ABSTRACT

Prediction of atmospheric radioactive dispersion is critical for nuclear disaster mitigation, requiring high-speed, accurate, and reliable systems. However, conventional tools such as *PC-COSYMA* still rely on historical *Weather* data and manual *input*, making them less responsive to *real-time* changes in atmospheric conditions. To address these challenges, this Capstone Design project presents an integrated, computer-based solution that provides *real-time Weather* data, short-term *Weather Prediction* using *machine learning*, and interactive simulation visualizations.

The solution is implemented as a *desktop* application named *Cuacane*, developed using Python, PyQt5, QML, and PyTorch. It integrates local *Weather* sensors (Vaisala WXT520), a data parser module, a *Multi-Task Learning*-based *Prediction* model, and interactive visualizations including temperature graphs, wind compass, and *real-time Weather Maps*, with support for Gaussian Plume Model simulations. The application also exports data in a format compatible with *PC-COSYMA*, enabling direct use in radioactive dispersion simulations. All technical specifications—both functional and non-functional, including speed, accuracy, data security, and UI responsiveness—have been verified successfully. The *Prediction* model achieves an accuracy of 88.5%, with an average data update interval of 14 minutes and 38 seconds.

Development follows a modular structure comprising five main features: Dashboard, *Maps*, *Prediction*, *Convert* Data, and *Setting*s, along with dark mode, CSV export, and offline capability. Verification results in CD-5 demonstrate that the system is ready for deployment by end-*User*s such as BRIN to support rapid decision-making in radiation emergency scenarios. By combining *real-time* data acquisition, AI-based forecasting, and modern visualization, *Cuacane* is expected to be a significant innovation in providing data resources and research tools for radioactive dispersion mitigation in Indonesia.

Keywords: Cuacane, radioactive dispersion *Prediction*, *real-time Weather* data, *PC-COSYMA*, *machine learning*, Gaussian Plume Model, interactive visualization, disaster mitigation, PyQt5, PyTorch.