**OPENING**

**1.** **Reason for choosing the topic:**

Governments and environmental agencies require continuous, high‑resolution data to enforce standards, assess pollution sources, and trigger timely public‑health advisories. Traditional monitoring stations are accurate but sparse and expensive; customers told us they need a distributed network of low‑cost sensors whose data is automatically validated and aggregated so that no “hot spot” goes unnoticed.

Meanwhile, urban planners, schools and hospitals want predictive insights—forecasts of pollutant spikes that let them adjust traffic flows, outdoor activities or ventilation schedules before air becomes unhealthy. They’ve asked for easy integration (APIs, dashboard widgets) into existing management platforms, mobile alerts for threshold breaches, and a user‑friendly web app for non‑technical staff.

Finally, community organizations and citizens need transparency: open data access, clear visualizations and localized alerts. By building an end‑to‑end system—sensor layer, AI‑driven anomaly detection and forecasting, plus customizable dashboards—we satisfy all these real‑world requirements, ensuring our solution isn’t just technically innovative, but truly useful to its customers.

Facing the need to view air quality on the internet as well as being passionate about web application programming. I chose the topic: "AI-powered air quality monitoring system" as the topic of my thesis.

**2.** **Purpose and meaning of the topic:**

**a. Purpose:**

• Develop a low‑cost, distributed sensor network with automated data‐validation and calibration;  
• Apply machine‑learning models to detect anomalies and predict pollutant trends hours in advance;  
• Expose clean, standardized data through APIs and integrate seamlessly with third‑party management systems;  
• Provide an intuitive web and mobile dashboard with customizable alerts and visualizations;  
• And validate system performance against reference stations to ensure reliability.

**b. Meaning:**

On the Theoretical Meaning:

* Advances research on applying AI and IoT in real-time environmental monitoring.
* Provides a foundation for developing smart, data-driven forecasting models.

On the Practical Meaning:

* Delivers a scalable, low-cost system for real-time air quality tracking and alerts.
* Supports timely decision-making and raises public health awareness.

**3.** **Object and scope of research:**

**a. Object:**

The system is designed for government environmental agencies, local authorities, schools, hospitals, urban planners, and the general public—anyone who needs real-time, reliable air quality information for decision-making, health protection, or public awareness.

**b. Scope:**

Responding to customer requirements for web development must:

* Deploy and calibrate low-cost air quality sensors.
* Collect, clean, and validate real-time environmental data.
* Apply AI models for anomaly detection and forecasting.
* Develop a web/mobile dashboard for data visualization and alerts.
* Integrate system components and validate overall performance.

**4. Research methods:**

* Review literature on AI and IoT in air quality monitoring.
* Design and deploy low-cost sensors for real-time data collection.
* Develop a data pipeline and train machine learning models for forecasting.
* Build and test a web/mobile dashboard for user interaction.
* Gather expert feedback during development.
* Observe the operations and features of similar existing platforms.

**5. Expected outcome:**

The expected outcome is to complete the system and documentation by May 2025.

**6. Topic layout:**

The content of this thesis includes the following parts:  
Part 1: An overview of the topic and related technologies.  
Part 2: Analysis and design of the “AI-powered air quality monitoring system.”  
Part 3: Implementation, deployment, and testing of several customer requirements.  
 Although I have made great efforts to carry out this thesis, due to limited time and capability, shortcomings are inevitable. I sincerely hope for your understanding. The feedback from teachers is a valuable lesson and will serve as essential guidance for my future journey.  
 Through this opportunity, I would like to express my gratitude to Mr. Nguyen Minh Nhat, who has enthusiastically guided and supported me throughout the process of completing this thesis.  
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Da Nang, April 18. 2025