PREDICTIVE MAINTENANCE OF INDUSTRIAL MOTORS

A PROJECT REPORT

submitted in partial fulfilment of the requirements

for the award of the degree of

BACHELOR OF TECHNOLOGY

in

ELECTRICAL AND ELECTRONICS ENGINEERING

by

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Contents

1. ABSTRACT

Internet of Things (IoT) may be a worldwide system of “smart devices” which will sense and connect with their surroundings and interact with users and other systems. Electric motor predictive maintenance is when you use non-destructive tests such as infrared-thermographic studies and electrical engine vibration analysis of electric motors currently in service to identify problems so that corrections can be made before 'they don't become serious problems requiring an unplanned work stoppage.

Essentially electric motor predictive maintenance tries to “predict” and correct problems before they affect productivity. Predictive maintenance is performed at regular intervals and the results are carefully documented to track potential issues.

2. INTRODUCTION

The Internet has become ubiquitous and popular in almost every corner of the globe and is affecting human life in an unimaginable way. So, we are now entering an era of "Internet of Things (IoT)". It includes traditional computing devices like laptops, tablets and smartphones, but also includes a growing list of other devices that have recently become internet enabled. Examples include home appliances, automobiles, wearable electronics, security cameras and lots of other things. In order for a device to be part of the Internet of Things, it must be able to communicate with other devices. Therefore, it requires some sort of built-in wired or wireless communication. Most IoT devices are Wi-Fi enabled, but Bluetooth also can be wont to transfer data to nearby devices. IoT devices are commonly called “smart devices”, since they're ready to communicate with other things. Along with the capacity to speak, many IoT devices also include an array of sensors that provide useful information. While the Internet of Things is still in its infancy, it provides promising opportunities for the future. In time, the web of Things will subside of an abstract idea and more of how of life.

3. LITERATURE REVIEW

J. A. Sánchez in 2020 developed a system to Predict the maintenance monitoring with periodic or continuous measurement of variables of the state of the equipment to be maintained and its comparison with pre-established patterns for the determination of the instant in which the maintenance intervention should take place. Three-phase induction motor drives are one of the industrial equipment that has been given greater attention regarding predictive maintenance plans. In recent years, switched reluctance motor drives have begun to have some relevance in the industry.

D. Shyamala in 2017.predictive maintenance of induction motors is well suited for small to larger scale industries in order to reduce downtime, increase efficiency and reliability. In this paper, the vibration and temperature of the induction motor is analysed in order to gather specific information that can predict motor's bearing failure. Well analysed vibration signal easily shows the difference between the running operation of the healthy and faulty motor. Using IoT

4. OBJECTIVE

In this project we are going to make an IoT Based System in which we will monitor the Realtime status of the motor using Node-red & IBM Watson and will send a SMS to user. To measure the values of current, voltage, temperature of electric motor and measuring these characters by using ML, a machine learning model can be developed by using IBM CLOUD. To develop it we are using AUTO AI mode of IBM cloud.

5. WORK FLOW

PHASE - 1: Detection of current, voltage and temperature Level

It indicates the early phase of the project. An IoT based detection is developed.
It deals with the collection of data from sensors (i.e., from python code).

PHASE - 2: Creating the interface

The data collected is stored, processed and can be monitored using the Mobile Application.
Users can review the stored data through the application.

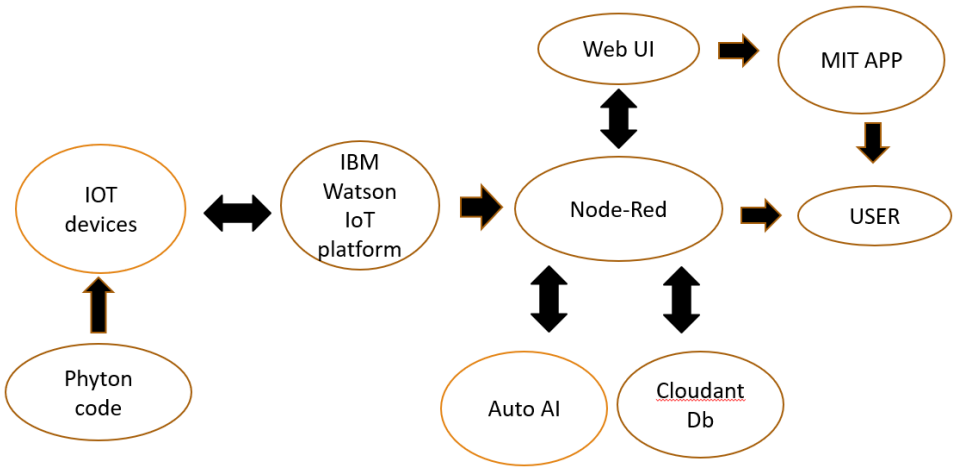
PHASE - 3: Execution and Testing

The testing, debugging and troubleshooting of the design is performed to test the performance of the design.

6. SOFTWARE TOOLS

- NODE-RED
- PYTHON
- IBM WATSON IOT PLATFORM
- MIT APP INVENTOR

7. BLOCK DIAGRAM



8. DESIGN OF IOT BASED AIR POLLUTION MONITORING SYSTEM

1. DEVELOP THE CODE

Create a device in IBM IoT platform and using those device credentials we are sending the sensor data to node-red. Since we are not using any sensors we are sending random data using python.

python code.py - C:/Users/HAI/Desktop/IoT Domain/project/python code.py (3.9.11)

File Edit Format Run Options Window Help

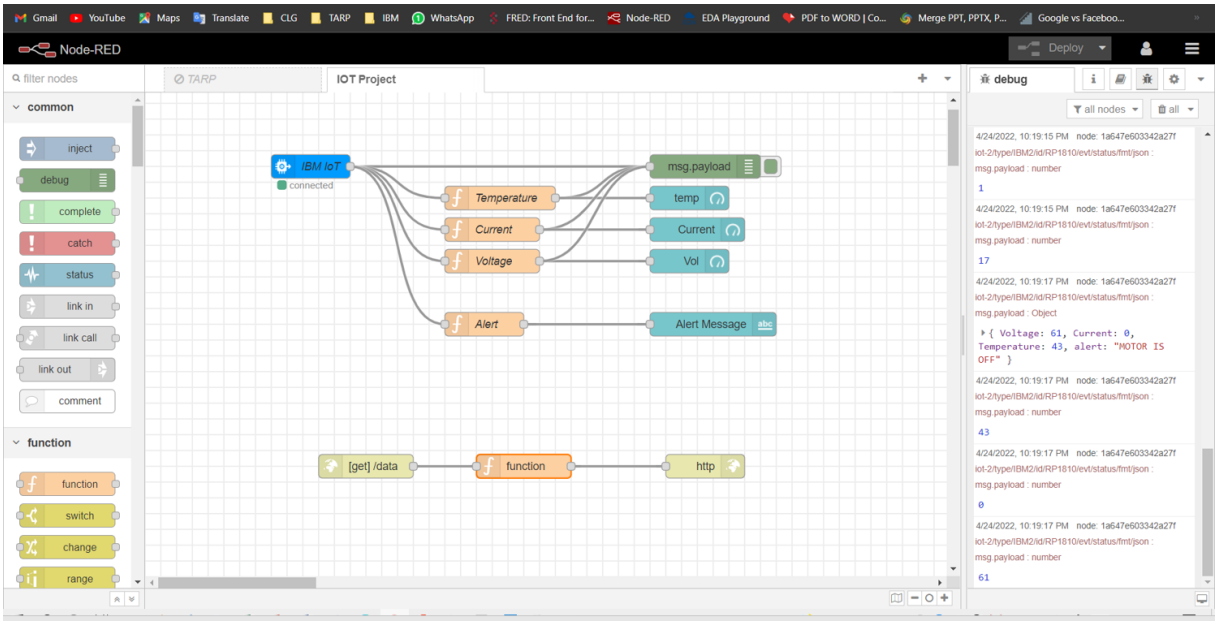
```
import wiotp.sdk.device
import time
import random
import requests
myConfig = {
    "identity": {
        "orgId": "0tasbq",
        "typeId": "IBM2",
        "deviceId":"RP1810"
    },
    "auth": {
        "token": "8179521130"
    }
}

def myCommandCallback(cmd):
    print("Message received from IBM IoT Platform: %s" % cmd.data['command'])
    print()
client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
client.connect()
while True:
    V=random.randint(0,250)
    I=random.randint(0,3)
    T=random.randint(0,100)
    if((0<V<230)and(0<I<2)and(0<T<80)):
        alert="MOTOR IS ON"
        print("MOTOR IS ON")
    else:
        alert="MOTOR IS OFF"
        print("MOTOR IS OFF")
    myData={'Voltage':V,'Current':I,'Temperature':T,'alert':alert}
    client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0, onPublish=None)
    print("Published data Successfully: %s", myData)
    client.commandCallback = myCommandCallback
    time.sleep(2)
client.disconnect()
```

2. NODE-RED FLOW

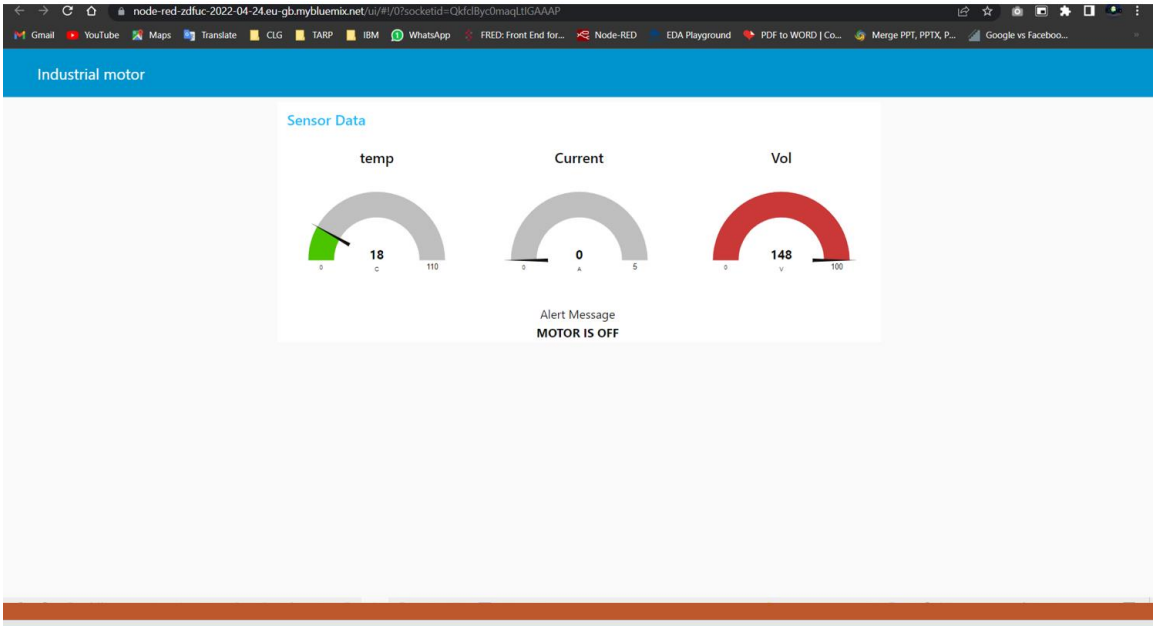
To develop a Node-red application we need to get a "JSON" file to run after getting that json file into node-red, just fill he required details which are needed. After setting IBM out enter the API key and token.

Before deploying the schematic, we need to run the python code and after that deploy the schematic we need to view (user interface) the web view of the application.



3. WEB UI

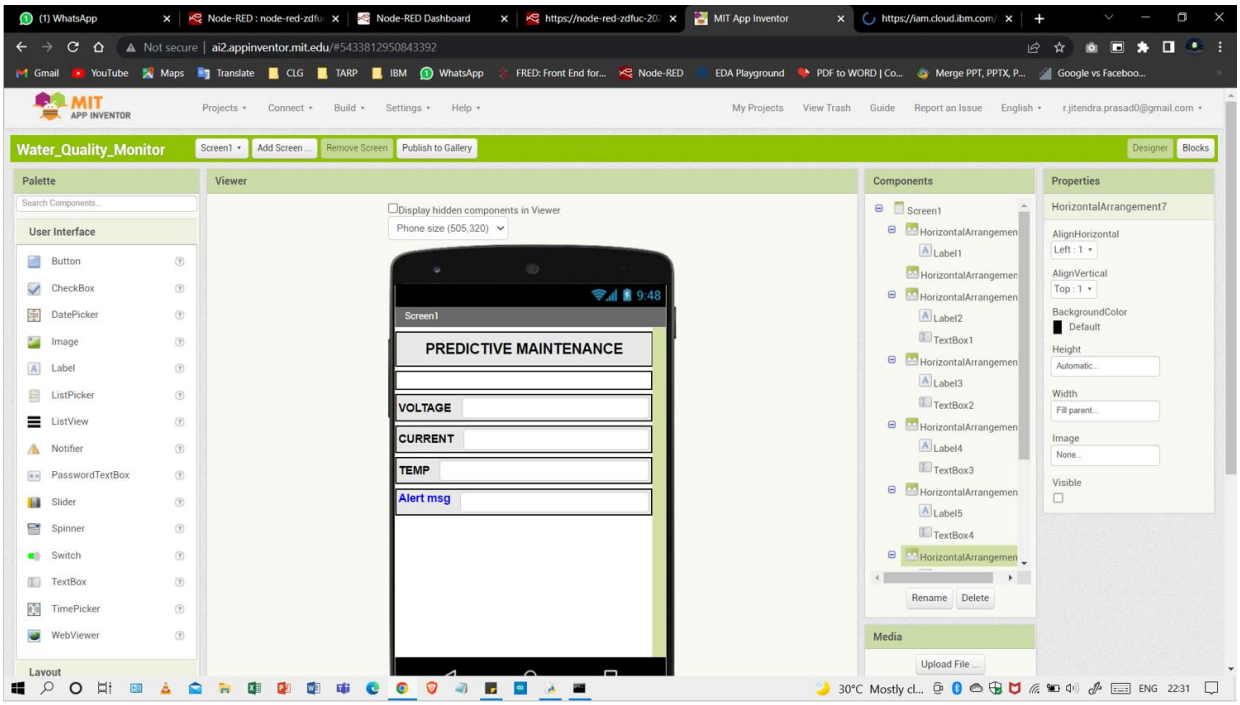
Creating a web UI using dashboard nodes.



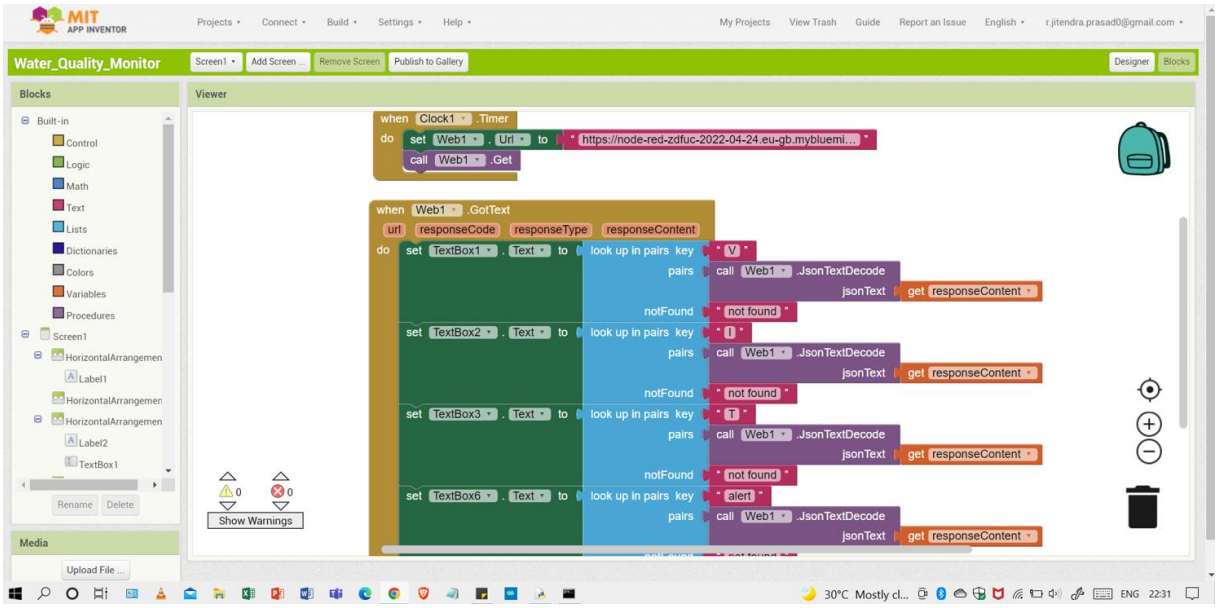
4. MIT App Inventor

Getting Started with MIT App Inventor. App Inventor is a cloud-based tool, which means you can build apps right in your web browser. This website offers all the support you'll need to learn how to build your own apps. Visit it at ai2.app inventor.mit.edu. You can get there by clicking the orange "Create Apps".

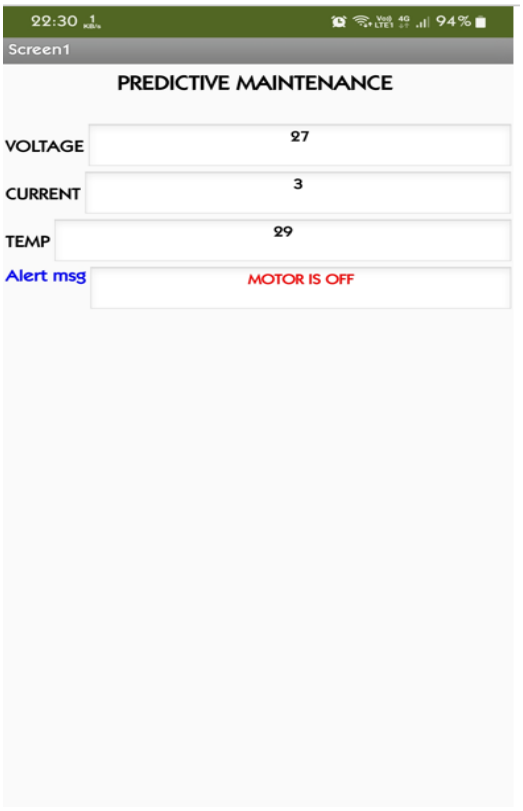
After setting this we need to develop for the app view for that we need get some connections with in same "http/in" & "http/response" node with including some. functions and to develop an app we are using the help of MIT APP INVERTER



Back-end



After creating the interface and back-end of the app we need to scan and view the app in the phone.



9. SIMULATION RESULTS

1. PYTHON SHELL

```
File  Edit  Shell  Debug  Options  Window  Help
Python 3.9.11 (tags/v3.9.11:2de452f, Mar 16 2022, 14:33:45) [MSC v.1929 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
======== RESTART: C:/Users/HAI/Desktop/IoT Domain/project/python code.py =======
2022-04-24 22:19:09,237  wiotp.sdk.device.client.DeviceClient  INFO    Connected successfully: d:0tasbq:IBM2:RP1810
MOTOR IS OFF
Published data Successfully: %s {'Voltage': 163, 'Current': 3, 'Temperature': 57, 'alert': 'MOTOR IS OFF'}
MOTOR IS OFF
Published data Successfully: %s {'Voltage': 52, 'Current': 2, 'Temperature': 30, 'alert': 'MOTOR IS OFF'}
MOTOR IS OFF
Published data Successfully: %s {'Voltage': 236, 'Current': 3, 'Temperature': 2, 'alert': 'MOTOR IS OFF'}
MOTOR IS ON
Published data Successfully: %s {'Voltage': 17, 'Current': 1, 'Temperature': 20, 'alert': 'MOTOR IS ON'}
MOTOR IS OFF
Published data Successfully: %s {'Voltage': 61, 'Current': 0, 'Temperature': 43, 'alert': 'MOTOR IS OFF'}
MOTOR IS ON
Published data Successfully: %s {'Voltage': 172, 'Current': 1, 'Temperature': 5, 'alert': 'MOTOR IS ON'}
MOTOR IS OFF
Published data Successfully: %s {'Voltage': 236, 'Current': 2, 'Temperature': 39, 'alert': 'MOTOR IS OFF'}
MOTOR IS OFF
Published data Successfully: %s {'Voltage': 105, 'Current': 3, 'Temperature': 5, 'alert': 'MOTOR IS OFF'}
MOTOR IS OFF
Published data Successfully: %s {'Voltage': 39, 'Current': 3, 'Temperature': 19, 'alert': 'MOTOR IS OFF'}
MOTOR IS OFF
Published data Successfully: %s {'Voltage': 152, 'Current': 3, 'Temperature': 4, 'alert': 'MOTOR IS OFF'}
MOTOR IS OFF
Published data Successfully: %s {'Voltage': 26, 'Current': 2, 'Temperature': 66, 'alert': 'MOTOR IS OFF'}
MOTOR IS OFF
Published data Successfully: %s {'Voltage': 102, 'Current': 0, 'Temperature': 17, 'alert': 'MOTOR IS OFF'}
MOTOR IS OFF
Published data Successfully: %s {'Voltage': 172, 'Current': 0, 'Temperature': 69, 'alert': 'MOTOR IS OFF'}
MOTOR IS OFF
Published data Successfully: %s {'Voltage': 202, 'Current': 0, 'Temperature': 64, 'alert': 'MOTOR IS OFF'}
MOTOR IS OFF
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MOTOR IS OFF
Published data Successfully: %s {'Voltage': 54, 'Current': 2, 'Temperature': 99, 'alert': 'MOTOR IS OFF'}
MOTOR IS OFF
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MOTOR IS OFF
Published data Successfully: %s {'Voltage': 126, 'Current': 2, 'Temperature': 78, 'alert': 'MOTOR IS OFF'}
MOTOR IS OFF
Published data Successfully: %s {'Voltage': 66, 'Current': 0, 'Temperature': 3, 'alert': 'MOTOR IS OFF'}
MOTOR IS ON
Published data Successfully: %s {'Voltage': 206, 'Current': 1, 'Temperature': 20, 'alert': 'MOTOR IS ON'}
MOTOR IS OFF
Published data Successfully: %s {'Voltage': 224, 'Current': 3, 'Temperature': 46, 'alert': 'MOTOR IS OFF'}
```
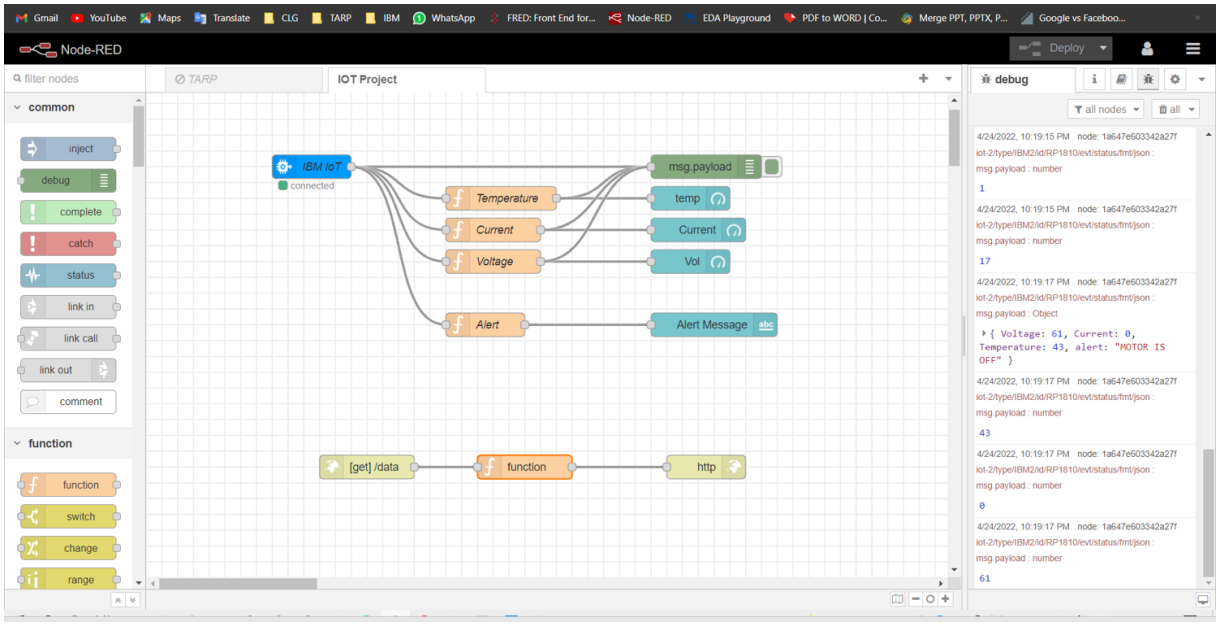
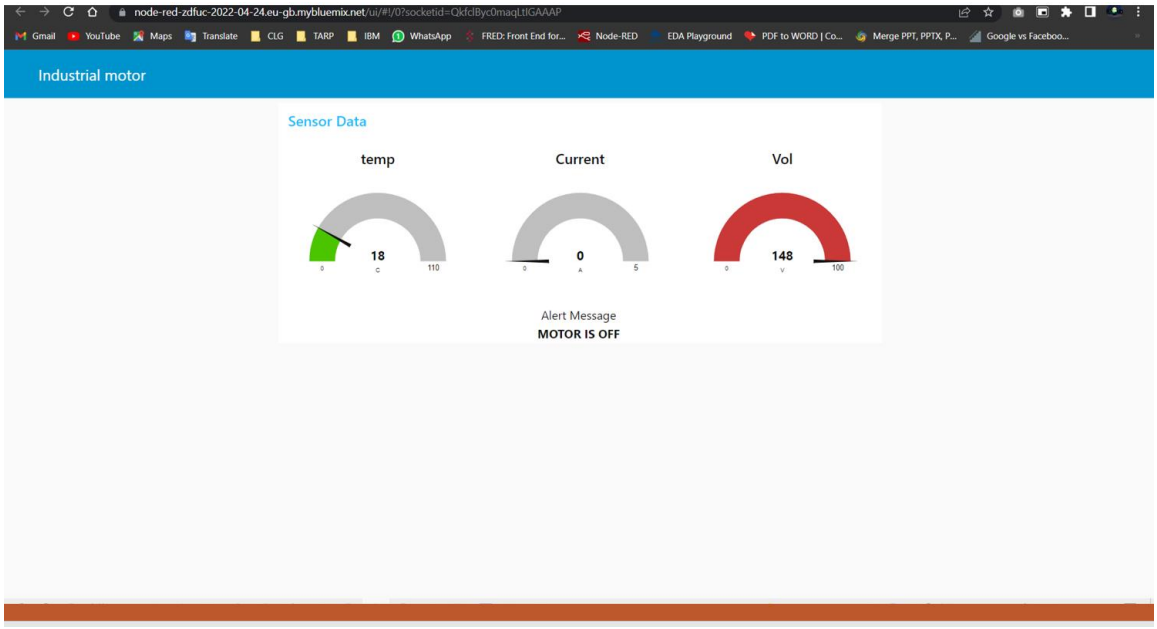
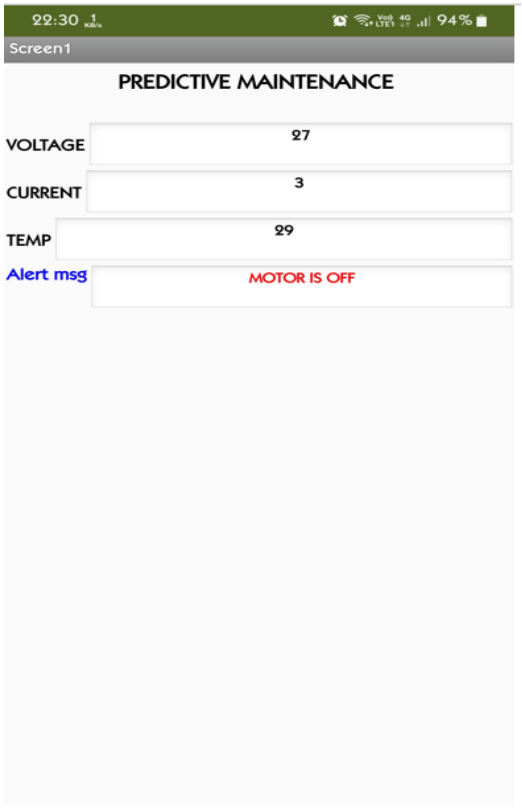

2. NODE-RED

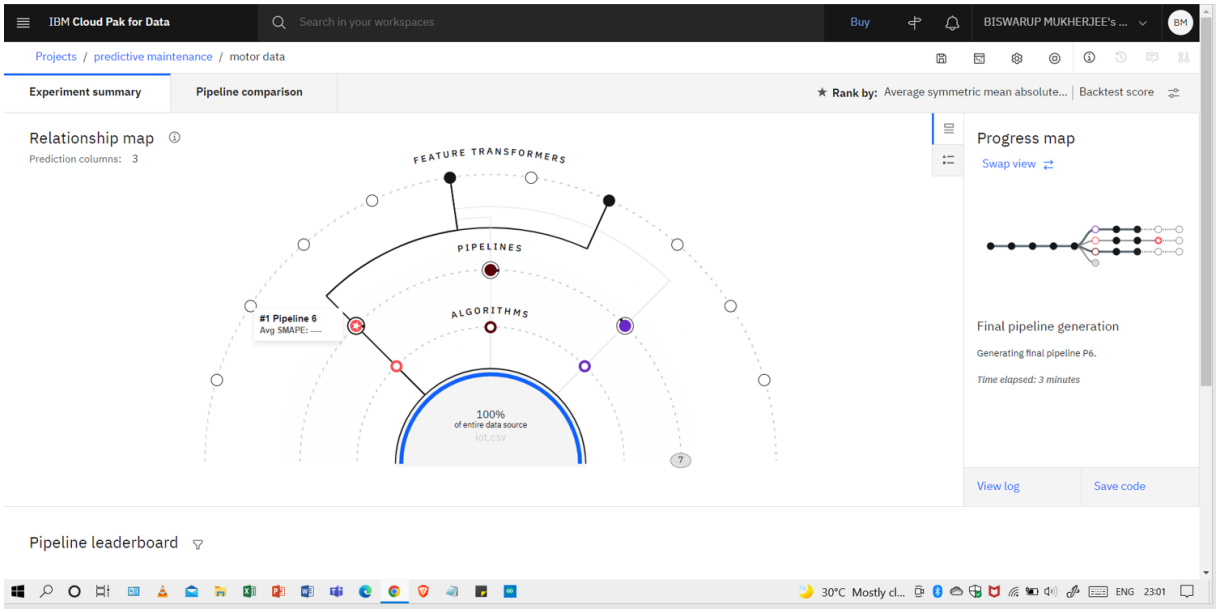


3. WEB UI



4. MOBILE APPLICATION

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Buy
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Projects / predictive maintenance / motor data
Experiment summary
Pipeline comparison
Rank by: Average symmetric mean absolute... | Backtest score
Relationship map
Prediction columns: 3
FEATURE TRANSFORMERS
PIPELINES
ALGORITHMS
#1 Pipeline 6
Avg SMAPE: ----
100%
of entire data source
iot.csv
Progress map
Swap view
Final pipeline generation
Generating final pipeline P6.
Time elapsed: 3 minutes
View log
Save code
Pipeline leaderboard
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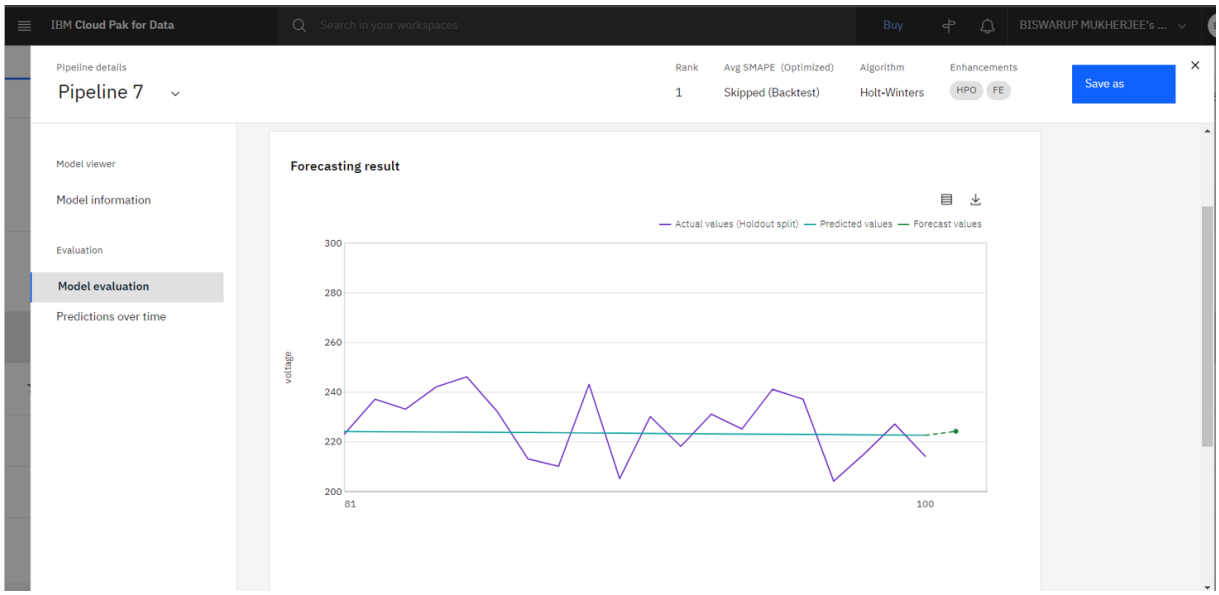
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Skipped (Backtest)
Algorithm
Holt-Winters
Enhancements
HPO
FE
Save as
Model viewer
Model information
Evaluation
Model evaluation
Predictions over time
Forecasting result
Actual values (Holdout split)
Predicted values
Forecast values
voltage
300
280
260
240
220
200
81
100

10. RESULT AND CONCLUSION

This project is mainly focused on the problem of carrying out predictive maintenance in a industrial motors and present the results of the preliminary data analysis and feature selection that are performed on a sample of the collected data sheet.

The system can be easily installed, with the base station kept close to the target area, and the task of monitoring can be done by less-trained individuals. Internet of Things (IoT) and its services are becoming part of our everyday life, ways of working, and business. There is a great deal of research on developing crucial building blocks and models for the next generation Internet services supported by a plethora of connected things.

11. REFERENCES

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