中文摘要

近年來人們對於身體健康、環保等議題漸漸關注，加上政府的政策推動，對於空氣品質的監控需求越來越多。本研究中主要的目的乃運用無線感測網路技術以及雲端運算兩技術，設計一套室內空氣品質監控系統，利用 ARIMA 預測模型推估二氧化碳未來趨勢，其預測的結果導入模糊控制器當中，讓監控不再只是監控，同時具有決策以及分析的功能。此外，提出一套金字塔功能更新機制，增加監控的彈性，可分別進行(1)參數調整；(2)功能微調；(3)程式重建等三種模式軟體更新。透過 CMMBCR 演算法，一方面找出最短路徑增加更新效率，另一方面加入節點電量判斷機制，避開過度使用的節點，藉以延長感測時間。在進行程式碼更新時，採用 SPIN 方法確保封包可送達，並運用廣播的方式提高更新節點接收封包的機率，加快更新的時間，有效降低能源消耗。

由實驗結果可知，(1)無線感測軟體更新機制：在 5*5 的網路拓樸中傳送 4 頁程式碼資料，在不同封包遺失率下，本研究方法跟 Deluge 比較，更新時間可減少 19%，總耗能平均節省 21%；(2)藉由程式碼的比對機制，可以降低 83.3%的程式碼傳輸量，在 4*1 的直線拓樸下，散佈時間以及電量方面皆可節省約 80%。(3)透過參數調整，資料傳輸量更可由程式重建的 26,496 Bytes 大幅降到 22 Bytes；

(4)ARIMA 預測模型，使用每 50 分鐘計算其二氧化碳濃度平均值去預測未來 10 分鐘的二氧化碳濃度變化，可達 96.73%的準確度；(5)在節能實驗下，利用模擬箱，模擬一整天的工作情況，維持在最佳的工作環境下，同時又能節省 55%的能源。

ABSTRACT

Individuals are becoming progressively more aware of health and the environment issues. In response to community concerns, government policy is increasingly focused on air quality monitoring as a means of measuring environmental health. This paper describes the construction of an air quality monitoring system that employs wireless sensor networks (WSN) in conjunction with cloud computing technology. The advantage of the system is the multifunctional capability that supports predicting for future trends in carbon dioxide using an ARIMA model, while integrating the forecast results into a fuzzy controller, which enables decision making and analysis. The flexibility of the system can be enhanced using a pyramid function update mechanism comprised of three components that include parameters adjustment, functional trimming, and program reconstruction. The benefit associated with employing a CMMBCR algorithm to calculate the transmission path of the sensors is a mechanism for determining the shortest path, which not only increases efficiency but also decreases the overall energy requirements, effectively extending the period of time the sensors can operate. The transmission period and energy use of the system is optimized by employing the SPIN method to transmit data, ensuring that retention of packets and broadcasting data is achieved. Results from the study have demonstrated a number of advantages from the use of the multifunctional air quality monitoring system. The advantages are associated with the software update mechanism for WSNs, a reduction in code image size, optimization of parameter adjustment, the accuracy of the ARIMA prediction model and

reduced operational energy requirements. The software update mechanism employed in the study is comparable to Deluge when sending 12 pages in a 5 x 5 network topology with a varying rate of packet loss, while reducing transmission time by 19% and overall energy use by 21%. Achieved reductions in code image size from the system method were approximately 83.3%, with the transmission time and energy savings made in a 4 x 1 network topology recorded at 80%. The amount of transmission data was reduced from 26,496 bytes to 22 bytes via adjustment of the parameters used in the system. Furthermore, by calculating the average carbon dioxide concentration over 50 minutes and then extrapolating the data to predict the next 10 minutes using the ARIMA prediction model, accuracies of 96% were achieved. Investigations into the energy saving potential of the system using simulation boxes to replicated daily work situations revealed energy savings of 55% for an optimal working environment.