

Bachelor/Master thesis

Design and Implementation of a Real-Time Embedded Monitoring System for Electric Bearing Fault Detection

Background of the topic:

This project focuses on the design and development of an embedded system that continuously monitors bearing voltage and motor housing vibration to detect early signs of bearing failures. Bearings are critical components in rotating machines, and their failure can lead to costly downtime. Therefore, early and accurate detection through real-time signal monitoring is essential.

The system will use embedded hardware and sensors to measure voltage and vibration data, process these signals in real-time, and detect anomalies based on defined thresholds or signal features. Upon detection of fault conditions, the system will trigger alerts/notifications to inform the user. Platforms such as Red Pitaya, Arduino, or Raspberry Pi may be used, based on feasibility and team preference.

Target and task description:

The primary goal of this project is to design and implement a real-time embedded monitoring system capable of detecting early-stage bearing faults in electric machines by analysing bearing voltage and motor housing vibration signals. By continuously acquiring and analysing the amplitudes and frequency spectrum of these two signals, the system will identify abnormal behaviours, which are early indicators of bearing degradation. When abnormal conditions are detected based on predefined thresholds, the system will promptly inform the user through visual, audio, or digital alerts.

The final product will be a working prototype—a compact, reliable embedded system that can operate effectively both in laboratory conditions and real-world field applications.

To achieve the project target, the following major tasks will be carried out:

- ☐ Study bearing damage mechanism
- ☐ Select voltage and vibration sensors
- ☐ Choose an embedded platform (like Raspberry Pi or STM32)
- ☐ Code real-time data capture, signal processing, and alerts
- ☐ Build the hardware system
- ☐ Test with real and simulated faults
- ☐ Document everything for the final report

Requirements: To take part in this project, the student should have knowledge and some experience in at least two of the following programming languages: Python, C, C++, or MATLAB. The student should also be familiar with at least two types of hardware systems such as microcontrollers, microprocessors, embedded systems, or system-on-chip platforms. Basic knowledge about electric machines and how they work, especially in relation to bearing faults, would be a helpful addition.

Appointments and organizations:

Supervisor:	Adisu Teshale Afeta
Room:	S3 10/113
E-Mail:	adisu.afeta@eas.tu-darmstadt.de