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PREDICTIVE MAINTENANCE IN AUTOMOBILE USING IOT AND MACHINE LEARNING

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ABSTRACT

Internet of Things (IoT) is fast emerging and becoming an almost basic necessity in general life. The concepts of using technology in our daily life is not new, but with the advancements in technology, the impact of technology in daily activities of a person can be seen in almost all the aspects of life. Today, all aspects of our daily life, be it health of a person, his location, movement, etc. can be monitored and analyzed using information captured from various connected devices. This paper discusses one such use case, which can be implemented by the automobile industry, using technological advancements in the areas of IoT and Analytics. 'Connected Car' is a terminology, often associated with cars and other passenger vehicles, which are capable of internet connectivity and sharing of various kinds of data with back-end applications. The data being shared can be about the location and speed of the car, status of various parts/lubricants of the car, and if the car needs urgent service or not. Once data are transmitted to the back-end services, various workflows can be created to take necessary actions, e.g. scheduling a service with the car service provider, or if large numbers of care are in the same location, then the traffic management system can take necessary action. 'Connected cars' can also communicate with each other, and can send alerts to each other in certain scenarios like possible crash etc. This paper talks about how the concept of 'connected cars' can be used to perform 'predictive car maintenance'. It also discusses how certain technology components, i.e., Eclipse Mosquito and Eclipse Paho can be used to implement a predictive car maintenance use case.

Keywords: Internet Of Things (Iot), Predictive Car Maintenance,Eclipse Mosquito,Eclipse Paho.

I. INTRODUCTION

Predictive Maintenance(PdM) in the automotive industry is a great example of predictive analytics. It helps businesses determine when a machine or vehicle part needs servicing, using techniques such as data mining, data preprocessing and employing machine learning algorithms. Predictive maintenance uses historical and real-time data from various parts of your operation to anticipate problems before they happen. Some examples of using predictive maintenance and predictive maintenance sensors include vibration analysis, oil analysis, thermal imaging, and equipment observation. In an automotive manufacturing environment, if there is scheduled or unscheduled downtime, the corresponding costs may result in a serious setback. With predictive maintenance, it is possible to constantly monitor the health of industrial equipment in real time and predict the probability of failures. This improves the efficiency of operations and reduces maintenance cost of equipment.

The automotive industry is increasingly adopting the concept of predictive maintenance to avoid unexpected breakdowns and minimize the maintenance cost. Predictive maintenance refers to the use of data analysis and machine learning algorithms to predict when maintenance is required before an equipment failure occurs. With the advent of the Internet of Things (IoT), the automotive industry can now collect vast amounts of real-time data from various sensors installed in vehicles. In this paper, we review the recent literature on the use of IoT and machine learning for predictive maintenance in the automobile industry.

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II. METHODOLOGY

Data collection: The first step in predictive maintenance is to collect data from various sensors installed in the vehicle. The sensors can include accelerometers, GPS, temperature sensors, oil pressure sensors, and many others. The data collected can be in the form of time series data, sensor readings, or event logs.

Data pre-processing: The collected data often contains noise, outliers, and missing values that need to be pre-processed before analysis. Pre-processing techniques such as data cleaning, data transformation, and feature engineering are used to prepare the data for analysis.

Data analysis: After pre-processing, the data is analyzed using various machine learning algorithms such as regression, decision tree, random forest, and neural network. The analysis can be used to predict when maintenance is required, identify potential faults, and determine the remaining useful life of components.

Model evaluation: The predictive models developed using machine learning algorithms are evaluated using metrics such as accuracy, precision, recall, and F1-score. The evaluation helps to determine the effectiveness of the models and identify areas for improvement.

Implementation: Once the predictive models are evaluated, they can be implemented in the automobile maintenance system. The implementation can involve integrating the models with existing maintenance software, scheduling maintenance activities based on the predictions, and monitoring the performance of the predictive models.

Continuous improvement: Predictive maintenance is an iterative process, and the models need to be continuously improved to adapt to changing conditions. This involves monitoring the performance of the models, collecting feedback from the maintenance team, and updating the models based on new data.

In summary, the methodology for predictive maintenance in automobile using IoT and machine learning involves collecting data from sensors, pre-processing the data, analyzing the data using machine learning algorithms, evaluating the models, implementing the models, and continuously improving the models. The effectiveness of the methodology depends on the quality of data collected, the accuracy of the predictive models, and the ability to integrate the models with the maintenance system.

III. MODELING AND ANALYSIS

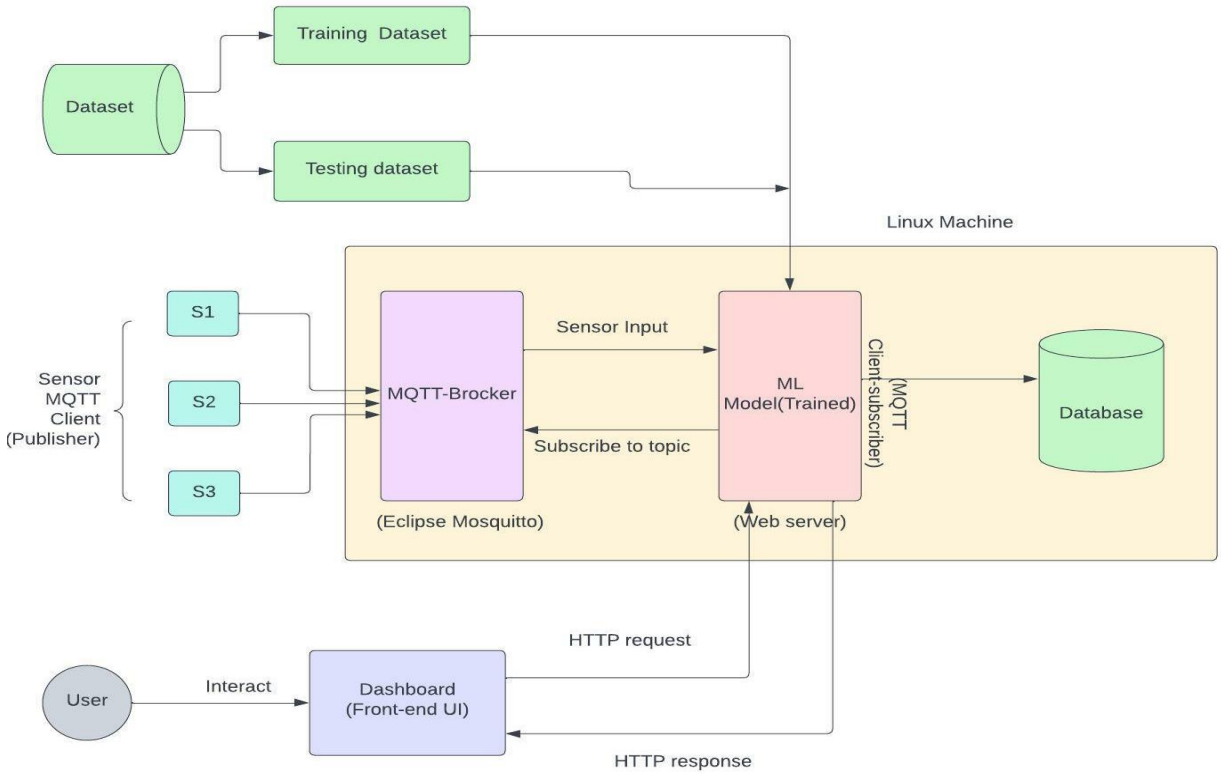

Figure 1: System Architecture

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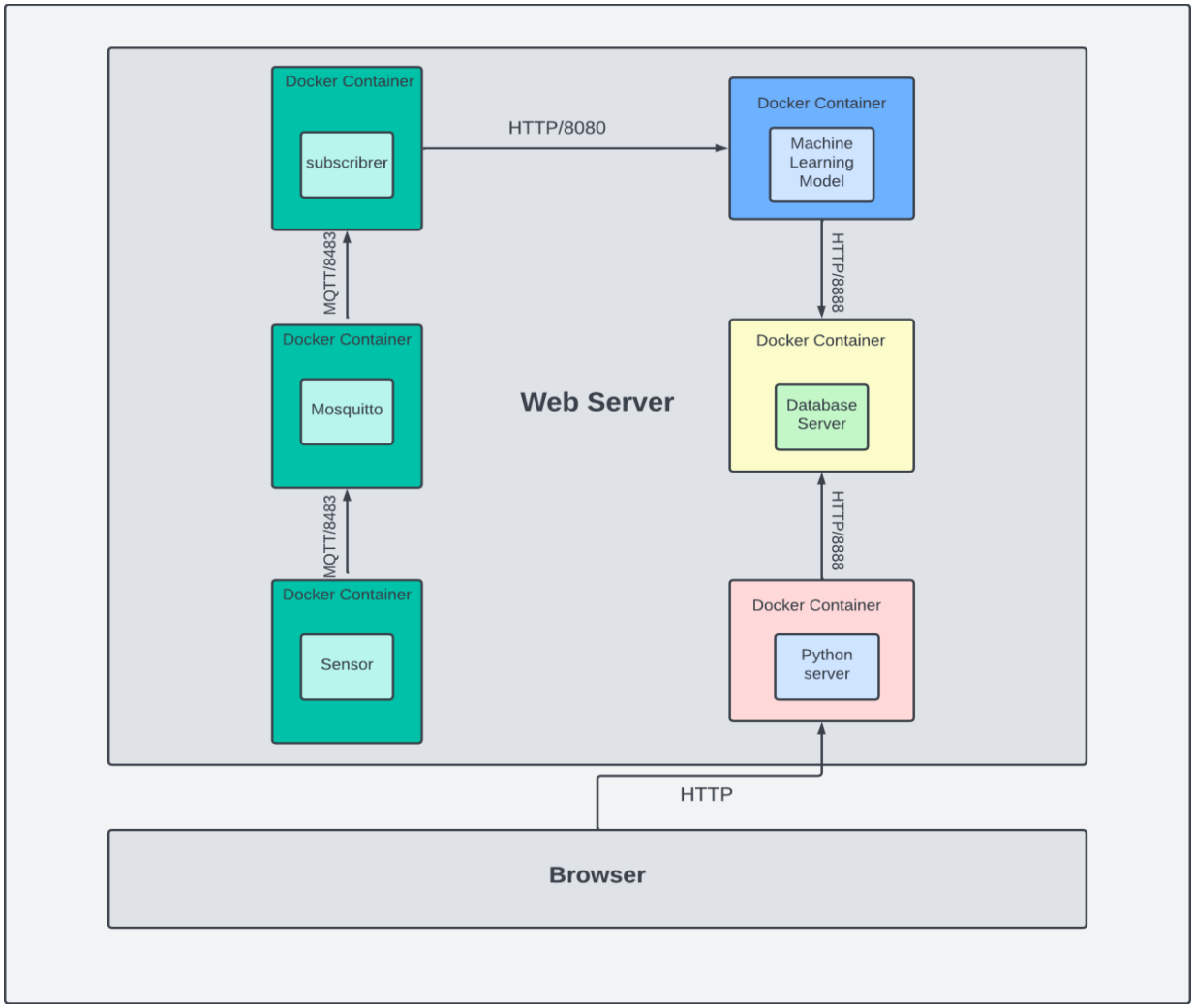

Figure 2: Deployment Diagram

IV. RESULTS AND DISCUSSION

```
plt.scatter(df["AFRDifference[AFR]"], df["MAPSource[Pressure]"])
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```

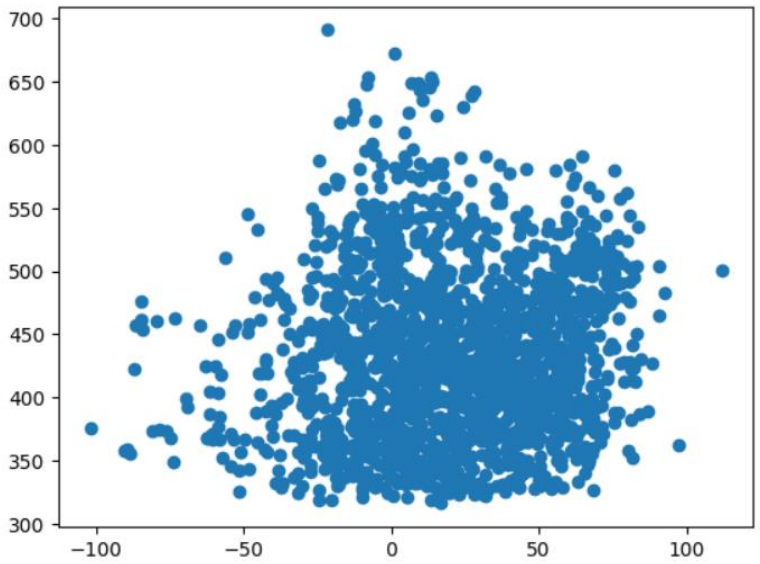

Figure 3

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```
plt.scatter(df["IgnitionTiming[Angle]"], df["MAPSource[Pressure]"])
plt.xlabel = "Ignition Advance"
plt.ylabel = "ManiFold Pressure"
plt.show()
```

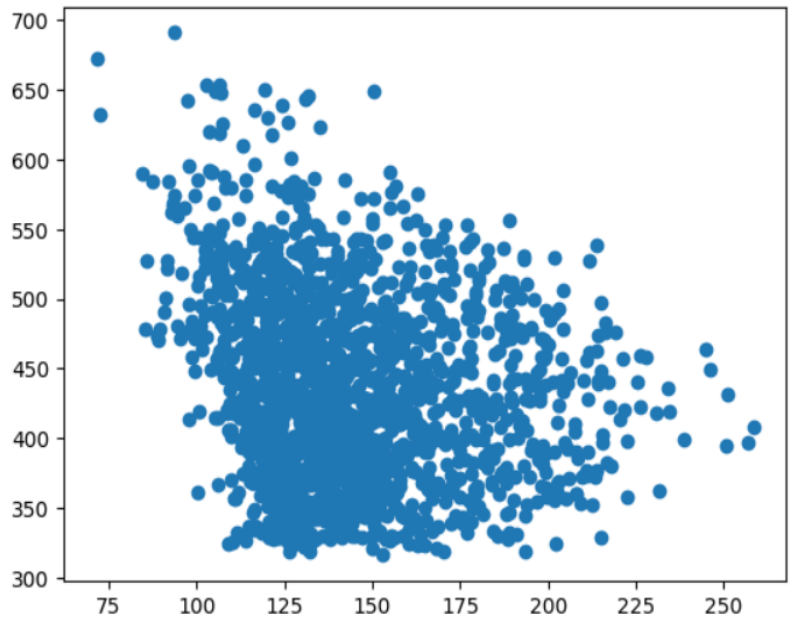

Figure 4

```
plt.scatter(df["RPM[EngineSpeed]"], df["BatteryVoltage[BatteryVoltage]"])
```

```
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```

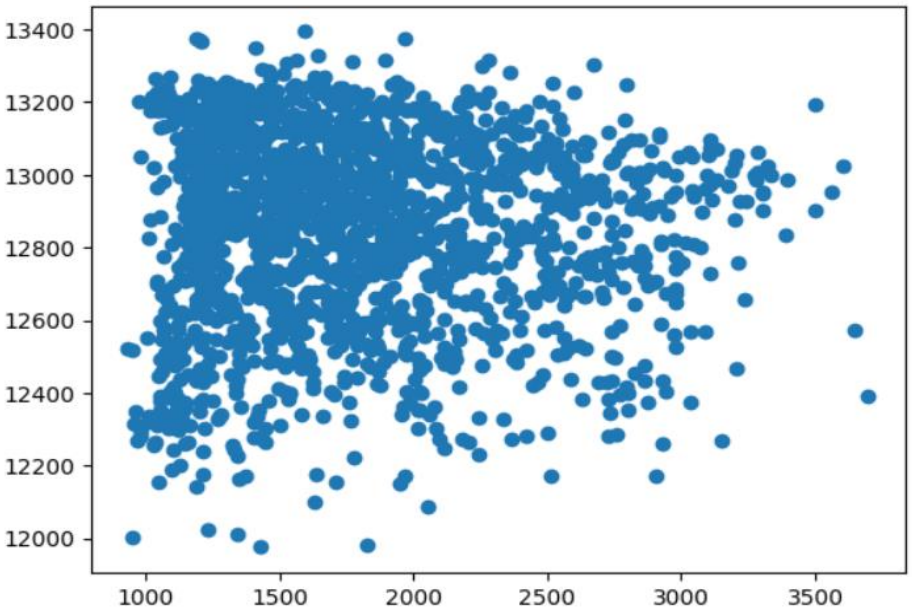

Figure 5

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```
plt.scatter(df["RPM[EngineSpeed]"], df["MAPSource[Pressure]"])
```

```
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```

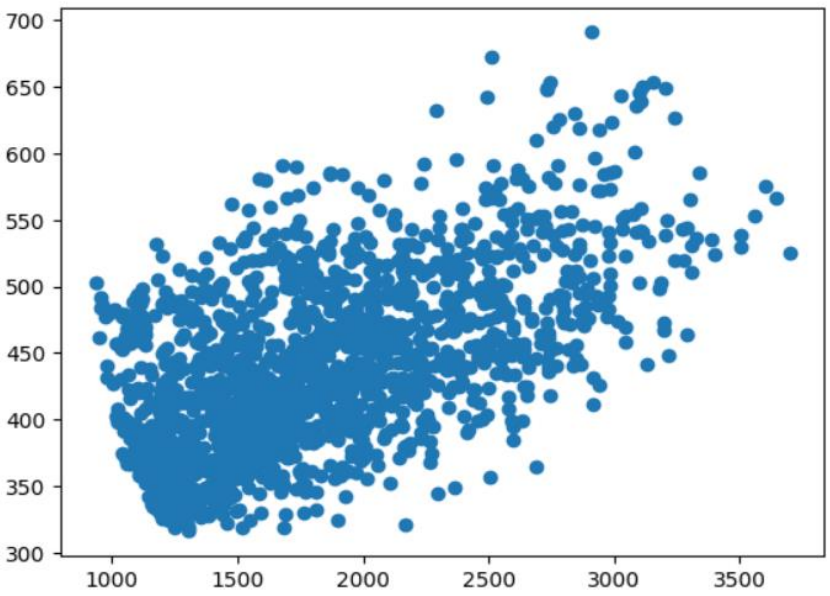

Figure 6

V. CONCLUSION

'Connected car' concept is getting lots of traction with automobile companies these days. There are multiple benefits of 'Connected Car' ecosystem, and one such benefit is Predictive Car Maintenance. This paper talked about what predictive car maintenance is all about, which problems it could solve. MQTT, a popular protocol for IoT is also discussed, followed by an introduction to Eclipse Mosquitto and Eclipse Paho, an implementation of MQTT.

The paper concludes that predictive maintenance in the automobile industry can help reduce maintenance costs, improve the reliability of vehicles, and increase safety. The authors highlight the importance of using IoT and machine learning techniques to collect and analyze real-time data for predictive maintenance. The paper also suggests that future research should focus on developing more accurate and efficient algorithms for predictive maintenance. Overall, the paper provides a comprehensive review of recent research on predictive maintenance in the automobile industry using IoT and machine learning.

VI. REFERENCES

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