Real-time Web Application for Predicting and Classifying Industrial Systems Faults

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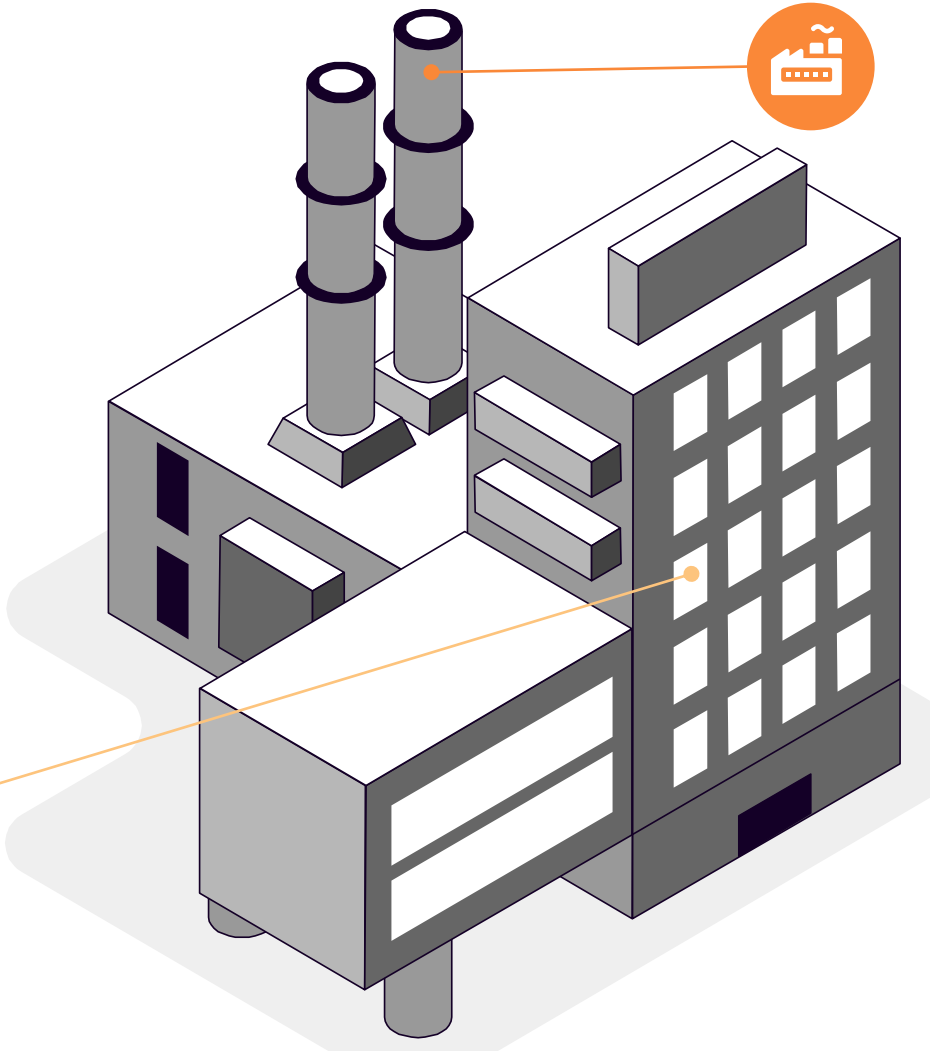
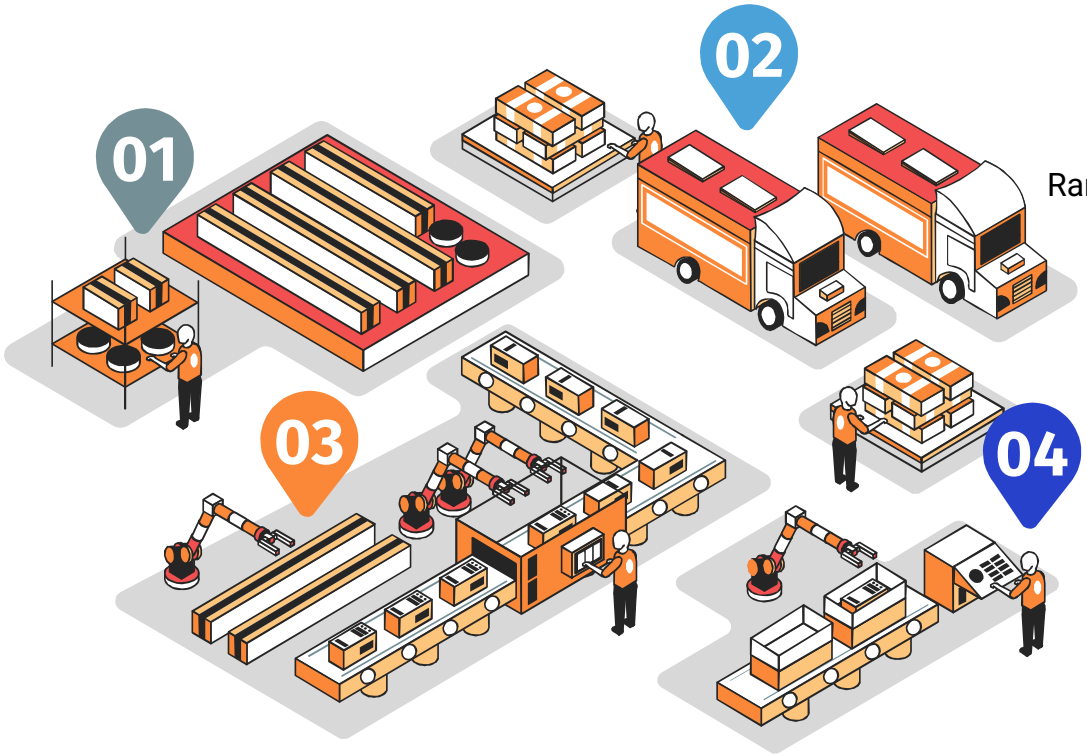


Plan

01
Introduction

The Challenges
Main Idea



02
Part 01

Prepare the Data
Random forest Classifiers
Contribution

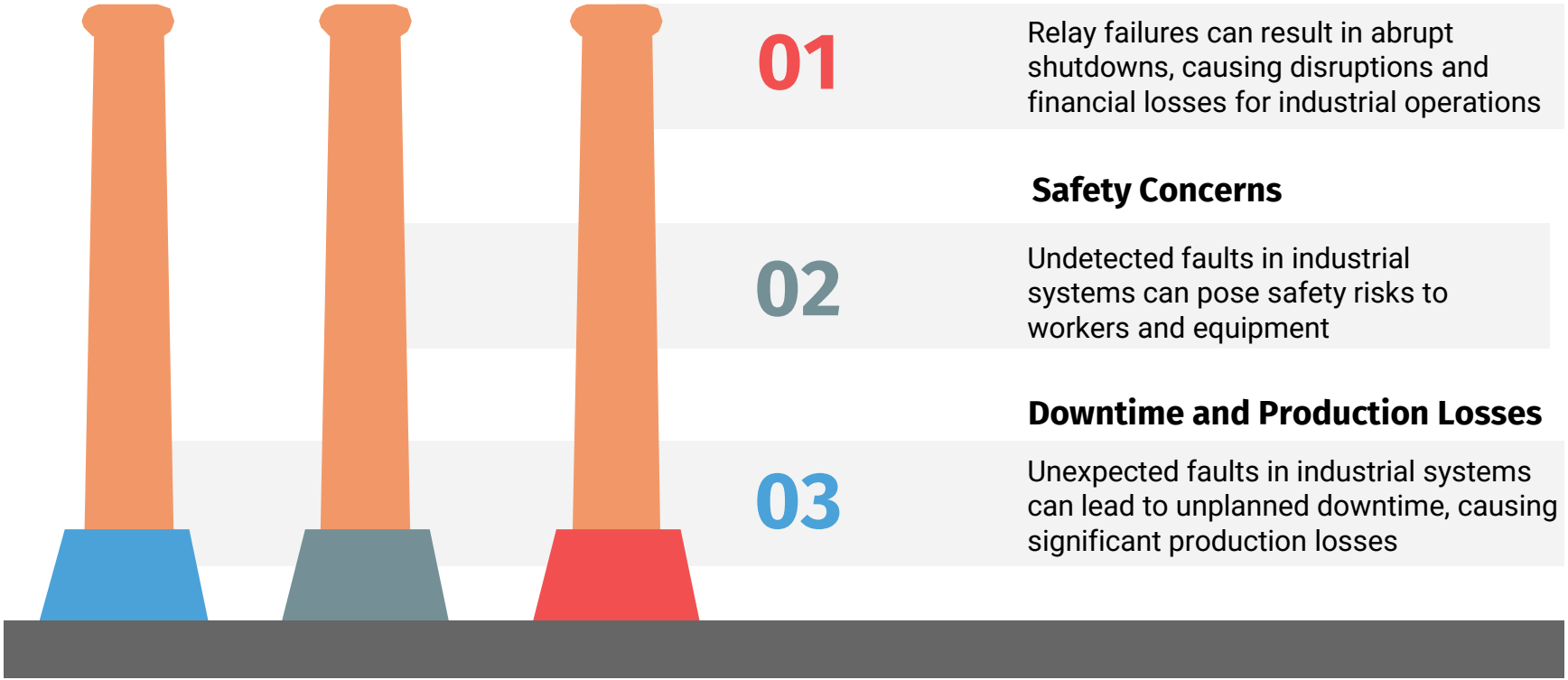
03
Part 02

Web Interface

04
Conclusion

Best Scenario
Future Work

The Challenges



01

Unplanned Relay Shutdowns

Relay failures can result in abrupt shutdowns, causing disruptions and financial losses for industrial operations

02

Safety Concerns

Undetected faults in industrial systems can pose safety risks to workers and equipment

03

Downtime and Production Losses

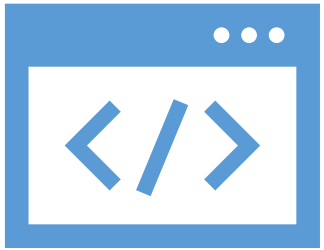
Unexpected faults in industrial systems can lead to unplanned downtime, causing significant production losses

Main idea

Prepare the Data

Create the model

Contributions



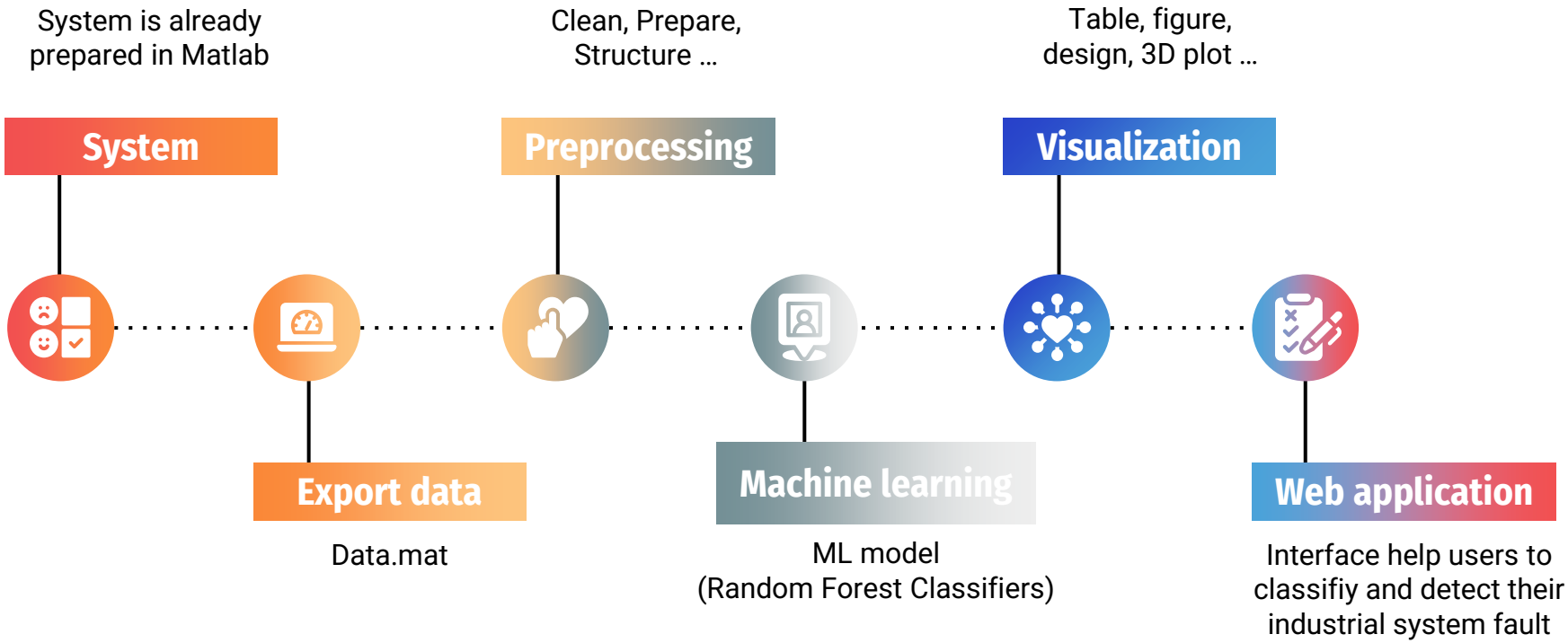
Interface

Industrial system

PART 01

PART 02

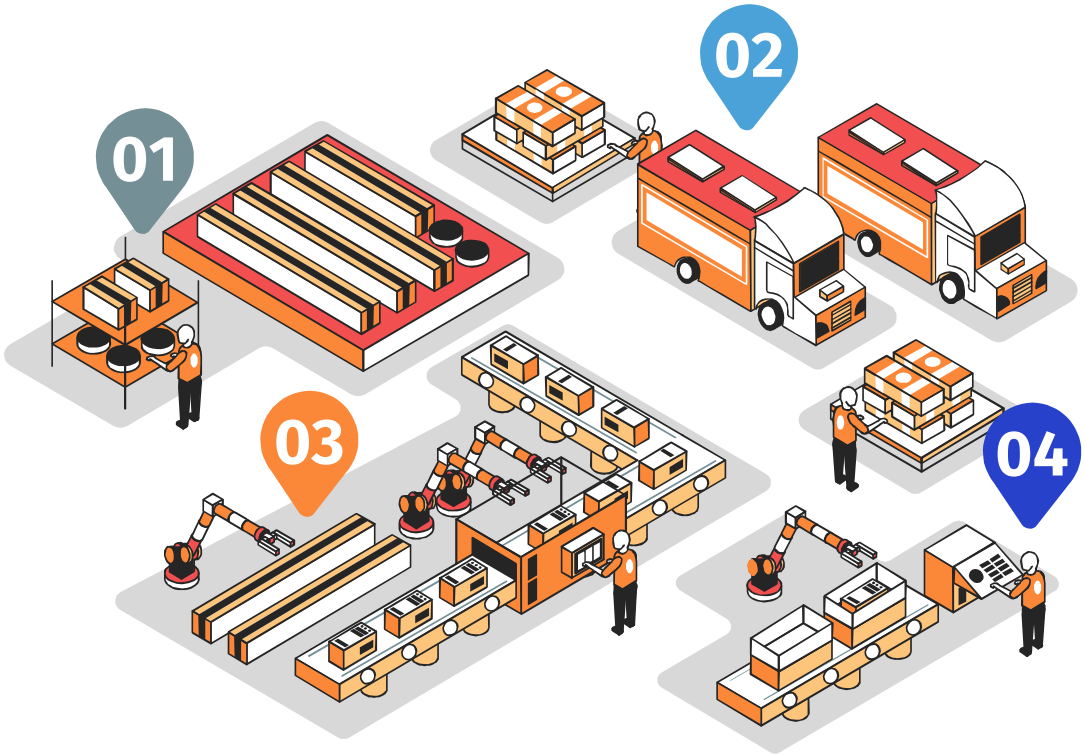
The Process


System is already prepared in Matlab
Clean, Prepare, Structure ...
Table, figure, design, 3D plot ...
System
Preprocessing
Visualization
Export data
Machine learning
Web application
Data.mat
ML model (Random Forest Classifiers)
Interface help users to classifiy and detect their industrial system fault

Plan

01
Introduction

Problematic
Main Idea



02
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Implementation

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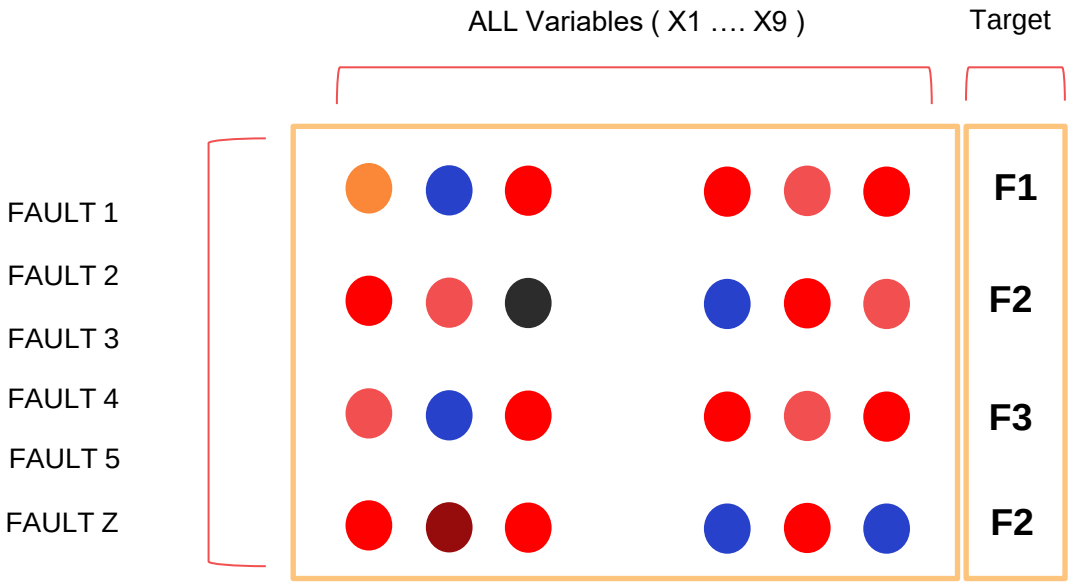
Data Variable Labeling

Measures	Symbol	Variable	Description
Grid Three phase current	I_a	x_1	Grid current phase a
	I_b	x_2	Grid current phase b
	I_c	x_3	Grid current phase c
PV current	I_{pv}	x_4	Output current of the PV panel
Grid three phase voltage	V_a	x_5	Grid voltage phase a
	V_b	x_6	Grid voltage phase b
	V_c	x_7	Grid voltage phase c
Output Voltage	V_{out}	x_8	Output voltage of the DC-DC converter
PV voltage	V_{pv}	x_9	Output voltage of the PV panel

Data Structure



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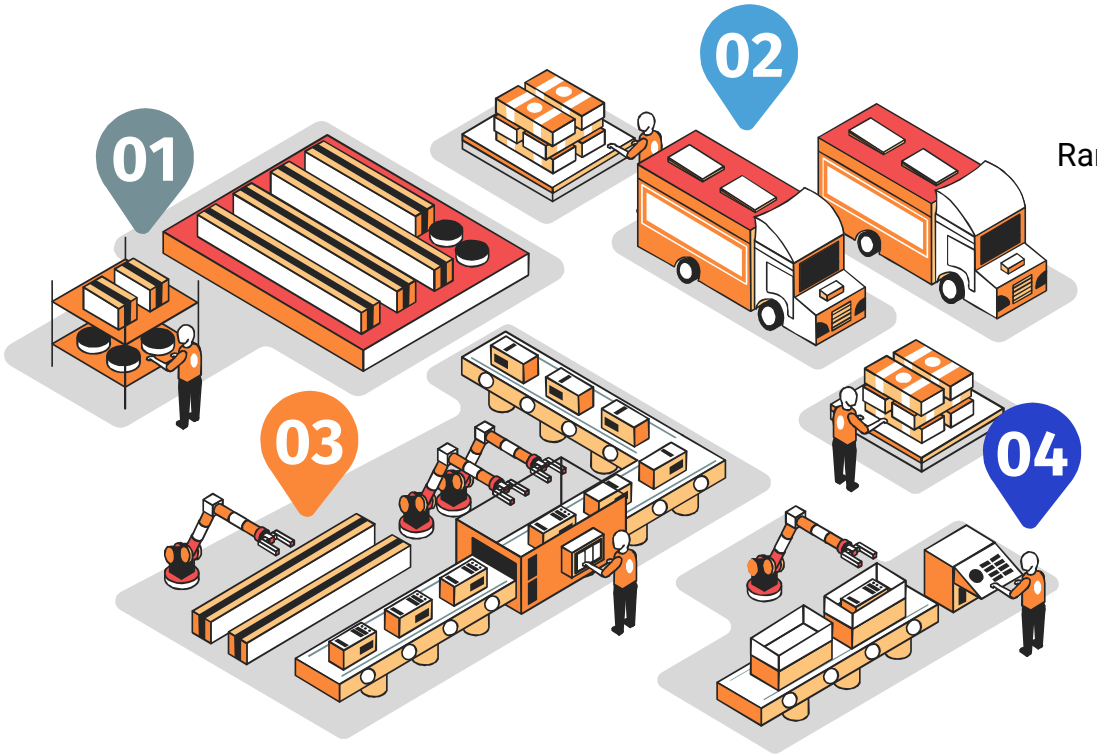

02
Part 01

Random Forest Classifier

03
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Type of machine learning

Supervised Learning

Unsupervised Learning

Reinforcement Learning

Type of machine learning

Supervised Learning

Unsupervised Learning

Reinforcement Learning

Type of Supervised Learning

Supervised Learning

Classification

Regression

Type of Supervised Learning

Supervised Learning

Classification

Regression

What is Classification ?

Supervised Learning

Classification

In supervised learning, the algorithm is trained on a labeled dataset, where each input is associated with a corresponding output. The model learns to map input data to the correct output by generalizing from the labeled examples

Solution under Classification

Supervised Learning

Classification

- KNN
- Decision Tree
- Random Forest

Solution under Classification

Supervised Learning

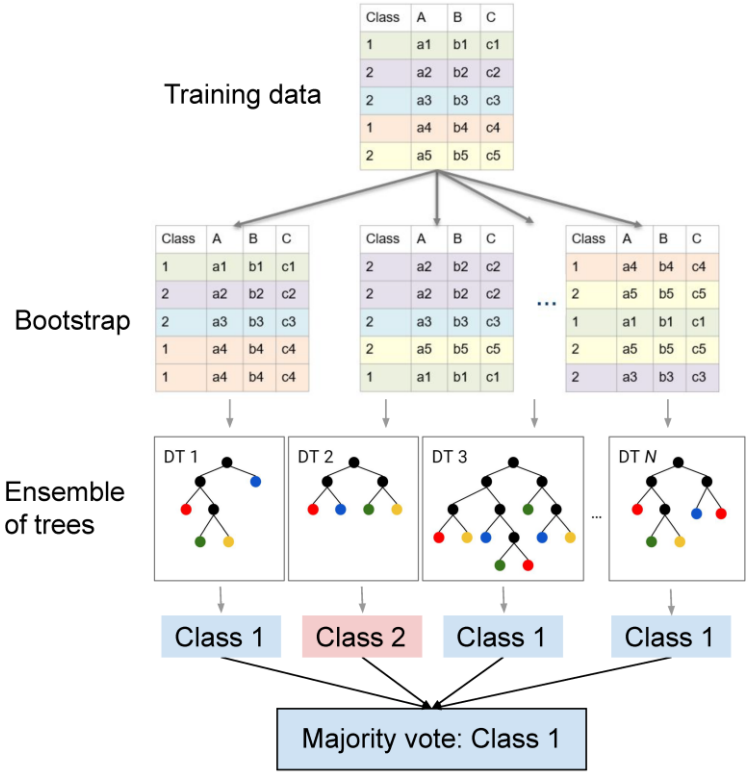
Classification

KNN

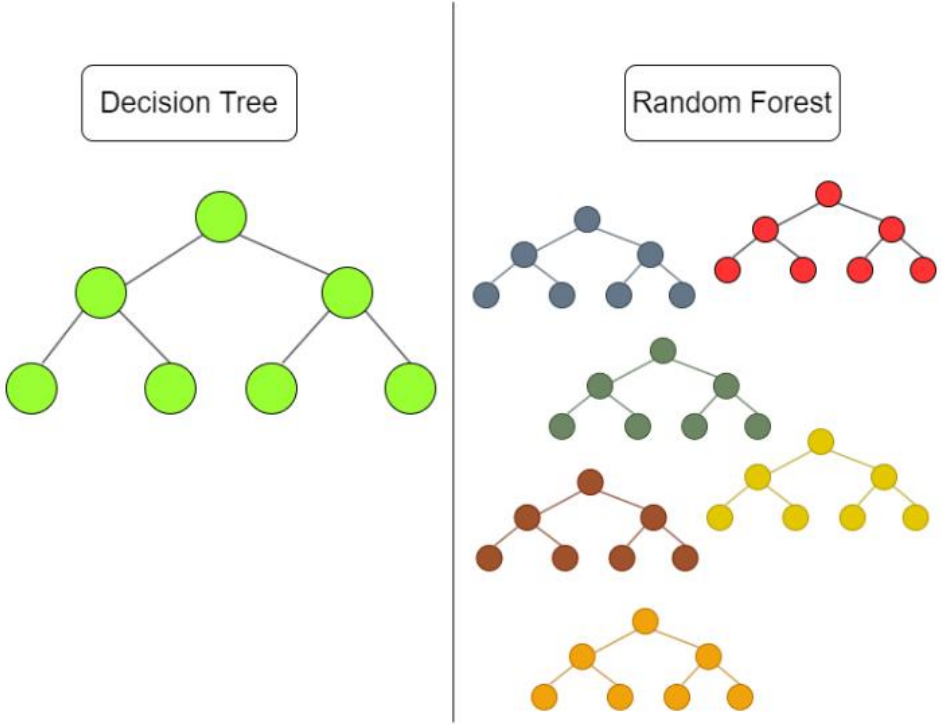
Decision Tree

Random Forest

What is Random Forest ?



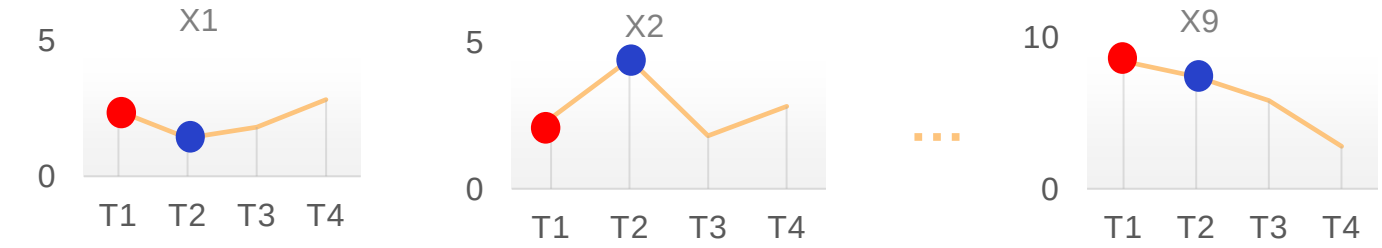
Decision Tree and Random Forest



Decision Tree and Random Forest

	Decision Tree	Random Forest
Accuracy	The Results are not accurate	The results are accurate
Computation	Require low computation power	Require High computation power
Visualization	Easy to visualize	Complex visualization
Performance	Overfits the data	Does not overfit the data

Summary of All Processes



Train the RF Algorithm

Find the relation between variables

First decision : **Fault 1**

Save the model

Final decision : **Fault 1**

Fault 1 = 3/4
Fault 2 = 1/4

Plan

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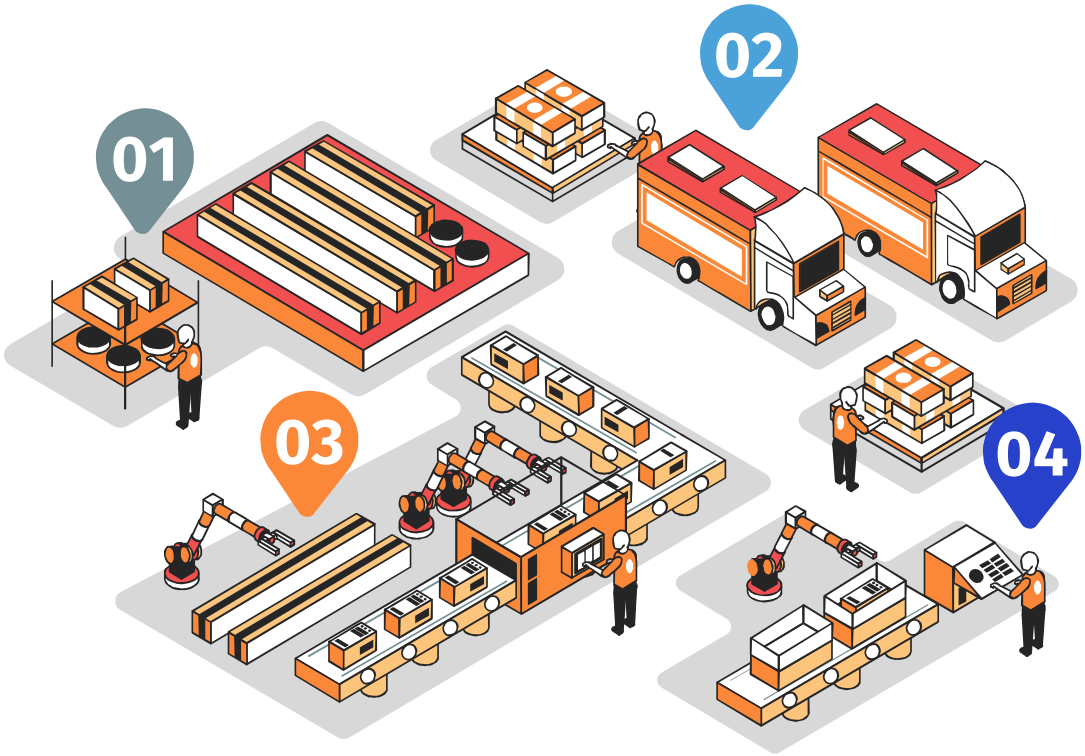

02
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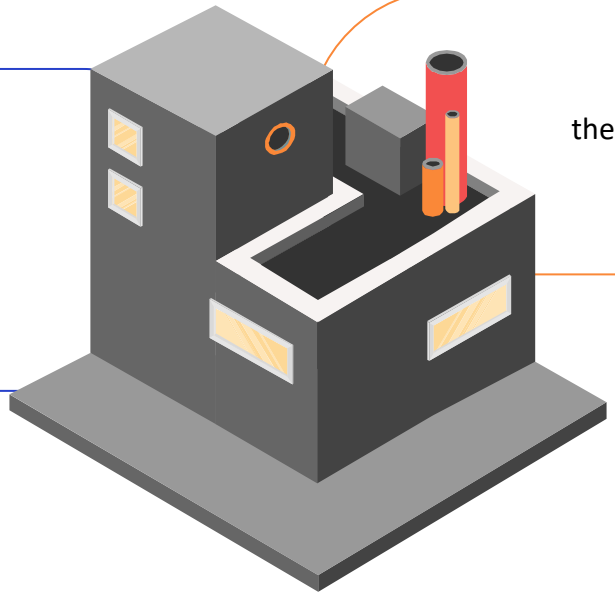
Contribution

Scenario 02

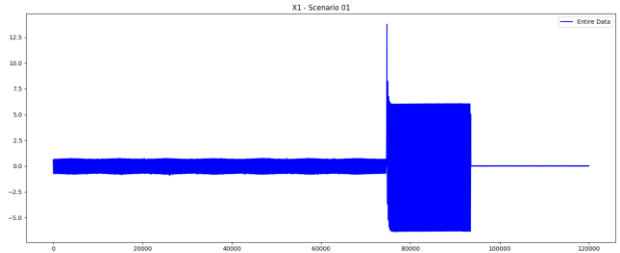
we will focus exclusively on the transitory regime

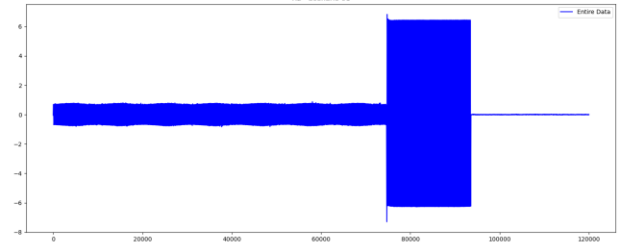


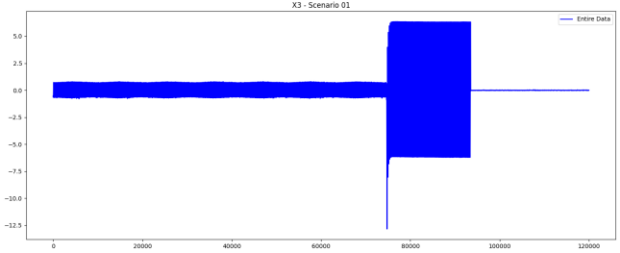
Scenario 01

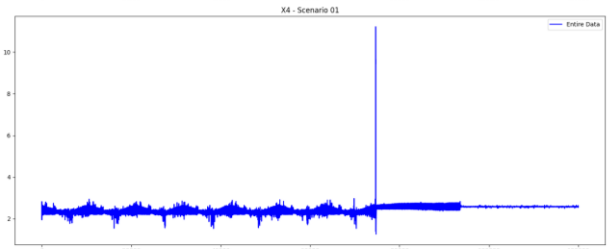
the first scenario involves training the model on all the data

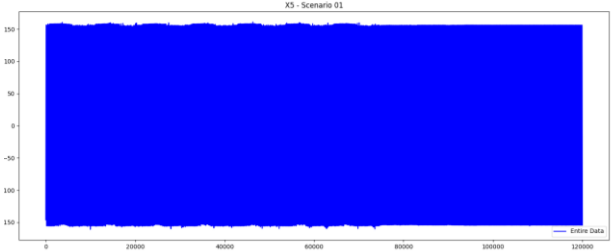
Scenarios 01 : Entire Data

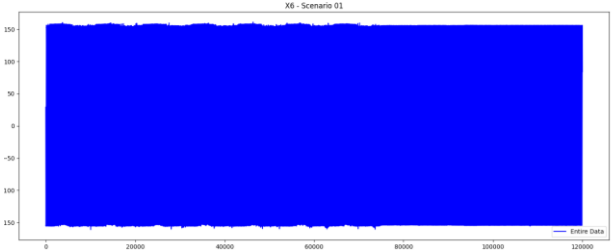


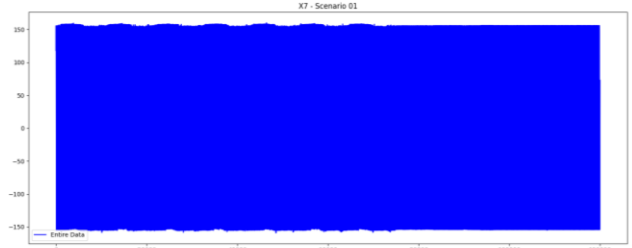


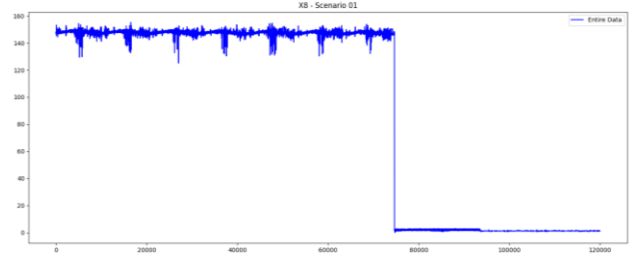


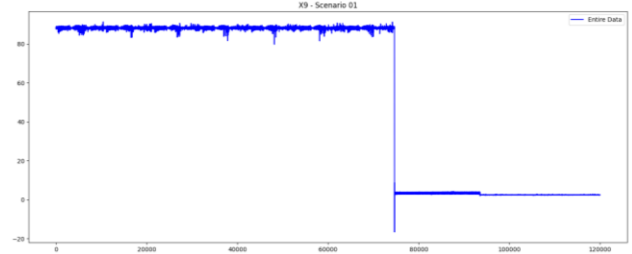












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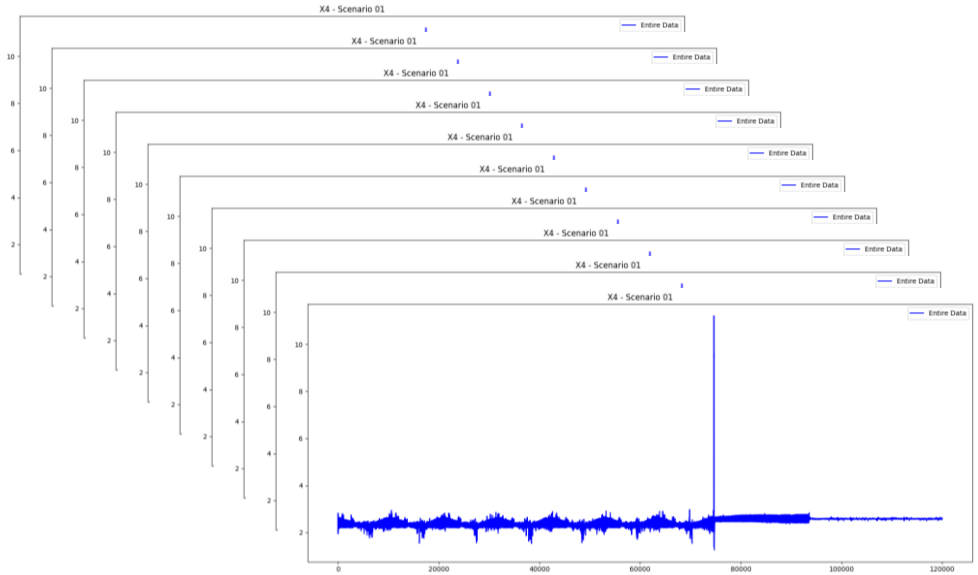


Discussion

In Scenario 01, the model's performance is commendable, with an accuracy 96.36%, indicating its ability to effectively detect and classify industrial faults

However, this scenario uses a relatively large dataset with ~550K samples, making it computationally intensive, especially during training

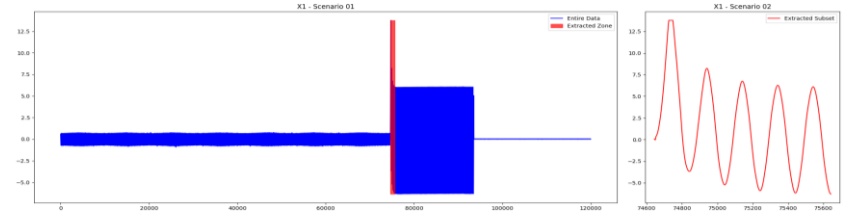
Accuracy

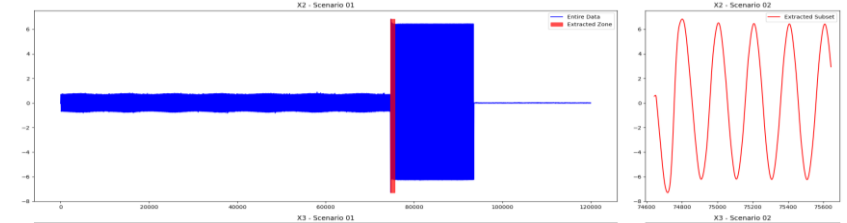
0.9631

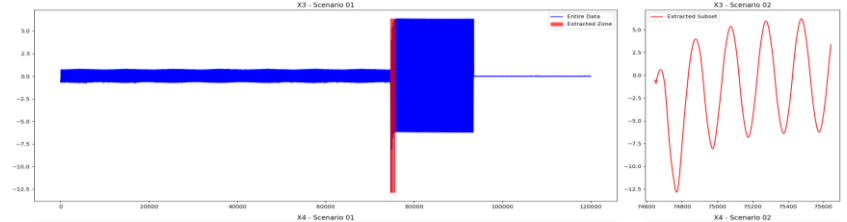
Computation time

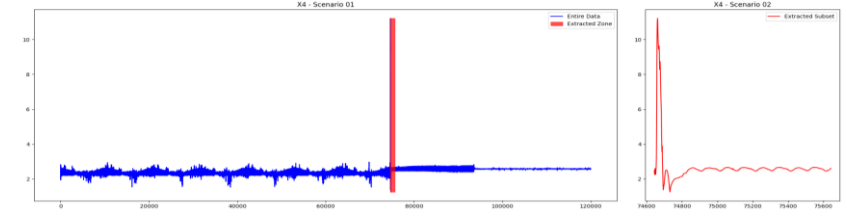
1.2200 seconds

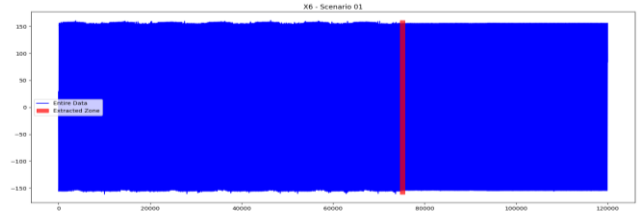
Scenarios 02 : Transitory Regime

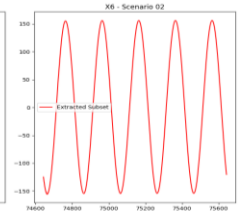


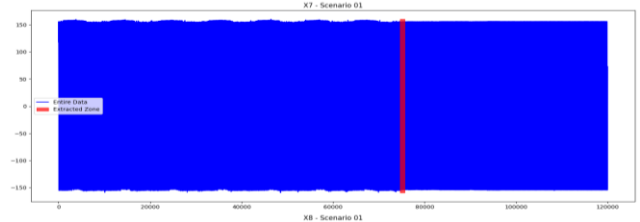


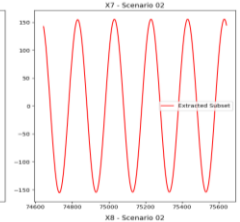


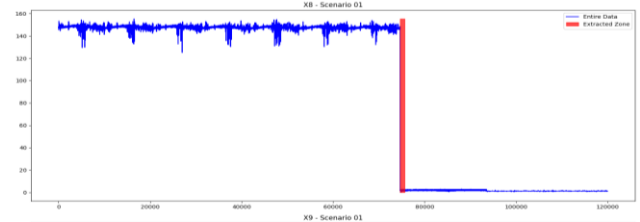


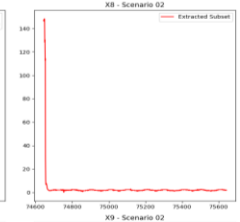


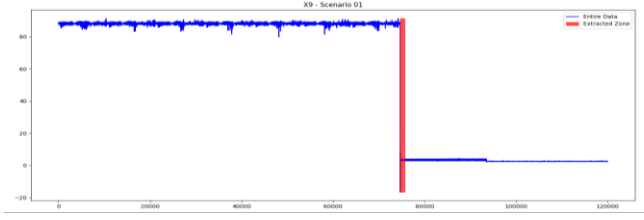


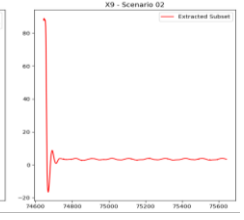




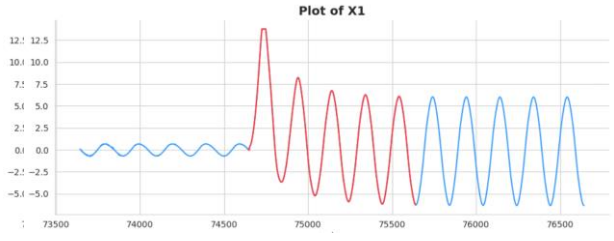


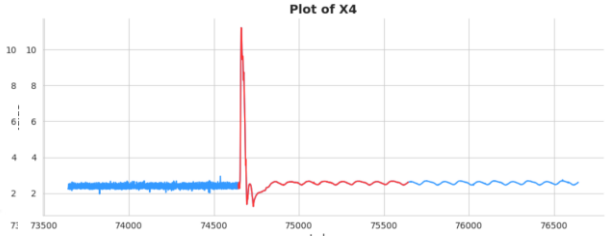


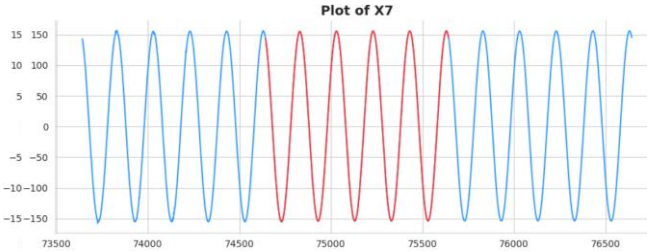


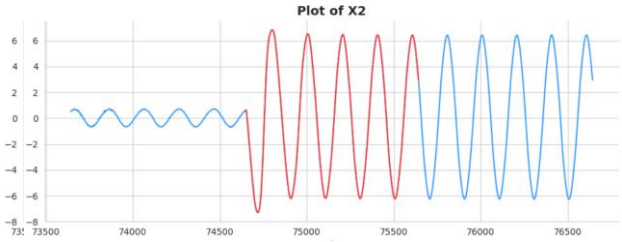


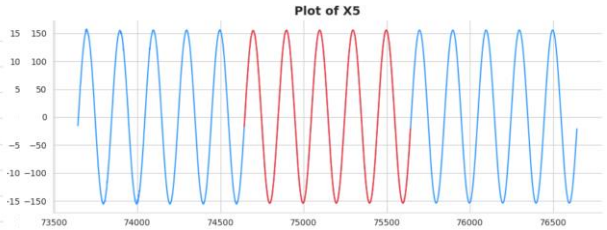
Visualization of the extracted part

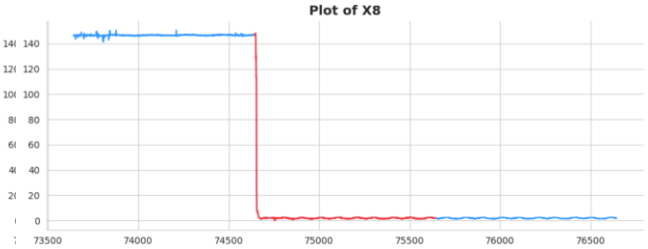


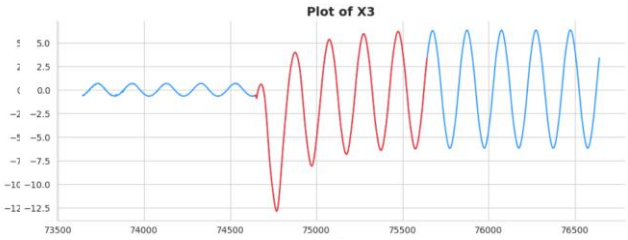


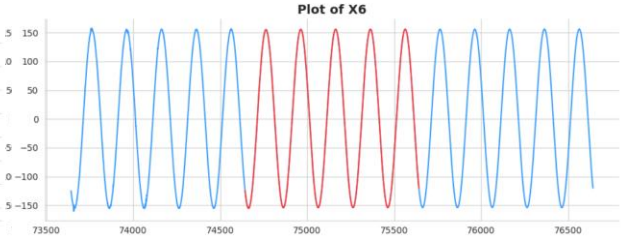




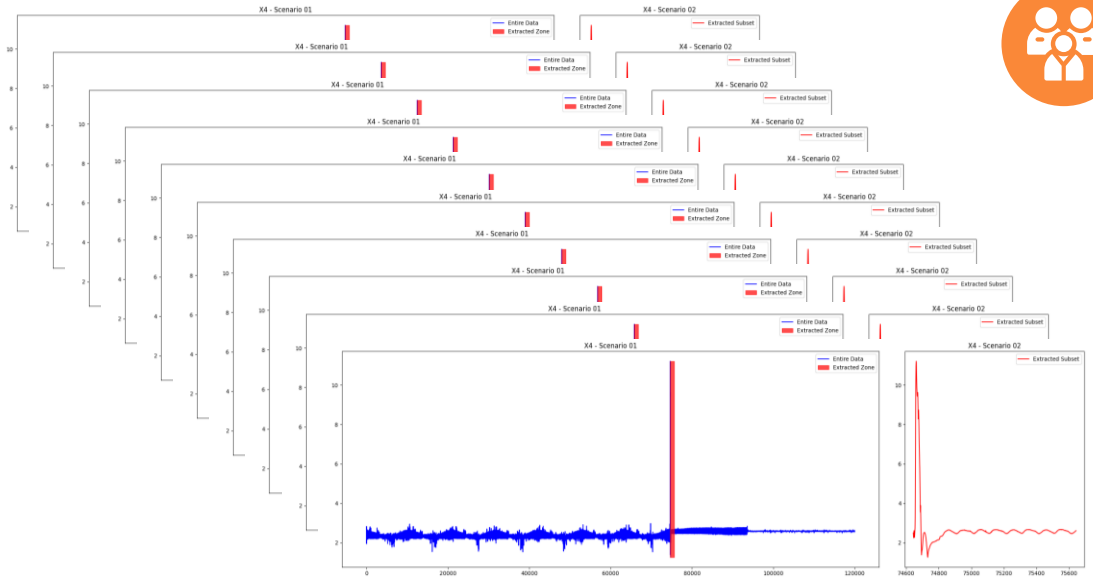








Scenarios 02 : Transitory Regime



Discussion

In Scenario 02, the model's performance surpasses that of Scenario 01, achieving a perfect accuracy of 1.0. This means it makes no misclassifications and is exceptionally reliable in fault detection

This drastic reduction in data size results in much faster computation times, both during training and testing

Accuracy

1.0

Computation time

0.008 sec

Plan

01
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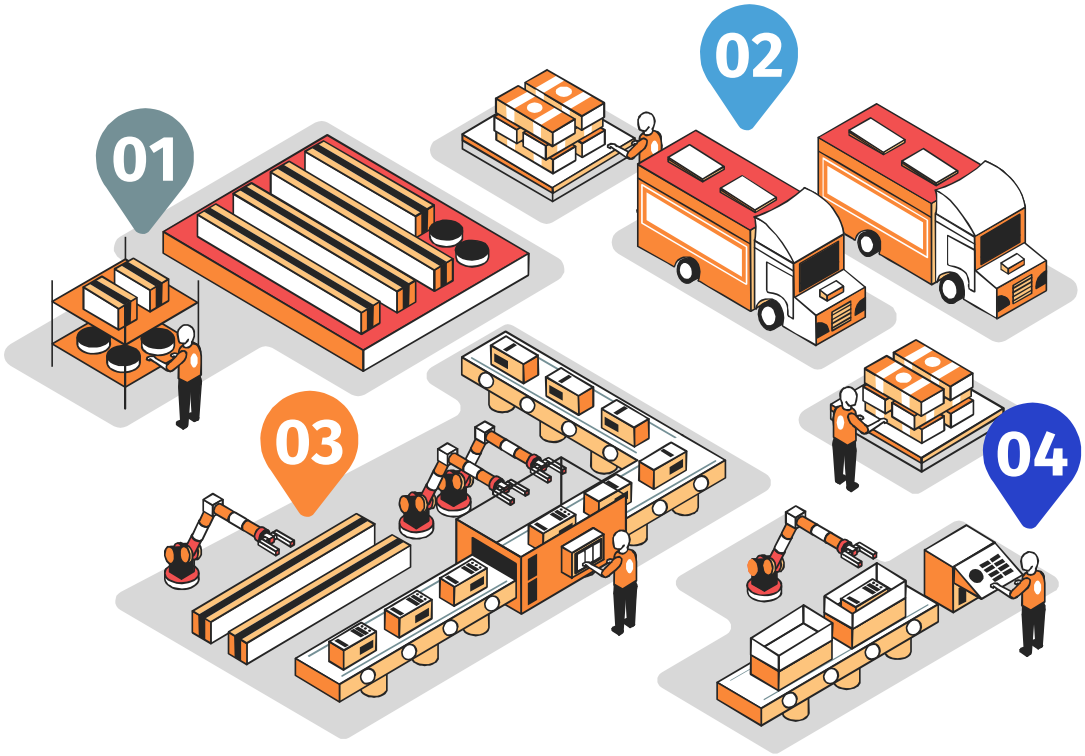

02
Part 01

Results and discussion

03
Part 02

Web Interface

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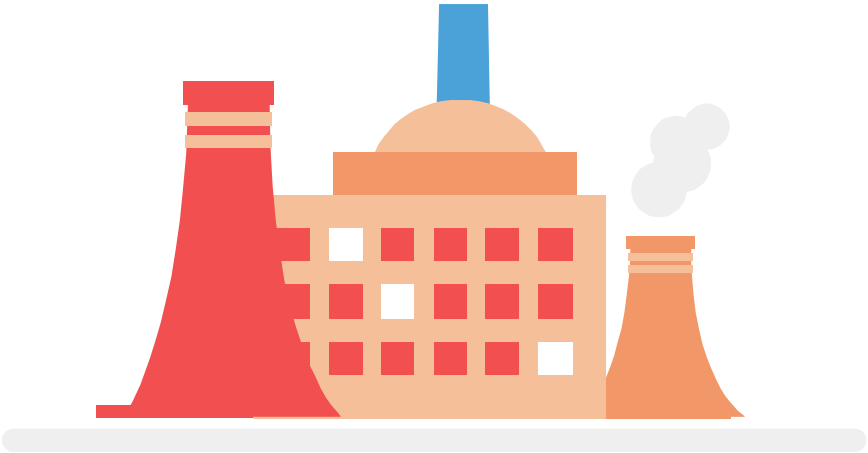
Future Work

Results and discussion



Accuracy

Confusion Matrix

Classification Report

Outliers

01

Indicating a highly effective solution for rapid fault detection in industrial systems

02

It correctly identified and classified all instances for each class, leaving no room for misclassifications

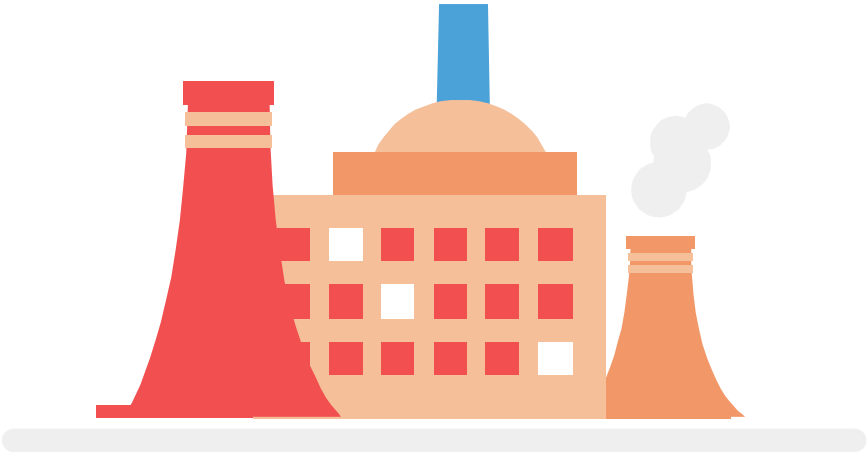
03

The model exhibits perfect precision, recall, and F1-scores for all classes

04

It contributes to data quality, model accuracy, robustness, and the overall success of the mode

Results and discussion



Accuracy

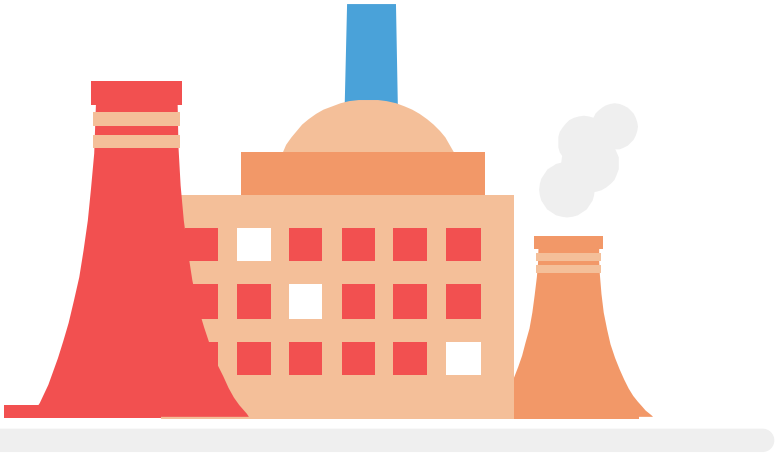
Confusion Matrix

Classification Report

Outliers

100 %

Results and discussion



Accuracy

Confusion Matrix

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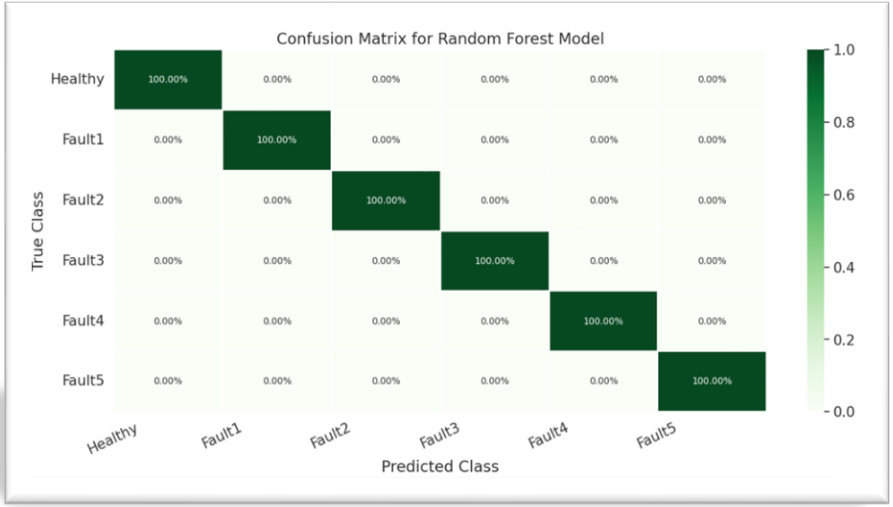
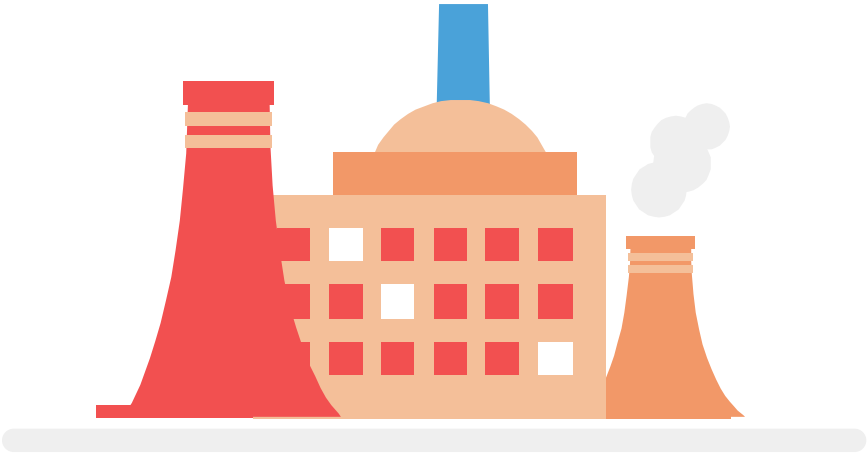


Results and discussion



Accuracy

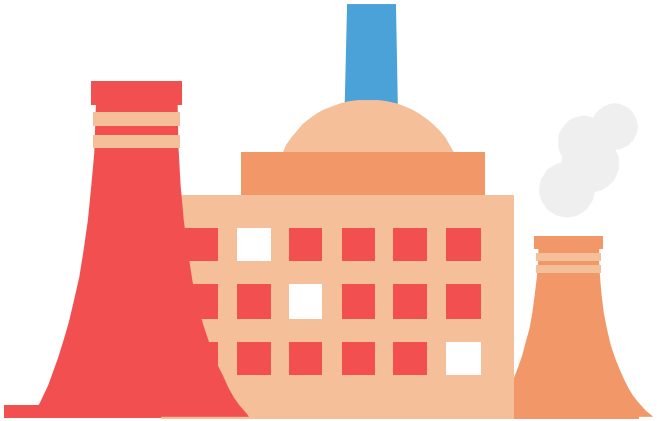
Confusion Matrix

Classification Report

Outliers

	Precision	Recall	F1-Score	Support
0	1.00	1.00	1.00	215
1	1.00	1.00	1.00	222
2	1.00	1.00	1.00	176
3	1.00	1.00	1.00	204
4	1.00	1.00	1.00	189
5	1.00	1.00	1.00	194
Accuracy			1.00	1200
Macro Avg	1.00	1.00	1.00	1200
Weighted Avg	1.00	1.00	1.00	1200

Results and discussion

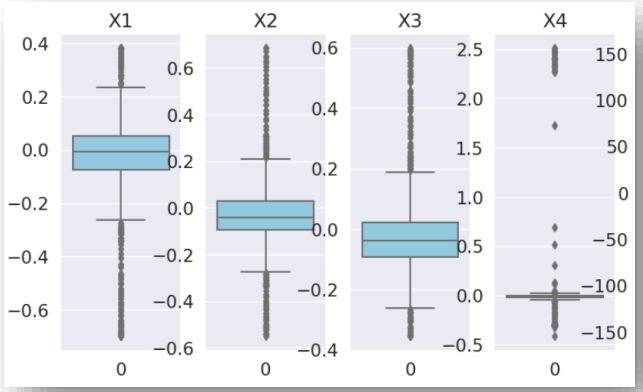


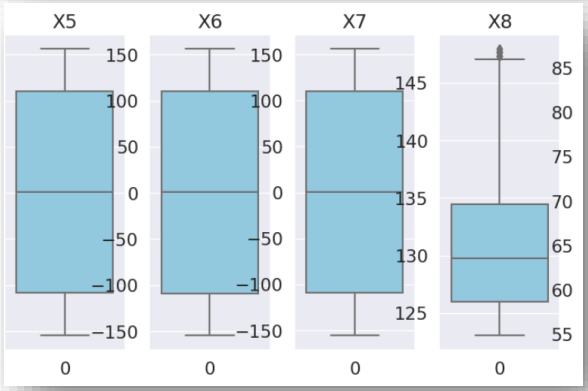
Accuracy

Confusion Matrix

Classification Report

Outliers

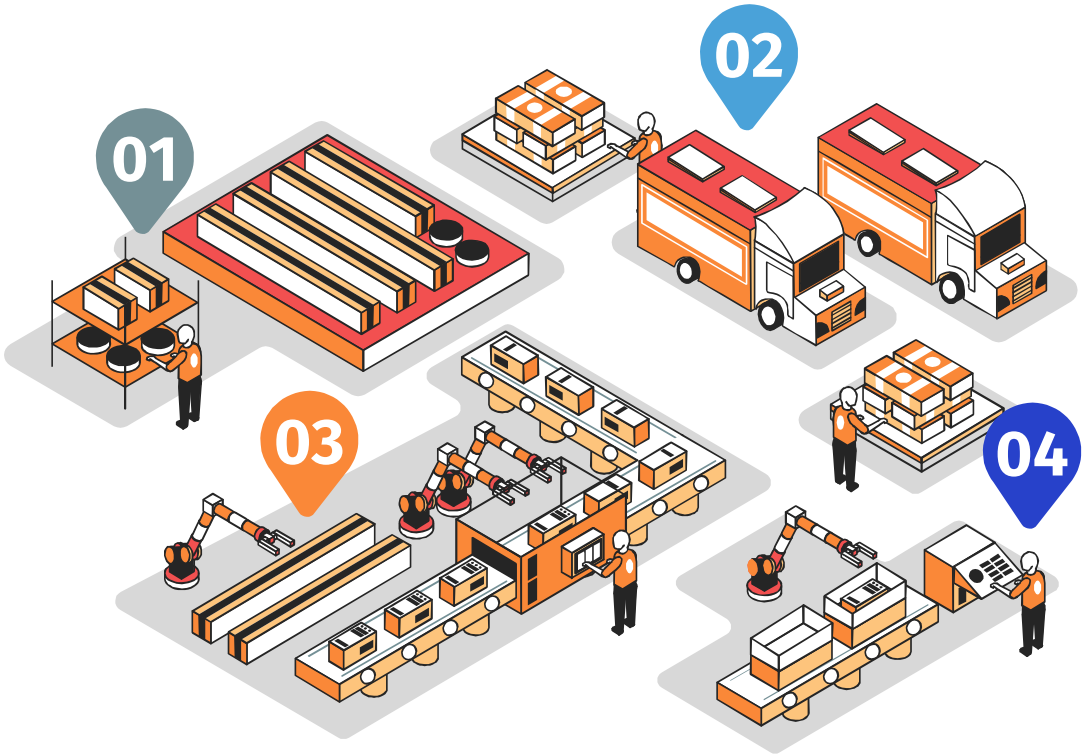




Plan

01
Introduction

The Challenges
Main Idea



02
Part 01

Results and discussion

03
Part 02

Web Interface

04
Conclusion

Best Scenario
Future Work

Build the Web Application

ML Model

Loading the best model

User Interface

Friendly interface & easy to use

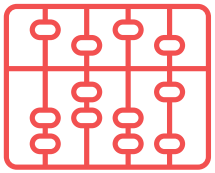
Signal Input and Processing

Users can input signals from their industrial system

Fault Prediction and Classification

The application provides all results to the user

The Process



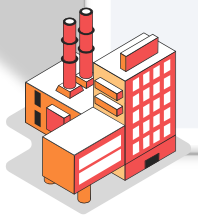
ML Model

Final App : Offline

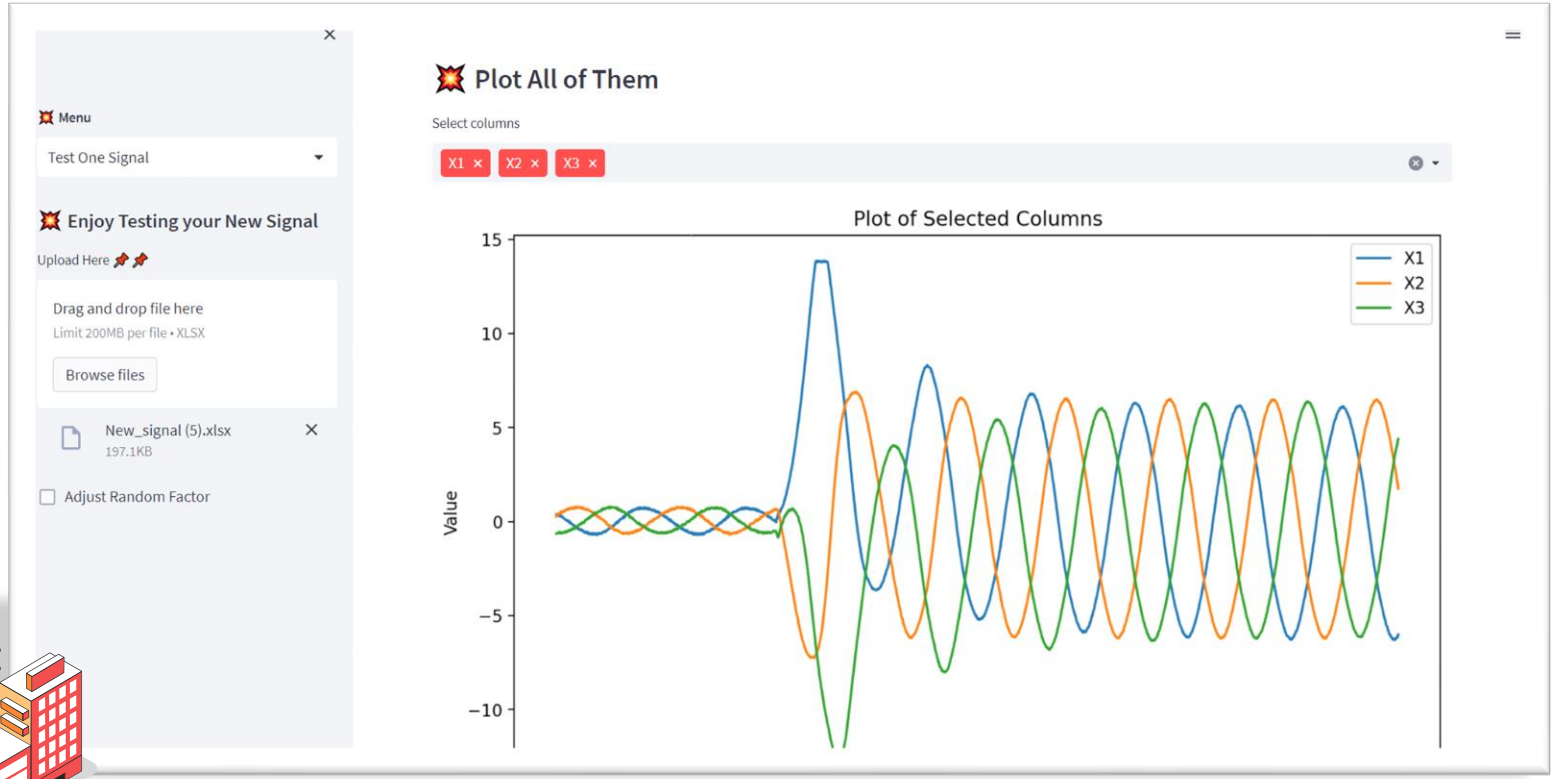
Coding

HOME Page

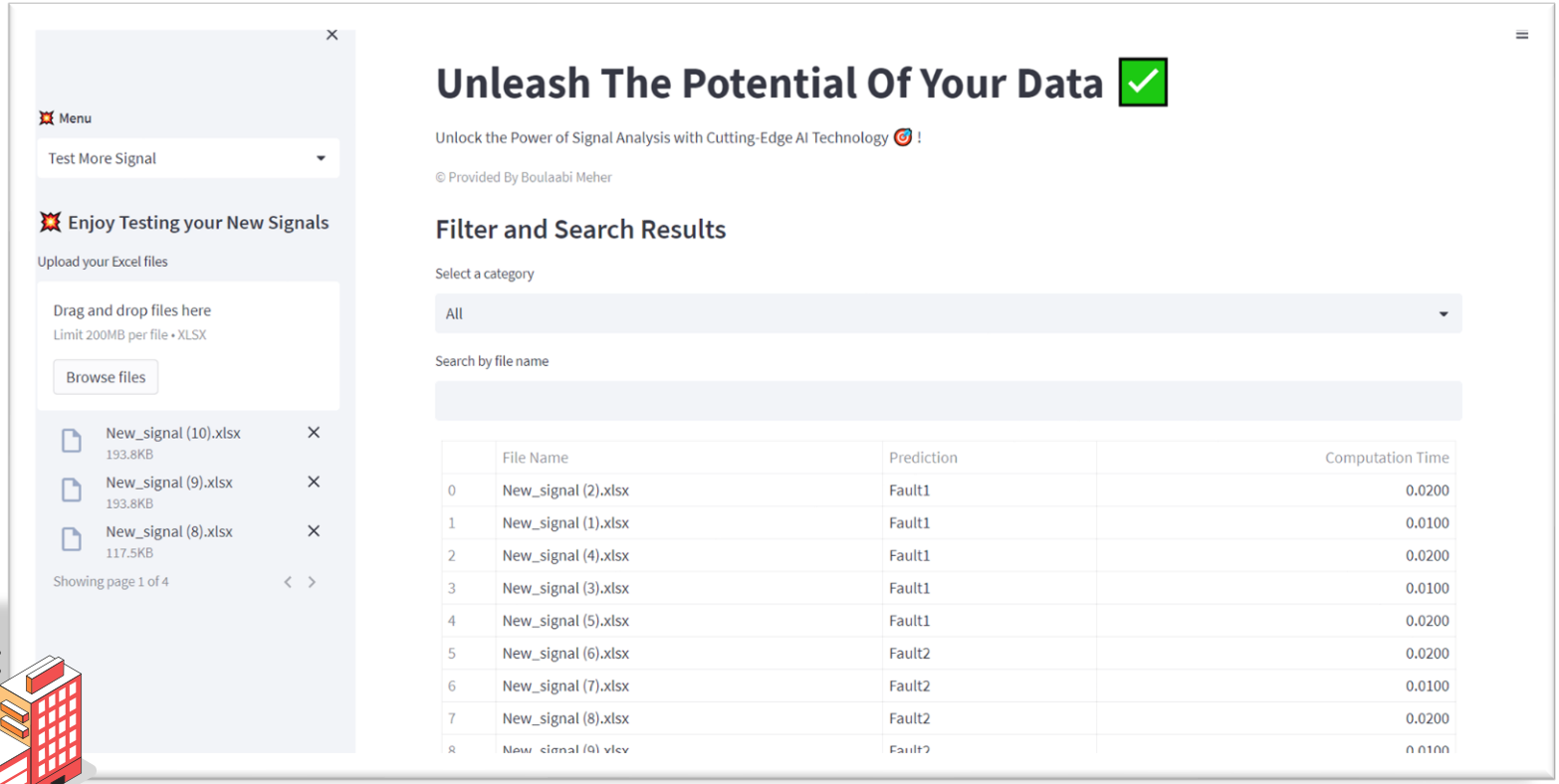

Menu
Home
Fast Signal Prediction and Classification
Unlock the Power of Signal Analysis with Cutting-Edge AI Technology !
© Provided By Boulaabi Meher



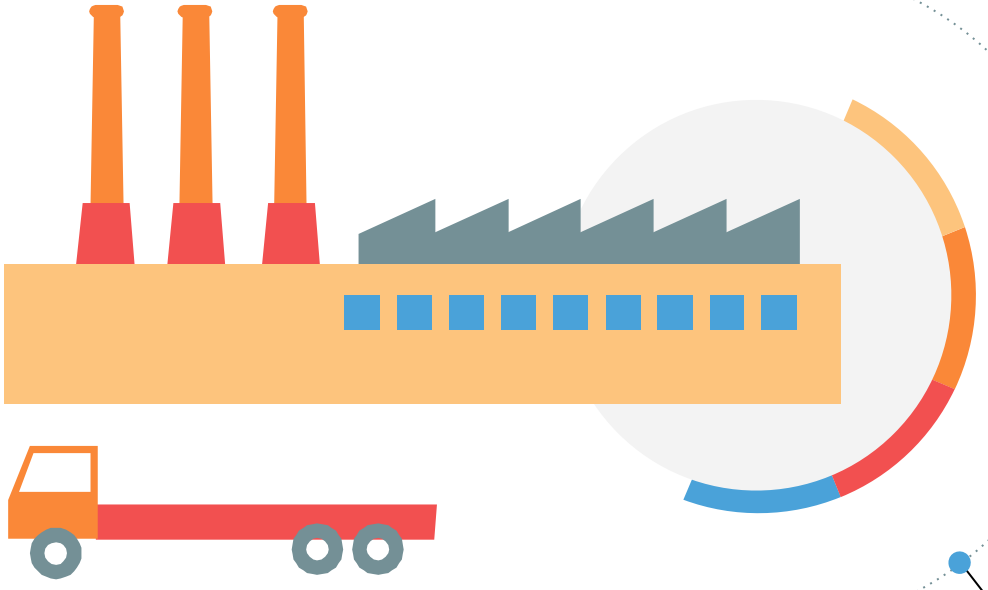
Test one signal page



Test multiple signal page



Conclusion and Future Work



01 Feature selection

02 Optimisation technique

03 Work on static and dynamic system

04 Test more ML & DL models

THANK YOU !!