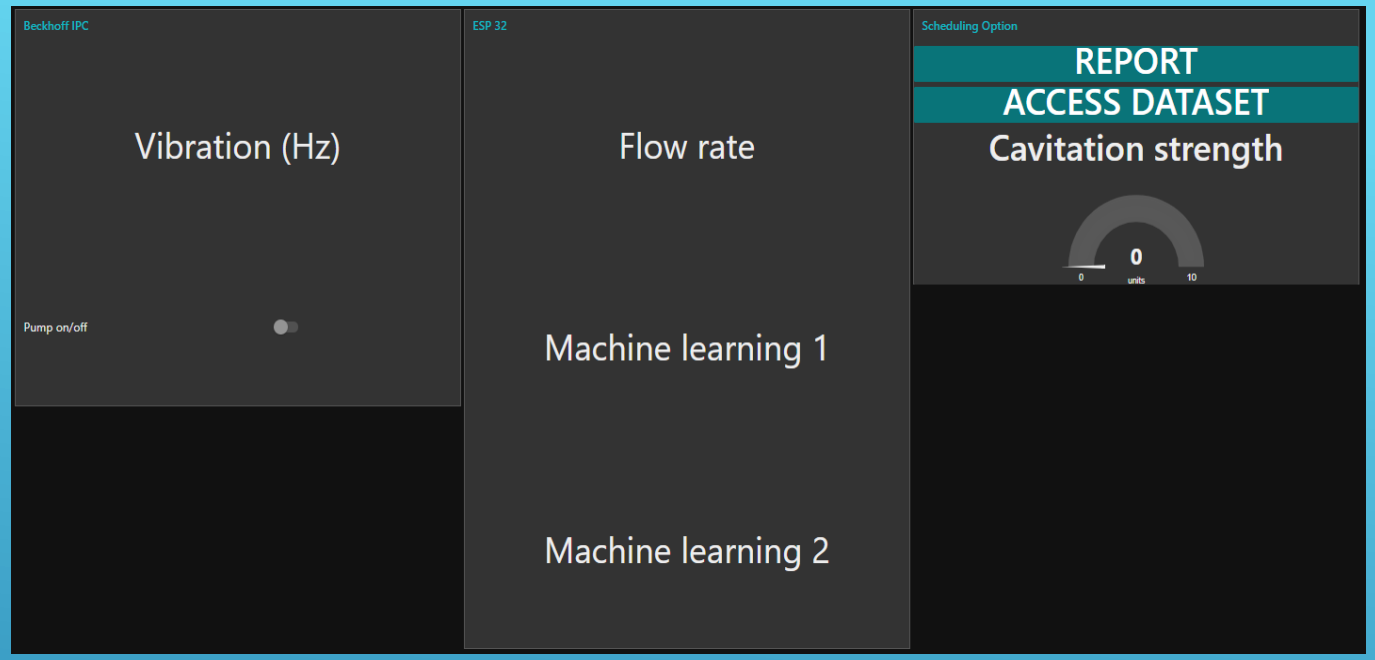


Concept design derived from fundamental engineering principles

Machine learning (AI)

IoT

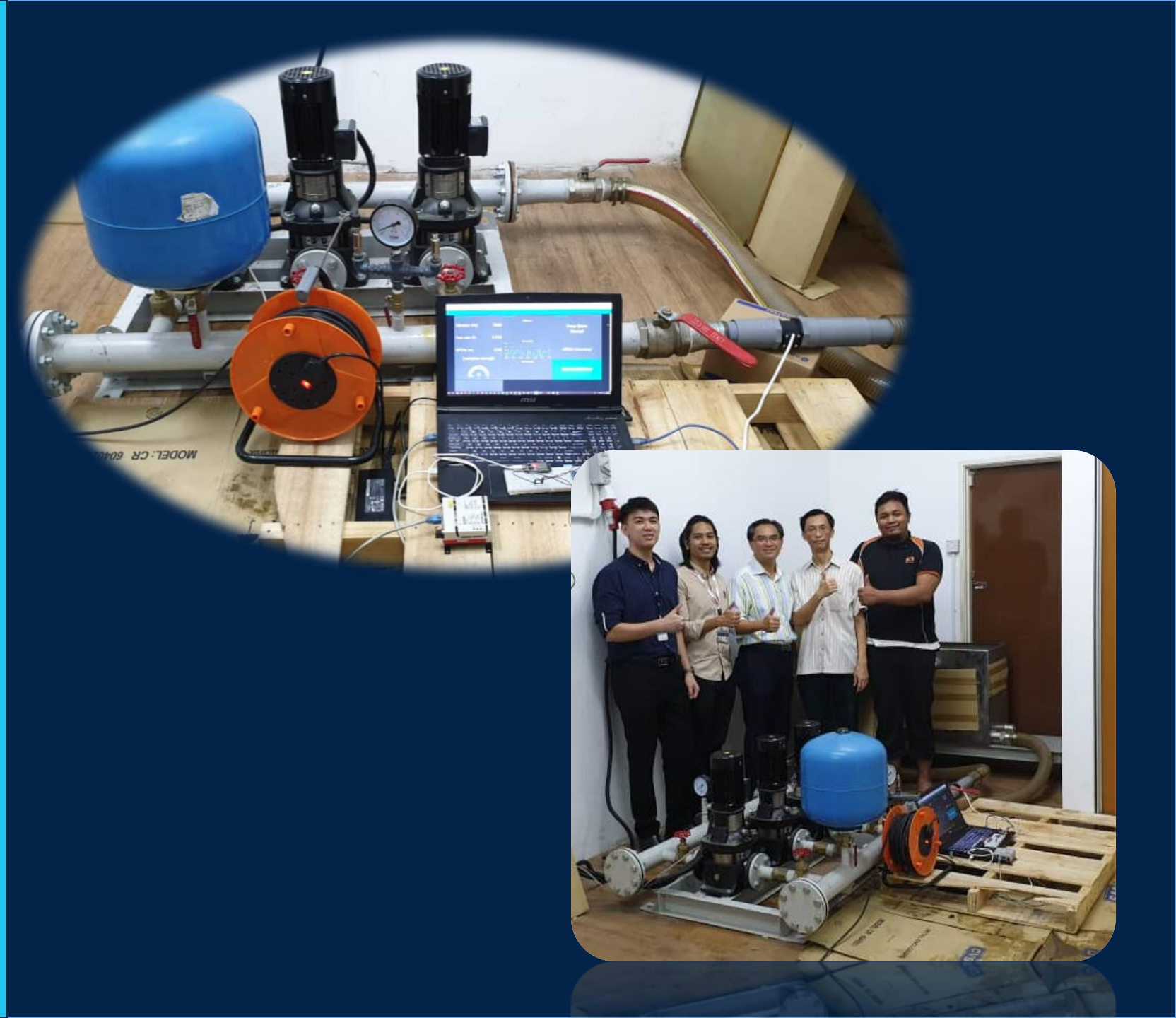
Phase 3 and phase 4

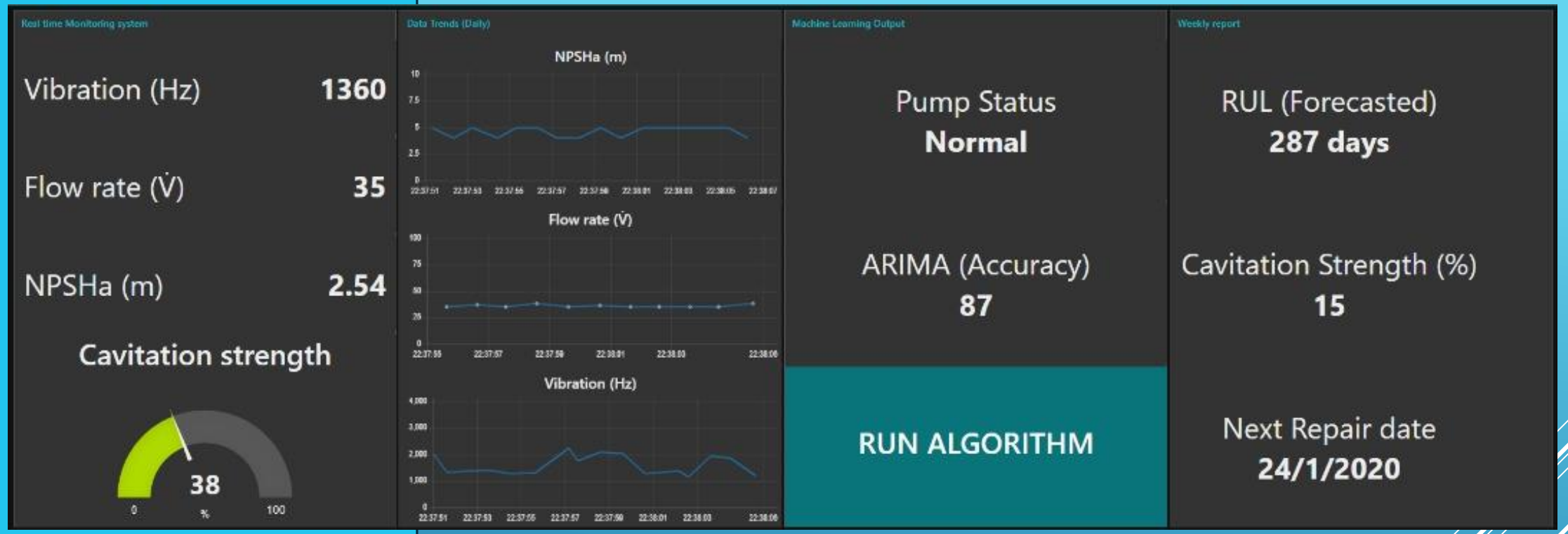



```
IF fbTimer.Q THEN // publish new payload every second
    //fbTIMER2(IN:=fbTimer.Q OR NOT , Q=> , ET=> );
    //fbTimer3(IN:= , PT:= , Q=> , ET=> );
    fbTimer(IN:=FALSE);
    i:=i+1;
    random_n := random_n+2;
    sPayloadPub :=TO_STRING(random_n) ;
    fbMqttClient.Publish(   sTopic:= sTopicPub,
                            pPayload:= ADR(sPayloadPub), nPayloadSize:=LEN2(ADR(i))+1,
                            eQoS:= TcIotMqttQos.AtMostOnceDelivery,
                            bRetain:= FALSE, bQueue:= FALSE );
```

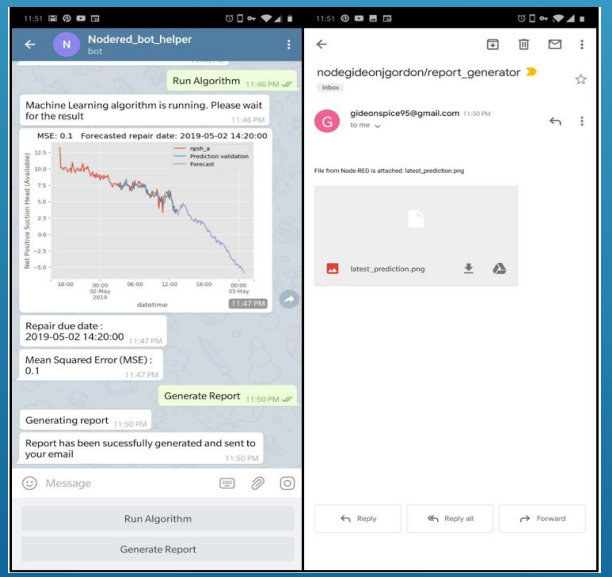
```
void data_aquisition_ESP32(){
  /*-------------------------MQTT-NODE_RED-------------------------*/

  str_TEG_TMP_COLD_grp = String(int_fromesp32);
  str_TEG_TMP_COLD_grp.toCharArray(char_fromesp32 , str_fromesp32 .length() + 1);
  client.publish(nodeRed_topic_fromesp32,char_fromesp32 );
}
void loop() {
  data_aquisition_ESP32()
}
```

Testing at Site





IoT Platform And Alerts



Questions?

Thank You

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