

# Vibration-based condition monitoring of air compressors / pumps

## Introduction

Air compressors and pumps are used in almost every industrial sector and operates under varying conditions. Whether for pressure generation, cooling or heating, material transportation, the demands placed on machines are diverse, making them prone to disruptions and faults:

- Unbalances;
- Misalignment;
- Roller bearing damage;
- Cracks in blades;
- Cavitation;

The requirements for the availability of air compressors or pumps are sometimes very stringent in some production processes. Machine malfunction can results in downtime for the production block and even destroy the entire machine trains. Therefore, special requirements are placed on monitoring their conditions.



*Air compressors*

## Vibration monitoring system

Vibrations are the basis for assessing machine conditions. Condition monitoring essentially comprises the measurement and recording of overall vibration values and operating parameters. It provides information and allows the diagnosis of the general machine condition or very specific 'disorders' of the machine.

WiiHey has brought up a new smart vibration monitoring system with MEMS and IoT technologies. Breakthroughs in MEMS technology make sensors much smaller and affordable. Nowadays with same budget, more sensors could be placed on machine components to precisely localize the vibrating source. While the IoT technology provides wireless connectivity so that experts could gain near-real-time visibility into machine conditions without traveling to locations.

## Tech specs

- 3-axis MEMS accelerometer;
- $\pm 2g/4g/8g/16g$  selectable scales, 8 to 12 bit resolution;
- 10 Hz to 1.6 kHz output rate, DC to 800 Hz bandwidth;
- 2.4 GHz Bluetooth low energy;
- 2 year battery life with 5 minute data uploading rate;

## Key features

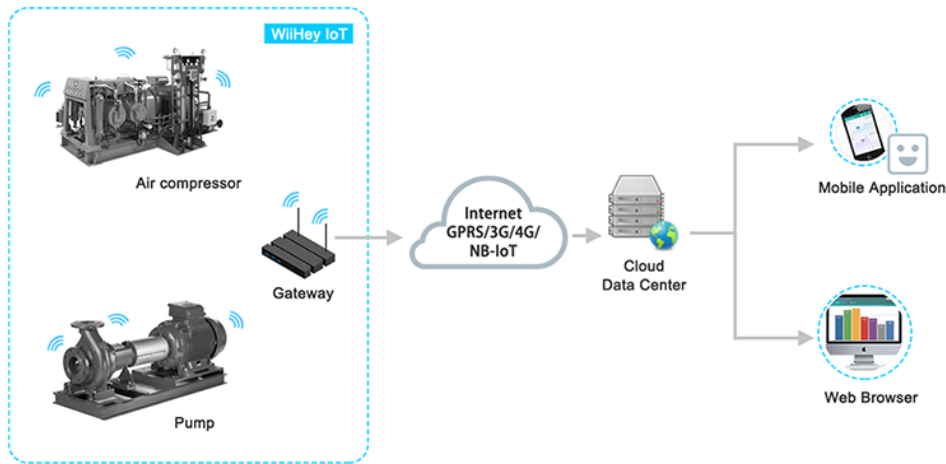
- Tri-axial MEMS accelerometer sensor with inside battery and IoT connectivity;
- Small hardwares - portable, easy to mount, wireless, low power and low cost;
- Rich cloud services like data fusion, display and analysis, etc;
- Quickly assess machine conditions, recognize warning signs;
- Multiple user terminals support, such as PC browsers and mobile APPs;

## Benefits

- Continuous and cyclic acquisition of overall vibration values;
- 24/7 remote monitoring, skip the costly old-fashioned manual inspections;
- Enables the identification of machine faults and give early warnings;
- Localizes the affected components to provide information on root causes;
- Prevent equipment failures and avoid unscheduled downtime;

## Architecture

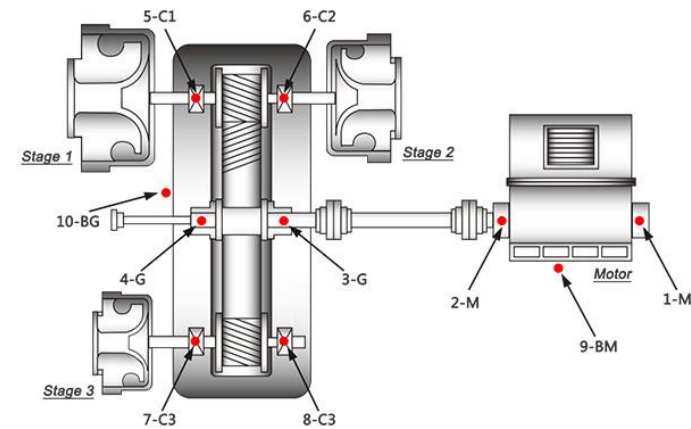
Integrated system includes monitoring targets, sensors, gateway, cloud services and user terminals:



System architecture

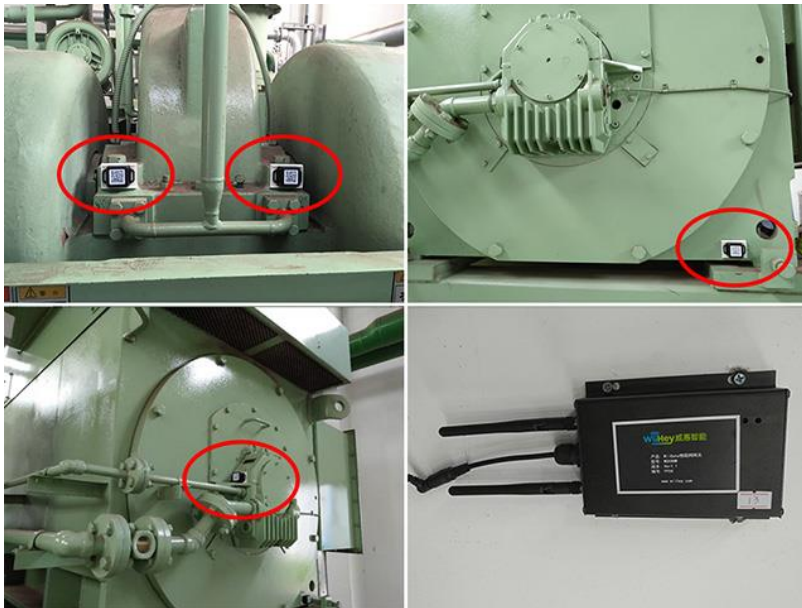
## Hardware installation

Sensors are placed on the components where potential problems are easy to occur. For a three-stage air compressor, as an example, there are several points for sensors to be mounted, such as the bearing house, foundation bed, etc:



Sensor mounting points

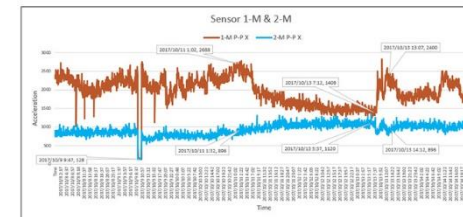
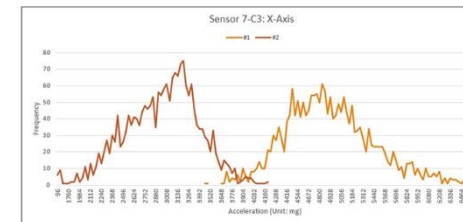
Here is a close look of the sensors. The sensor uses MEMS accelerometer to acquire vibration data, it has an inside battery and support wireless connectivity with gateway, no hard wire is required. The gateway transmits data to the cloud for further process. Detailed information of products could be found here - [WiiMine Sensor](#), [WiiGate Gateway](#).



WiiMine sensors & WiiGate gateway



Data display on PC browser



Data analysis:

Histogram of one week's vibration values (above) & Trending of time waveform (below)

## Software

The cloud supports rich software services including data display, data analysis and message notification. The data analysis allow user to see trending of the overall values, perform wavelet transform, or calculate statistics of comparison for prediction and optimization of subsequent maintenance. Detailed information of cloud services could be found here - [WiiMatrix](#).



Notification of daily report and warn messages on mobile APP (Wechat)

## Summery

Condition monitoring helps to avoid disruptions, to detect wear processes early on and to optimize the service life of the machine components. The IoT (Internet of Things) enables condition monitoring to be performed in a remote and wireless way, plants could automate maintenance processes to increase efficiencies and decrease costs.