Edge-based Vibration Monitoring System for Textile Machinery

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***Abstract*—Due to the high acquisition and operation cost of industrial machinery, their cost-effectiveness is highly influenced by the quality and continuity of their production. In this context, Predictive Maintenance emerges as maintenance strategy that aims to maximize uptime by constantly monitoring machinery health in order to perform maintenance stops only when strictly required. The implementation of this strategy, however, faces two major challenges. The first is related to the cost and operation of the data acquisition systems required for the health monitoring. The second one is given by the intelligence required for analysing real-world data generated within uncontrolled industrial environments and producing a machinery health indicator from it. This work illustrates a vibration monitoring system currently operating in a textile manufacturing machine and also proposes a versatile procedure for the analysis the real-world data produced by such systems and extraction of a machine health indicator from it.**

***Index Terms*—Predictive Maintenance, Anomaly Detection, Vibration Analysis, Condition Monitoring, Industry 4.0**

I. Introduction

A. The Way to Predictive Maintenance

B. Industry 4.0: Enabling Predictive Maintenance

C. Building a Predictive Maintenance model

Here we explain what we want to do. Developing a strategy for analysing the sensor data in a way to help implementing Predictive Maintenance.

II. Related work

Here I will present some articles and other sources about vibration analysis and talk about their shortcomings which we intend to overcome.

III. implementation concept

A. Data acquisition setup

1) Overview: Talk about DELTA Systems and the textile machine. Include concept figure.

2) Hardware units: Electronic sensor: microcontroller unit. Wiereless. Radio communication and battery power. Energy constraints. Fully-fledged Linux system: internet connectivity, Python scripting, etc. Power-over-Ethernet, no energy constraints.

B. Data analysis techniques

1) Vibration Analysis: RMS numerical value of total vibration. Speed is always important. Induction motors. Frequency Analysis: helps identifying source of problem. Which features are important.

2) Signal Processing: Used to extract information from vibration signals

a) Fourier Transform: Rich but expensive information. Equations. Explain how to extract a specific range.

b) Digital Filters: Simple and computationally effective implementation. Information not very rich: we can extract RMS of frequency ranges.

3) Clustering: Handling operation variability. dads

4) K-Means: Segregation into clusters.

5) Principal Component Analysis: Helps applying human expertise to associate data clusters to physical operational modes of the machine.

6) Anomaly Detection:

a) The Multi-Variate Gaussian Distribution:

b) Quantile Transform - Ensuring the data is Gaussian:

IV. Results and discussion

A. Data Exploration

Explain vibration signals: Length, sampling rate, axes.

B. Clustering: Segregation of Operational Modes

C. Approach to Anomaly Detection

V. Conclusion

Acknowledgment

Who should we thank?

REFERENCES