

Distributed Database Semantic Integration of Wireless Sensor Network to Access the Environmental Monitoring System

Ubaidillah Umar, M. Udin Harun Al Rasyid*, Sritrusta Sukaridhoto

Electronics Engineering Polytechnic Institute of Surabaya (EEPIS), Indonesia

Received 21 May 2017; received in revised form 01 January 2018; accepted 05 February 2018

Abstract

A wireless sensor network (WSN) works continuously to gather information from sensors that generate large volumes of data to be handled and processed by applications. Current efforts in sensor networks focus more on networking and development services for a variety of applications and less on processing and integrating data from heterogeneous sensors. There is an increased need for information to become shareable across different sensors, database platforms, and applications that are not easily implemented in traditional database systems. To solve the issue of these large amounts of data from different servers and database platforms (including sensor data), a semantic sensor web service platform is needed to enable a machine to extract meaningful information from the sensor's raw data. This additionally helps to minimize and simplify data processing and to deduce new information from existing data. This paper implements a semantic web data platform (SWDP) to manage the distribution of data sensors based on the semantic database system. SWDP uses sensors for temperature, humidity, carbon monoxide, carbon dioxide, luminosity, and noise. The system uses the Sesame semantic web database for data processing and a WSN to distribute, minimize, and simplify information processing. The sensor nodes are distributed in different places to collect sensor data. The SWDP generates context information in the form of a resource description framework. The experiment results demonstrate that the SWDP is more efficient than the traditional database system in terms of memory usage and processing time.

Keywords: environment monitoring, semantic database, distributed data, wireless sensor network, semantic web

References

- [1] W. Y. Yi, K. M. Lo, T. Mak, K. S. Leung, Y. Leung, and M. L. Meng, "A survey of wireless sensor network based air pollution monitoring systems," *Sensors*, vol. 15, no. 12, pp. 31392-31427, December 2015.
- [2] M. U. H. Al Rasyid, I. U. Nadhori, A. Sudarsono, and Y. T. Alnovinda, "Pollution monitoring system using gas sensor based on wireless sensor network," *International Journal of Engineering and Technology Innovation*, vol. 6, no. 1, pp. 79-91, January 2016.
- [3] G. Bovet and J. Hennebert, "Distributed semantic discovery for web-of-things enabled smart buildings," 6th International Conf. New Technologies, Mobility and Security (NTMS), April 2014.
- [4] K. A. Bispo, N. S. Rosa, and P. R. F. Cunha, "SITRUS: Semantic Infrastructure for Wireless Sensor Networks," *Sensors*, vol. 15, no. 11, pp. 27436-27469, November 2015.
- [5] M. U. H. Al Rasyid, A. Sayfudin, A. Basofi, and A. Sudarsono, "Development of semantic sensor web for monitoring environment conditions," *Proc. Intelligent Technology and Its Application (ISITIA)*, IEEE Press, July 2016, pp. 607-612.
- [6] S. Zhao and E. Chang, "From database to semantic web ontology: an overview," *Lecture Notes in Computer Science (LNCS)*, Springer, vol. 4806, pp. 1205-1214, 2007.
- [7] M. Koubarakis and K. Kyzirakos, "Modeling and querying metadata in the semantic sensor web: the model stRDF and the query language stSPARQL," *Lecture Notes in Computer Science (LNCS)*, Springer, vol. 6088, pp. 425-439, 2010.

* Corresponding author. E-mail address: udinharun@pens.ac.id

Tel.: +6285645065911; Fax: +62315946114

- [8] H. N. Yadav, and R. V. Patel, "DBpedia Based SAWSDL for Semantic Web Services," Proc. 2nd International Conf. on Computing for Sustainable Global Development, IEEE Press, March 2015 pp. 35-39.
- [9] P. Ristoski and H. Paulheim, "Semantic web in data mining and knowledge discovery: a comprehensive survey," Journal of Web Semantics: Science, Services and Agents on the World Wide Web, vol. 36, pp. 1-22, January 2016.
- [10] S. Ali, S. Khusro, I. Ullah, A. Khan, and I. Khan, "Smartontosensor: ontology for semantic interpretation of smartphone sensors data for context-aware applications," Journal of Sensors, vol. 2017, pp. 8790198-1-8790198-26, February 2017.
- [11] K. Rohloff, M. Dean, I. Emmons, D. Ryder, and J. Sumner, "An evaluation of triple-store technologies for large data stores," Lecture Notes in Computer Science, Springer, vol. 4806, pp. 1105-1114, 2007.
- [12] A. J. G. Gray, J. Sadler, O. Kit, K. Kyzirakos, M. Karpathiotakis, J. P. Calbimonte, K. Page, R. G. Castro, A. Frazer, I. Galpin, A. A. A. Fernandes, N. W. Paton, O. Corcho, M. Koukabarlis, D. D. Roure, K. Martinez, and A. G. Perez, "A semantic sensor web for environmental decision support applications," Sensors, vol. 11, no. 9, pp. 8855-8887, September 2011.
- [13] A. Moraru, C. Fortuna, and D. Mladenic, "A system for publishing sensor data on the Semantic Web," Proc. 33rd International Conf. on Information Technology Interfaces, IEEE Press, June 2011.
- [14] Y. Chenzhou, W. J. Shen, W. Sun, G. Hu, J. Li, L. H. Xu, X. Z. Sun, and Y. Pan, "Active linked data for human centric semantic web of things," Proc. IEEE International Conf. on Green Computing and Communications, IEEE Press, November 2012, pp. 9-16.
- [15] H. S. Choi and W. S. Rhee, "Distributed semantic sensor web architecture," Proc. IEEE Region 10 Conf. TENCN, IEEE Press, November 2012, pp. 1-6.
- [16] A. S. Butt and S. Khan, "Scalability and performance evaluation of semantic web databases," Arabian Journal for Science and Engineering, vol. 39, no. 3, pp. 1805-1823, March 2014.
- [17] T. Okuno, "Aggregation and application of community tourism information contents by using linked open data," Proc. IEEE International Symposium on Soft Computing and Intelligent Systems, IEEE Press, December 2014.
- [18] S. Poslad, S. E. Middleton, F. Chaves, R. Tao, O. Necmioglu, and U. Bugel, "A semantic IoT early warning system for natural environment crisis management," Proc. IEEE Transaction on Emerging Topic in Computing, IEEE Press, May 2015.
- [19] S. Kwon, D. Park, H. Bang, "Semantic sleep management service in healthcare sensor networks," Proc. IEEE International Conference on Consumer Electronics, IEEE Press, January 2014, pp. 268-269.