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System Architecture and Deployment Engineering of AI_R for Indoor and Outdoor Air Quality Sensing

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AI_R is a low-cost, scalable air-quality monitoring and prediction system that uses efficient sensing hardware, affordable IoT connectivity, and AI-based analytics to support informed decisions in public health, risk management, and environmental governance. The system includes two sensing solutions: an outdoor unit built around the Sensirion 55 sensor and the Nordic nRF9160 LTE-M/NB-IoT module with LoRa included for specific cases. It's typically deployed in mines, industrial sites, and other harsh environments. The indoor unit is mostly used for buildings, conference spaces, hospitality settings, and homes, which connects to the cloud via Wi-Fi.

A key engineering feature of AI_R is its smart deployment tool, which enables true plug-and-play installation. The tool automatically captures essential deployment metadata, including node ID, physical location, firmware version, description, and configuration parameters, significantly reducing installation complexity and human error. The system supports over-the-air (OTA) firmware updates and leverages a centralized configuration database to ensure scalable, secure, and maintainable deployments across large, distributed networks. A companion Android user application provides real-time monitoring and device management for indoor deployments. Field experience has proven the architecture's effectiveness. Deployments across industrial sites, schools and homes have demonstrated rapid, error-free node registration and reliable operation over extended periods.

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