Indian Institute of Technology Delhi

School of Interdisciplinary Research (SIRe)

SIRe Project Number

2025-01-37

(will be assigned by SIRe)

Project Proposal for Ph.D.

Project Details (The research problem must clearly indicate the need for an interdisciplinary approach)	
Project Title	**Development of a Multi-Modal Sensing System for End of-Service-Life Indicator (ESLI) of NBC Canisters & Filters**
Project Summary (Minimum 500 and maximum 2000 characters)	Nuclear, Biological, and Chemical (NBC) protection equipment protects workers from respiratory hazards like toxic dust, mist, fumes, vapors, and gases. However, the effectiveness of these NBC canisters and filters diminishes over time, eventually permitting the passage of hazardous agents unless they are replaced. Determining the operational life span of NBC canisters and filters is a significant challenge due to many factors involved, such as environmental temperature, relative humidity, the nature and concentration of contaminants, and the user's breathing rate. Some methods for determining NBC canister and filters replacement rely on user experiences like odor, taste, or irritation. This poses a significant risk as some pollutants' odor limit may exceed the permissible exposure limit. Although health organizations recommend implementing NBC canisters and filters change schedules, these programs can be burdensome, time-consuming, and often unreliable, resulting in either premature canisters & filters replacement or, more alarmingly, the continued use of saturated canister and filters. Ideally, the canisters and filters should integrate an End of Service Life Indicator (ESLI) system to alert users when cartridge replacement is necessary reliably. Current ESLI systems fall into passive or active indicating systems. Passive indicators use chemically coated paper strips that change color as the sorbent material nears depletion. They offer a cost-effective solution but have drawbacks. This includes requiring active monitoring by the user, dependence on lighting conditions, and selectivity towards specific chemical groups. However, active indicator systems incorporate electronic sensors to monitor contaminants and provide automatic visual or audible warnings to the user. While these systems offer the advantage of being less selective towards specific chemicals, their major limitation is the high cost of manufacturing. This project aims to develop a multimode sensing system for ESLI of NCB canisters and filters.

Ph.D. Supervisors
(Supervisor 1 and Supervisor 2 cannot be from the same department of IITD)

Role	Name of Faculty	Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1	Shahid Malik	SeNSE	smalik@iitd.ac.in
Supervisor 2	Hussain Kanchwal	CART	Husain.Kanchwala@cart.iitd.ac.in

Project requirements (Student qualifications, experience required, etc)
***The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)**

- B. Tech in ECE, EEE with a minimum CPGA of 8.0/10 and a minimum 1 year experience of working in IIT Delhi .
- M. Tech in Sensing Systems, Electronic Instrumentation and Control or similar fields.

Source of fellowship/funding and project number (CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any)
Project Fellowship

Role of Faculty Members involved:	
Supervisor-1	Prof Shahid will assist in system development, sensor fusion algorithms, testing and evaluation of the sensors.
Supervisor-2	Prof Hussain will assist in problem formulation, experimental facility, system modelling and control system integration.