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Review of Improved Cross Redundant Data Cleaning Algorithm for RFID and WSN Integration

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Abstract: ***Radio Frequency Identification (RFID) system is used for detecting and identifying the tagged objects by electromagnetic signals. Wireless Sensor Networks (WSN) which consists of a huge numbers of nodes and monitor the condition of the environment including pressure, humidity, and temperature. Integration of RFID and WSN will open a large number of applications in which it is important to sense environmental conditions and to obtain additional information about the surrounding objects. This paper will give an overview of RFID and WSN integration and gives overview of data cleaning algorithm for RFID and WSN integration.***

Keywords: Radio-frequency identification (RFID), system integration, wireless sensor network (WSN), Data cleaning algorithm.

1. Introduction

Wireless sensor networks (WSNs) and radio-frequency identification (RFID) systems provide excellent infrastructures to acquire, distribute, and process data in decentralized dynamic environments. Radio Frequency Identification (RFID) is a technology for identifying objects or humans automatically with the use of radio waves. The main components of RFID are the tag and reader. The next revolution in computing technology is the widespread use of small wireless computing and communication devices that will integrate seamlessly into our daily life.

Therefore, in the future the use of lots of devices such as tags, sensors, and readers etc., to grow by many orders of magnitude. From a technology perspective, RFID and sensor networks are important components of this paradigm, since both technologies can be used for coupling the physical and virtual worlds, usually known as pervasive computing .WSNs are networks of small, cost effective devices with sensing, data processing, and communication ability. WSN are being used for several applications ranging from military surveillance to habitat monitoring.

However, integrating the WSN with RFID provides context to the sensed data. This integration has facilitated our lives in many areas such as supply chain management, health care, tracking and monitoring of objects and humans. RFID technology was developed to replace traditional barcode systems. It consists of reader, tags, and applications. Readers read the tags attached on objects, store data in their memory, and the applications access it. Existing RFID technology does not support multi-hop communication from reader to reader. By integrating it with WSN, RFID data can route from readers to base stations/servers/applications by using existing sensor network protocols. The improved cross-redundant data cleaning algorithm that will be specially taken into consideration to eliminate redundancy data effectively and also improve the efficiency of data communication.

1.1 Radio-frequency identification (RFID)

RFID is to obtain identity data of targeted objected through RF signals; it is used to implement an automatic recognition and management of objects. An RFID system consists of two parts: electronic tag and reader. An electronic tag is composed of a chip and an antenna; a tag communicates with a reader by the principle of inductance coupling or electromagnetic reflection. A reader is to read the identity label of a targeted object; it can also write the information on reading cards. An antenna can be attached to a tag, a reader, or to an interface to reader via a coaxial cable.

In a RFID system, a reader can scan multiple tags simultaneously. If a tag is found, its identifier will be recognized and transmitted to the information server; after the information server records the tag information, the tag identifier is further transmitted to the integration server.

1.2 Wireless Sensor Network (WSN)

A wireless sensor and actuator network is a collection of small randomly dispersed devices that provide three essential functions; the ability to monitor physical and environmental conditions, often in real time, such as temperature, pressure, light and humidity; the ability to operate devices such as switches, motors or actuators that control those conditions; the ability to provide efficient, reliable communications via a wireless network. A WSN consists of a large number of sensor nodes. Sensor nodes are equipped with the capacities of message processing and data dissemination. The low energy consumption is a primary objective in the deployment of WSN. Two leading international standards for low-power wireless communications are Bluetooth (802.15.1) and ZigBee. A WSN consists of three layers like sensor node layer, cluster layer, and sink node layer. Under the standard of IEEE 802.15.4, a sensor node and RFID can be treated equally in a sense that both of them can build peer-to-peer networks randomly for the communication in networks. In integrating the WSN and RFIDs, both readers and sensor nodes use wireless transceiver chips which are compatible with IEEE802.15.4.

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2. Literature Review

2.1 Application of RFID and WSN

RFID are used in the industrial field like supply chain management, distributed and process control, real time monitoring of health and radiation check. Wireless sensor network do not required wired connections for communication so they are mostly used in embedded system applications. Many applications have been proposed to use WSNs and RFID for various purposes. Y. Liu et al. [11] integrated open-loop services infrastructure and RFID and then applied it to the blood management and traceability system. Chowa al. [12] used RFID technologies for the collection and sharing of data in a warehouse. Yoon et al. [13] applied the WSN in the supply chain so that project stakeholders can obtain real-time data for their decision making.

2.2 Integration of RFID and WSN

RFID and WSN are important components of pervasive computing. WSN is usually used to sense and monitor physical, chemical, and biological environments through sensing of sound, temperature, light, etc. In the application of an RFID system the object embedded with an RFID tag can be track-able or sensible. RFID technology has some limitations such as low tolerance to fluid or metal environments. Whereas wireless sensor networks has number of advantages over traditional RFID. First, incorporation with sensors enables RFID to push logic into nodes to enable RFID readers or tags to have intelligence. Second, sensors are able to provide much more information, such as the measurement of pressure, vibration intensity, sound intensity, power-line voltage, chemical concentrations, pollutant levels, temperature, humidity, etc.,. The new applications, such as real-time warning of proximity to hazardous substances or enforcement of safety rules in the operation of heavy machinery.

2.3 Data cleaning algorithm

2.3.1. G. Vannucci, A. Bletsas, and D. Leigh

In this paper [3] proposed to use backscatter radio in a RFID. Transmitter for each sensor is simplified to a transistor connected to an antenna, and therefore, the cost for each sensor's communicator become negligible, while energy used for wireless communication per sensor is minimized.

2.3.2. Z. Zou, D. S. Mendoza, P. Wang, Q. Zhou, J. Mao, F. Jonsson, H. Tenhunen, and L.-R. Zheng

This paper [4] introduced an impulse radio ultra-wideband receiver to detect energy level of sensors.

2.3.3. R. Jeffrey, G. Alonso, M. Franklin, W. Hong, and J. Widom

This paper [5] proposed an algorithm based on the pipeline framework. Different steps of cleaning are applied based on the characteristics of the raw data. This algorithm worked well for data leakage and repeated reading.

2.3.4. R. Jeffery, M. Garofalakis, and M. J. Franklin

In this paper [6] introduced a data cleaning strategy based on the time correlation. This algorithm used a probability model and mainly developed to solve the problem of data leakage.

2.3.5. A. D. Sarma, S. R. Jeffery, M. J. Franklin, and J. Widom

This paper [7] introduced a pipeline algorithm to improve the quality of the data flow. All of the aforementioned algorithms were developed to address the problem of unreliability of RFID data caused by data leakage and repeated readings; the problem of data redundancy has not been tackled and a data cleaning, transformation and loading technique. It was implemented based on the probability theory.

2.3.6 B. Carbunar, M. Ramanathan, M. Koyuturk, C. Hoffmann, and A. Grama

This paper [8] discussed the problem of redundant data; he suggested cleaning data by keeping inspection and silence of redundant readers. However, the proposed algorithm for detecting the device of redundant readers cannot avoid the fact that many readers have to work together at the same time. Based on the specified application

2.3.7. N. Khoussainova, M. Balazinska, and D. Suciu

This paper [9] developed a data cleaning method that relies on the application conditions and it needs restrictive rules.

2.3.8. S. R. Jeffery, M. J. Franklin, and M. N. Garofalakis

This paper [10] designed an RFID middleware for the data cleaning between a heterogeneous sensor and upper application. The developed method is adaptive and applicable to unreliable RFID with the stream data smoothing; this method can only process data cleaning for single reading and writing device.

3. Conclusion

RFIDs and WSNs become the better choices for many applications over traditional wired network. In this paper the literature on RFID and WSN has been reviewed. Also the integration of RFID and WSN and data cleaning algorithm reviewed.

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