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PS Station: Electrono Solutions

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Project: Early-stage bearing faults detection using machine learning and deep learning techniques

Introduction to project (Max. 400 words):

- Condition Monitoring is the measuring of specific equipment parameters, noting signs of any significant changes that could be indicative of an impending failure.
- Rolling bearings are among the most important components in the vast majority of machines. Their health is extremely important, as they are an integral tool in the physical functioning of a wide range of machines used in industrial sites.
- Thus, detecting bearing faults early on is of paramount importance in the real world, requiring methods to be able to make conclusions on the presence/absence of faults, and the part affected.
- Bearing faults can be of several different types, including but not limited to:
    - Incorrect lubrication
    - Misalignment
    - Electrical damage
    - Improper mounting
    - Contamination
- As we see, the location of the bearing fault plays an important role in the detection of future faults, as we are then more confident of where (and how) the fault is possibly present.
- For the purposes of this project, and for reasons explained later, the specifications of the motor, and its underlying data are as follows:
    - Motor used: 3-phase 2 hp Reliance Electric motor.
    - Faults introduced: of depths of 7mils ,14mils,21mils, and 28mils.
    - SKF bearings were used for the 7, 14, and 21 mils diameter faults, and NTN equivalent bearings were used for the 28 mil and 40 mil faults.
    - Types of faults to be monitored: rolling element faults (of all sizes), inner race faults (of all sizes), and outer race faults (of all sizes)

Preliminary work (Max. 400 words):

- Initially, I have gone through a wide selection of research papers, observing different approaches to classify early-stage bearing faults.
- I also familiarized myself with some basic aspects of the LabVIEW tool.
- Some of the papers I have looked into for guidance include:
    - A review of ML and DL algorithms for bearing fault diagnostics
    - A DL-based method for fault detection
    - An unsupervised machine-learning-based method to detect the presence of a fault
    - Detection and diagnosis of bearing faults
    - Using CNNs for fault classification

  Apart from these, I am actively in the process of looking at more papers, to try and understand the approach I will take toward this classification problem.

- Apart from that, I have identified the dataset that I will be using to train the learning algorithm which I will operate- the open-source dataset on bearing faults, maintained by the Bearing Data Center of the Case Reserve Western University, Cleveland- which, I also observed through reading multiple other papers, is the dataset of choice for most researchers working in the field for developing models.
- While the above-mentioned dataset- which is used to train the model- is in a MATLAB format, I will be converting it during the course of my program into a Python file, which is also what I will be using to write into code the learning algorithm- and to finally execute the project.

Objectives (state 2-3 bullet points):

- My primary objective is to successfully work on the project at hand, i.e, building an ML/DL-based classification algorithm that can classify the test data into different fault conditions (or can return no faults if the input readings are not faulty)
- Beyond that, I hope to familiarize myself with libraries and tools used for training and deploying the model on Python. (ex, SciKit, TensorFlow, Pandas)
- The final objective is to get familiarized with a real-world working environment, and all the associated benefits it carries- allowing it to sharpen my soft skills.