Near-Field EMI Detector

A Project Proposal Submitted to the

Department of Electrical and Information Engineering

Faculty of Engineering

University of Ruhuna

Sri Lanka

On 7th November 2024

Of the module EE5305 – Sensors and Transducers

By

Group No 22

KASTHURIARACHCHI K.A.A.D - EG/2021/4605

WEERASIRI G.M.I - EG/2021/4858

WEERASOORIYA W.M.I - EG/2021/4859

1. Project Overview

This project aims to design and develop a near-field electromagnetic interference (EMI) detector capable of measuring electric and magnetic fields separately. The detector will use a microcontroller and two sensor probes one for detecting electric fields (E-fields) and one for detecting magnetic fields (H-fields). By measuring these fields individually, the detector will provide precise data on EMI sources, which is valuable for troubleshooting and optimizing electronic circuits.

2. Objectives

1. To design and build a cost-effective near-field EMI detector capable of detecting both electric and magnetic fields.
2. To develop a microcontroller-based system to read, process, and display field strength measurements in real-time.
3. To enhance the device with features such as data logging, mobile connectivity, or visual indicators for EMI levels.

3. Project Scopes

The project will focus on:

- Designing the E-field and H-field probes for near-field measurement.
- Integrating the probes with a microcontroller (Arduino) for data acquisition and processing.
- Implementing software to process sensor data, filter noise, and display real-time measurements.
- Testing and calibrating the detector for optimal accuracy in detecting EMI from various sources.

4. Required Resources

1. **Hardware**:
    - Microcontroller (Arduino or ESP32)
    - Magnetic Field Sensor (H-field Probe):
        - DIY option: Inductor coil or loop of wire
        - Pre-made option: Hall Effect sensor (for low-frequency magnetic fields)

- Electric Field Sensor (E-field Probe):
    - DIY option: Small metal plate or antenna with Op-Amp
    - Pre-made option: Commercial E-field sensor module

- Operational Amplifiers: For amplifying signals from the probes
- Capacitors: To filter noise
- Display Module: OLED, LCD, or Serial Monitor
- Wires, connectors, and soldering tools

2. **Software**: Arduino IDE or similar development environment.
3. **Testing Equipment**: Oscilloscope, multimeter, EMI sources (e.g., power adapters, electronic devices).

5. Technical Approach

1. System Design:
    - A microcontroller (Arduino/ESP32) will serve as the central processing unit to handle data acquisition and user interface.
    - Two probes will be developed:
        - **E-field Probe**: A metal plate or antenna with an operational amplifier for high-impedance measurement of electric fields.
        - **H-field Probe**: A loop antenna or Hall Effect sensor to detect magnetic fields.
    - Both sensors will connect to the microcontroller's analog inputs for signal processing.
2. Signal Processing:
    - Operational amplifiers will be used to boost the signal strength from both probes.
    - Signal conditioning, including filtering and threshold detection, will be applied in software.
3. Software Development:
    - The microcontroller will read sensor data, apply signal filtering, and output field strength measurements.
    - Threshold levels will be set to indicate varying EMI levels.
    - Data will be displayed on an OLED/LCD screen or sent to a mobile device for real-time monitoring.

4. Testing and Calibration:
    - Testing near known EMI sources (e.g., power supplies, transformers) to verify the accuracy and range of the detector.
    - Calibration of sensor sensitivity to ensure reliable differentiation between electric and magnetic field strengths.

6. Expected Outcomes

- A functional, portable near-field EMI detector.
- Real-time measurements of electric and magnetic fields displayed in an easy-to-understand format.
- This will provide a valuable tool to identify and troubleshoot EMI issues in electronic circuits and systems.

7. Timeline

Task	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Research and Design								
Sensor Prototyping								
Circuit Assembly								
Microcontroller Programming								
Testing and Calibration								
Documentation								