PROJECT ABSTRACT

Motor Fault Diagnosis Dashboard using Current Signature Analysis

An Arduino/STM32-based motor-current monitoring prototype that samples stator current, computes the FFT spectrum on the edge device, and streams fault signatures — broken rotor bars, bearing defects and stator winding faults — to a live web dashboard. Delivered built-to-order with working prototype, firmware, wiring documentation, report, PPT and viva kit.

File: k-1797-abstract.pdf

Project type: Hardware + dashboard (hybrid)

Availability: Built to order

Suitable branches: Electrical

Technologies: Arduino/STM32, ACS712 current sensor, FFT, Motor Current Signature Analysis, MQTT, Web dashboard

Price: Request a quotation

Prepared by Projectech · projectech.in — for academic project reference.

1. Title

Motor Fault Diagnosis Dashboard using Current Signature Analysis

2. Introduction / Background

Three-phase induction motors drive most industrial loads, and unplanned motor failure causes costly downtime. Motor Current Signature Analysis (MCSA) is a well-established non-invasive diagnostic technique: faults such as broken rotor bars or bearing defects modulate the motor's stator current, producing characteristic frequency sidebands that can be detected without vibration sensors or dismantling the machine. This project packages MCSA as a low-cost student-built prototype: a current sensor feeds a microcontroller that computes the current spectrum in real time, and a web dashboard visualizes the spectrum, flags fault signatures and logs diagnosis events.

3. Problem Statement

Small workshops and college labs cannot afford industrial condition-monitoring systems, so motor health is usually judged by ear, by temperature, or after a failure. Conventional overcurrent protection trips only on gross faults and gives no early warning of developing rotor or bearing damage. There is a need for an affordable, transparent, educational tool that demonstrates how frequency-domain analysis of a single current signal can reveal incipient motor faults before they become breakdowns.

4. Objectives

- Build a prototype that samples single-phase motor current at a minimum 2 kHz using an ACS712 Hall sensor.
- Compute a real-time FFT (1024-point, design target) on the microcontroller every ~512 ms.
- Detect broken-rotor-bar sidebands at 50 ± 2·s·f, BPFO bearing harmonics and elevated 3rd-harmonic content against configurable thresholds.
- Stream spectrum data and fault status over Wi-Fi (MQTT) to a live web dashboard.
- Log diagnosis events with timestamps for report and viva discussion.

5. Proposed Methodology

The ACS712 current sensor output is biased to mid-rail and sampled by the controller's ADC. A Hanning window and 1024-point FFT produce the current spectrum; the 50 Hz fundamental is located and sideband amplitudes at the fault frequencies are extracted. A rule-based classifier flags a fault only when a signature persists across three consecutive windows, suppressing transient false alarms. Spectrum frames and status are published over MQTT; the dashboard renders the spectrum, time-domain current, KPI cards and the event log.

6. System Architecture / Working

- Sensing: ACS712-20A Hall current sensor in series with the motor phase conductor.
- Acquisition: microcontroller ADC sampling at ~2 kHz, anti-alias RC filter.
- Edge processing: Hanning window, 1024-point FFT, sideband extraction, persistence classifier.
- Communication: ESP-class Wi-Fi link publishing spectrum frames and status via MQTT.
- Visualization: web dashboard with live FFT plot, time-domain current, KPIs and diagnosis log.
- Local display: 16x2 LCD showing RMS current and fault status at the prototype.

7. Hardware / Software Requirements

- Hardware: Arduino Uno or STM32 board, ACS712-20A current sensor module, 16x2 LCD, 12 V DC or small single-phase induction motor as test load, relay module (optional trip), breadboard and wiring.

- Software: Arduino IDE / STM32Cube firmware (ADC + FFT + MQTT), web dashboard (HTML/CSS/JS), MQTT broker.
- Test gear: multimeter; a known-healthy motor for baseline spectrum capture.

8. Expected Outcomes

A working prototype that displays the live current spectrum with the 50 Hz fundamental and fault sidebands clearly visible on the dashboard. Fault injection (e.g. an unbalanced rotor load or a notched bearing on the test rig) produces the corresponding signature above the -42 dB design threshold and raises a dashboard alarm. The event log documents each detection with timestamps for the project report.

9. Applications

- Predictive maintenance demonstrations for small motors and pumps.
- Teaching aid for signal processing, FFT and condition monitoring courses.
- Base platform for multi-motor or three-phase MCSA extensions.
- Workshop safety: early warning of developing motor faults.

10. Future Scope

- Three-phase current acquisition and Park-vector analysis.
- Machine-learning classifier trained on labeled fault spectra.
- Automatic protective trip output to a contactor on confirmed fault.
- Cloud history with trend analysis of sideband growth over weeks.