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Technical note

IoT-Enabled Vibration Analysis

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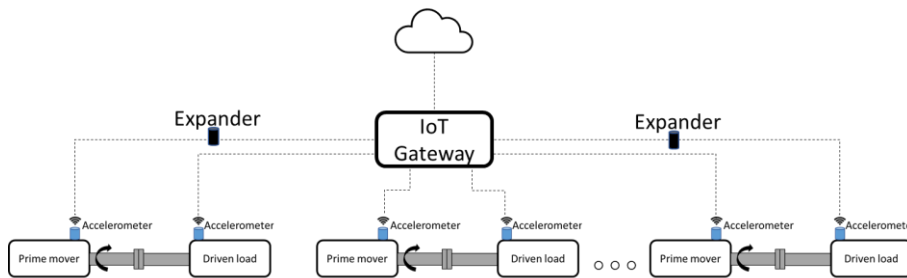
1. Overview

Wireless triaxial accelerometers are installed at suitable locations to capture vibration data from rotating machines. Raw vibration data is converted into useful features, which are then fed to analytics engines at IoT platform to identify remaining useful life and probable failure causes. The RUL (remaining useful life) estimates and identified causes help in reducing downtime. Further, early indication of impending failure provides sufficient time to plan maintenance work without affecting other operations.

2. Data processing and transmission

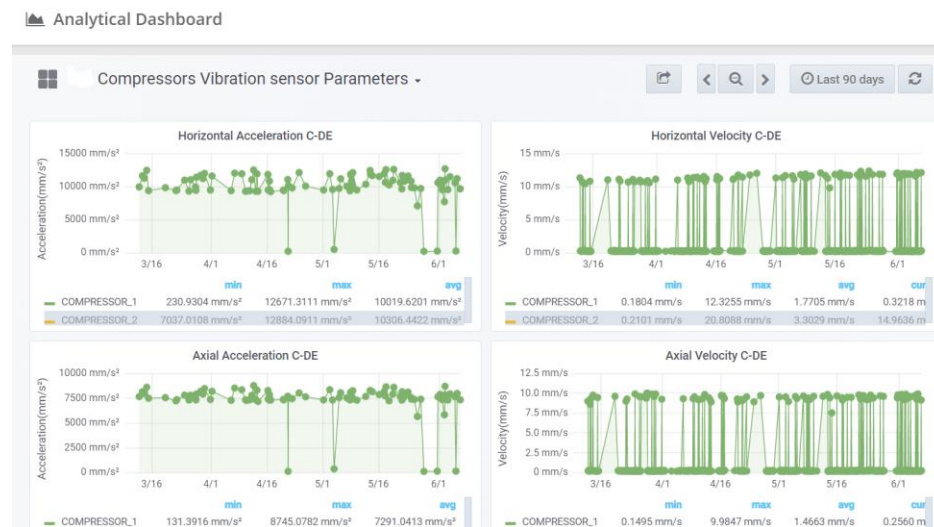
Acceleration time waveforms are measured by accelerometers that are attached firmly at the selected measurement points (mostly bearings' housing). Raw vibration data are then filtered, transformed to frequency domain, and transmitted to the IoT gateway for further processing. Wireless sensors can directly communicate to gateway when there is a clear line of sight and machine is located within the range. In case of absence of line of sight or if machine is located outside the wireless range, range extenders are used for data transmission.

Measurement can be performed either at a pre-defined interval (for continuous running machines) or trigger based. Real-time continuous data are then sent to the cloud platform for analytics. User can see the data on Vadict IIoT dashboards. On-premises arrangement can also be made based on the requirement.



3. Data presentation on dashboard

Vadict IIoT platform has different dashboards with multiple features. Key parameters with historical trends can be seen on the dashboards. User can also customize the dashboard. Threshold are set for various parameters for alert and alarm indications based on current measurement. Following is a snapshot from Vadict IIoT dashboard showing trends of vibration data.



4. Predictive analytics

Features derived from the vibration data are used for RUL and fault type identification using predictive models. Predictive models are built from a good number of datasets recorded from similar machines. Based on the efficacy and performance, these models are regularly updated.

Predictive analytics dashboard contains RUL, confidence level, and probable failure causes. Confidence is calculated based on the various factors such as maintenance history, diagnosis, prognosis process, etc., as recommended by ISO standard. A view of the predictive analytics dashboard is shown below

The screenshot shows a web dashboard titled "Predictive Analytics Dashboard". On the left is a dark sidebar with navigation options: Smart Terminal Dashboard, Analytical Dashboard, Predictive Analytics Dashboard (highlighted), Geographic Dashboard, Operational Dashboard, Battery Monitoring Dashboard, and FRVT Monitoring Dashboard. The main content area shows a table of equipment data with the following columns: ID, Site, Equipment, Due for, State of Health, Date Time, RUL (Days), Probable Failure Causes, Pred. Conf. (%), and Supporting Data. The table contains four rows of data, with the first three rows having a "HANDLED REVIEWED" status and the fourth row having a "Reviewed" status with "Acknowledge" and "Review" buttons.

ID	Site	Equipment	Due for	State of Health	Date Time	RUL (Days)	Probable Failure Causes	Pred. Conf. (%)	Supporting Data
PEV-43926f		SKO Pump 2	HANDLED REVIEWED	ABNORMAL	Jul 19, 2020 12:04:54 AM	0	Faulty impeller, Looseness	77.75	
PEV-1e6a6c		Fire Engine 1	HANDLED REVIEWED	ABNORMAL	Jul 19, 2020 12:02:54 AM	0	Cavitation, Looseness, Misalignment, Misfiring	79	
PEV-1b1e50		Fire Engine 2	HANDLED REVIEWED	DEGRADATION STATE 1	Jul 15, 2020 10:21:51 AM	63	Degraded lubricant	78.5	
PEV-db4b64		HSD TLF Pump 2	Reviewed	ABNORMAL	Jul 10, 2020 3:58:08 PM	0	Bent shaft, Faulty impeller, Misalignment	78.25	