IMPLEMENTING PREDICTIVE MAINTENANCE FOR AN INDUSTRIAL ROBOTIC ARM USING LORA TECHNOLOGY

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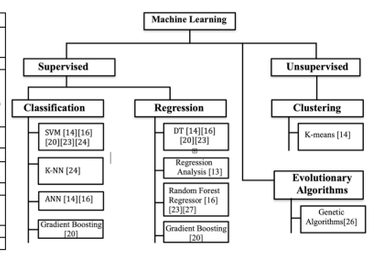
PROBLEM STATEMENT

Industrial Internet of Things (IIoT) systems enable businesses to monitor and analyze their equipment in real-time to prevent breakdowns and optimize performance. Predictive maintenance is a crucial part of IIoT systems.Industries can foresee probable equipment breakdowns, save downtime, and boost overall equipment effectiveness by using Long Range (LoRa) technology in predictive maintenance.The goal of this project is to create a predictive maintenance system utilising LoRa technology for an industrial robotic arm. A data analysis system that use machine learning techniques to forecast when maintenance is required and gather information on the robotic arm's performance.

BACKGROUND

Reference & year	Tech Stack	Limitation
[3] 2018, [7] 2018, [15] 2019, [16] 2020	LoRaWAN	[3] [15] Increase power consumption [7] Limited comparison with IEEE 802.15.4 [16] Impact of external factors
[5] 2017, [25] 2022	LoRa & NB-IoT	[5] Simulation
[17] 2020, [20] 2021, [21] 2021, [23] 2021, [27] 2023	MQTT	[17] The single-channel LoRa gateway is limited [20] Regarding the supported operations [21] Eventual incorrect predictions [23] Challenging implementation of ML models in resource-constrained IoT devices [27] Simulation
[18] 2020	ETSI MEC (Multi-access Edge Computing) framework	[18] Simulations
[10] 2019	RT-LoRa	[10] Increased the communication reliability
[4] 2017	MATLAB and LoRa technology for wireless communication	[4] complexity,security
[9] 2019	LoRa Radio	[9] Simulation
[19] 2021	Azure IoT, AWS IoT and LoRa technology for wireless communication	[19] Limited bandwidth and low data rate
[24] 2022	LoRa and Thingspeak	NA
[26] 2023	FogWorkflowsim	[26] Scalability

Technology Stack and Limitations

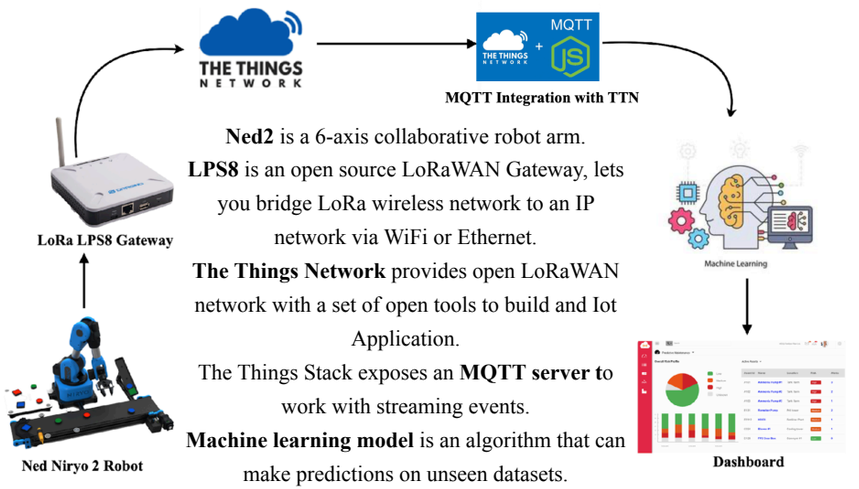


ML Model Classification

DATASET

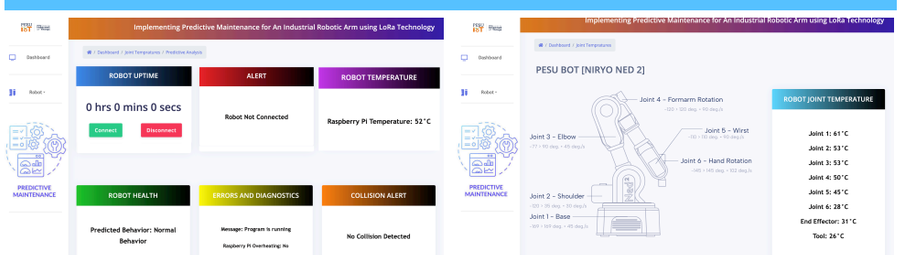
No_of_Position: This column represent the number of positions.
Speed: This column represents the speed of the robot arm..
Seconds: This column seems to represent a duration in seconds taken complete a particular movement.
Temperature: This column represents a temperature value.
Target: This column is labeled as "Target" and has binary values (0 or 1).

DESIGN APPROACH/METHODOLOGY



Ned2 is a 6-axis collaborative robot arm.
LPS8 is an open source LoRaWAN Gateway, lets you bridge LoRa wireless network to an IP network via WiFi or Ethernet.
The Things Network provides open LoRaWAN network with a set of open tools to build and Iot Application.
The Things Stack exposes an **MQTT server to** work with streaming events.
Machine learning model is an algorithm that can make predictions on unseen datasets.

RESULTS



Unit testing was done for separate independent components with multiple inputs to ensure that the output of the component matches the expectations.After completion of unit testing integration testing was done to ensure that the independent components work accordingly after integration.The accuracy achieved for ML Model is 97.98%.The dashboard was prepared according to the requirements to achieve live data prediction.

SUMMARY OF PROJECT OUTCOME

The project's goal was to create a system that could predict probable faults and take corrective actions before they occurred, therefore enhancing the reliability and efficiency of the industrial robotic arm and lowering maintenance costs while increasing total production.We were able to achieve the requirements, for failure prediction a basic formula has to be defined to calculate MTBF.

CONCLUSION AND FUTURE WORK

In summary, when it comes to digitizing operational insights that may be difficult to obtain through manual observation, LoRaWAN technology is invaluable. The potential for human-dependent processes to unintentionally ignore unconventional indicators highlights the significance of incorporating LoRaWAN technology. The benefits of using LoRa devices go beyond prevention; they provide the ability to rank maintenance tasks in order of importance. This involves supporting long- and mid-term maintenance plans in addition to proactive inspection techniques made possible by the early identification of anomalies.

REFERENCES

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[2] Haxhibeqiri, J.; De Poorter, E.; Moerman, I.; Hoebeke, J. A Survey of LoRaWAN for IoT: From Technology to Application. Sensors 2018, 18, 3995.

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