International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 04 | Apr-2016 www.irjet.net p-ISSN: 2395-0072

A Review on RFID and WSN Integration for Redundant Data Filtering

Akshay Behere [1], S. P. Dhanure [2]

[1]*PG Student, Dept. of Electronics and Telecommunication, Sinhgad Institute of Technology and Science, Maharashtra, India*
[2]*Assistant Professor, Dept. of Electronics and Telecommunication, Sinhgad Institute of Technology and Science, Maharashtra, India*

Abstract - *Wireless Sensor Network (WSN) and Radio Frequency Identification (RFID) integration is an emerging technology which uses advantages of both systems making it more reliable and efficient. The Hybrid network formed by WSN and RFID integration provides excellent infrastructure to acquire, process and distribute data in dynamic environments which are decentralized. The integrated network consists of various challenges among which redundant data is critical as it is coupled with delay, time and energy consumption which results in waste of various network resources. In this paper redundant (duplicate) data issue is taken into consideration and it is further eliminated to improvise the performance of the hybrid network. Redundant data filtering is discussed in detail along with its effects on the system.*

***Key Words*: System integration, radio frequency identification (RFID), wireless sensor network (WSN), data filtering, redundant data.**

1.INTRODUCTION

Wireless Sensor Network (WSN) and Radio Frequency Identification (RFID) integration is an emerging technology which uses advantages of both systems making it more reliable and efficient. The Hybrid network formed by WSN and RFID integration systems provide excellent infrastructure to acquire, process and distribute data in dynamic environments which are decentralized. The integrated network consists of various challenges among which redundant data is complex as it is coupled with delay, time and energy consumption which results in waste of various network resources.

Wireless Sensor Network (WSN) and Radio Frequency Identification (RFID) has received importance due to their phenomenal advances in very large integrated systems, highly integrated low power digital electronics and micro electro-mechanical systems. They are emerging as an ubiquitous computing technology due their broad applicability and various advantages which are noteworthy[2].

WSN is a network consists of a Sink Node which is also known as base station and a number of small, light-weight and wireless nodes called sensor nodes. The sensor nodes sense the environmental conditions like humidity, temperature, pressure, light, sound, vibration and accordingly collect the information [3]. The sensor nodes has computational capability which allows processing of collected information. This collaboratively collected and processed information is further transmitted to the base station. WSNs provide cost effective monitoring of important applications including border monitoring, industrial control, environmental monitoring, military and healthcare application [4]. In contrast, RFID technology enables detection and identification of an object. An RFID network contains readers and tags. A tag consists of a chip and an antenna which is incorporated on a target object. Iinformation is obtained by reader by scanning these tags and transmitting information to the server. Generally, applications of an RFID systems are supply chain management, highway toll collection, controlling building access, public transportation, developing smart home appliances, animal tracking etc. [4]. RFID technology has been extensively accepted in industrial applications while on the other hand, sensor networks found important applications in harsh environmental conditions. Nonetheless, there are also many applications where information retrieved by sensing environmental conditions is not enough and additional information's like identity or the location of an object is also important [3]. Due to the use of sensor networks in these environments, the location and identity of an object remain critical. In these cases, both WSN and RFID integration is the optimal solution as they complement each other. WSN and RFID integration enhances their effectiveness and give innovative perspectives to a wide range of applications [4].

The Hybrid network formed by integration of RFID and WSN networks has various identified challenges viz. real-time performance, energy conservation, data cleaning and filtering, , anti-collision, authentication and localization [1]. Among all above challenges, redundant data filtering and cleaning is important to circumvent inefficient utilization of network resources [6]. In an RFID network, a reader cross-examines its tags multiple times to increase the observed read rate due to which several copies are attached to a single object. Also the RFID tags and sensor nodes are densely deployed in an area . It is done to cover each and every area under observation. This results in data redundancy as some areas are covered by more than one nodes. Redundant data is nothing but repeated (duplicate) reading. The filtration or removal of this redundant data is essential as it does not provide any useful information. It unnecessarily utilizes

valuable resources. The process of filtering or removing redundant information from gathered information is known as data cleaning. More precisely, redundant data removal is a process of replacing, modifying or deleting the irrelevant, inaccurate or incorrect or part of data [7].

In this review paper, redundant data issue is taken into consideration and it is eliminated further to improvise the performance of the complex hybrid network. Redundant data filtering is discussed in detail along with its effects on the system.

The next section briefs about the literature survey done for this review paper.

2. LITERATURE SURVEY

1. Li Wang, Li Da Xu," Data Cleaning for RFID and WSN Integration", *IEEE Transactions On Industrial Informatics*, Vol. 10, No. 1, February 2014

In this, Improved Cross Redundant Cleaning Algorithm (ICRDC) proposed by Li Wang. A structure called "Cross Tag List (CTL) which contains tuple queue, ensures inserting and deleting operation which is maintained in the memory. Then a verification is carried out to determine whether the tags which are waiting for arbitration are nearby the reference tags in CTL.

If there are no arbitration tags then Euclidean distance of the tags which are waiting for arbitration can be calculated. With minimum relative position method, the cross redundant data can be removed. If there are some tags which are waiting for arbitration, then based on sliding window mechanism, the tuple cache queue in tuple groups can be checked and detected for redundancy. This CTL tuple containing redundant data is removed and thus a reasonable amount of memory can be maintained.

2. Shawn R. Jeffery, Minos Garofalakis and Michael J. Franklin, "Adaptive Cleaning for RFID Data Streams" , *in Proc VLDB*, pp. 163174.,Seoul, Korea, 2006.

Shawn R. Jeffery proposed SMURF algorithm and gave various shortcomings of static smoothing filters to correct missed readings. The proposed SMURF algorithm employs adaptive smoothing scheme for RFID data filtration. It acts as the adaptive smoothing filter for data cleaning and is the first declarative algorithm. SMURF aims at two data cleaning mechanisms i.e, Pre-tag cleaning and Multi-tag cleaning.

As SMURF is an adaptive smoothing scheme, setting the window size is not required as it adjusts its size automatically by considering the characteristics of data streams. For adapting the window size automatically, the algorithm should differentiate between tag movement and the dropped reading.

SMURF uses a statistical sampling based approach to achieve above goals and thus accurate data streams are produced with a balance between tag motion and missed readings.

3. S. R. Jeffrey, G. Alonso, M. Franklin, W. Hong, and J. Widom,"A pipelined frame-work for on line cleaning of sensor data streams", *in Proc.* pp. 140142, IEEE Comput. Soc. Atlanta, 2006.

Shawn R. Jeffery proposed an Extensible receptor Stream Processing (ESP) algorithm which is a declarative query based framework. Its purpose is to clean data streams produced in sensor network.

ESP is a pipeline framework for data processing. It is used for cleaning data of receptor data streams online. ESP organizes the receptor data stream into five stages, they are : Point - Smooth -Merge - Arbitrate - Virtualize. By processing multiple receptor streams, it takes benefit of spatial and temporal aspects of receptor data streams and produces more accurate and enhanced data stream. ESP gives considerable development over raw sensor data and reflects the physical world.

4. Ali Kashif Bashir, Se Jung Lim, Chauhdary Sajjad Hussain and Myong-Soon Park, "Energy Efficient In-network RFID Data Filtering Scheme in Wireless Sensor Networks", *Sensors 2011,* 7004-7021; doi:10.3390/s110707004, 2011

In this paper, EIFS i.e. Energy Efficient In-Network RFID Data Filtering Scheme is proposed by Dong-Hyun Lee. Redundant data is divided into two types: Intra-cluster and Inter-cluster cases. The type of RFID data packet received by the cluster head is decided from its f field. If the value of f is 1, then the sender is an intra-cluster node and cluster head should filter out the data.

After data cleaning, the field f is set to 0. Therefore the cluster head will not filter the packets with field f equal to 0 thus reducing the cost for computation. After intra-cluster filtering, CHs send their data towards sink. Firstly, the EIFS algorithm detects the inter-cluster redundant data. Then it sends a feedback messages to the intermediate nodes which results in reduction of unnecessary transmissions. If a redundancy is detected by a CH then through feedback it informs to its intermediate CHs. Then according to the feedback, updation of tag lists are carried out.

5. Dong-Hyun Lee, Eun-Mook Lee, Ali Kashif Bashir and Myong-Soon Park, "Efficient In-Network Redundancy Filtering in RFID System Integrated with Wireless Sensor Networks ", *6th International Conference on Networked Computing (INC),* 2010 .

EIRF (Efficient In-Network Redundancy Filtering) proposed by Ali Kashif Bashir, makes use of hash tables to determine the redundant data streams. It also utilizes
Height balanced tree to revise the expired chronological data which are faster than previous methods. EIRF has less processing latency and network delay.

6. Barjesh Kochar and Rajender Chhillar, "An Effective Data Warehousing System for RFID Using Novel Data Cleaning, Data Transformation and Loading

Techniques", *The International Arab Journal of Information Technology,* Vol. 9, No. 3, May 2012.

Barjesh Kochar has proposed a novel data cleaning technique along with data
transformation and data loading techniques in this paper.

The cleaning is performed on the basis of the probability of response of the tags and the window size. The window size is increased if the strength of the dirty data is low and decreased if it is high in the past window of interrogation.

7. B. Carbunar, M. Ramanathan, M. Koyuturk, C. Hoffmann, and A. Grama, "Redundant reader elimination in RFID systems," *Sensor Ad Hoc Commun. Networks,* pp. 176–184, 2005.

This paper discusses the problem of cleaning data by keeping inspection and silence of redundant readers. However, the proposed algorithm for detecting redundant readers cannot avoid the fact that many readers have to work together at the same time based on the specified application.

3. CONCLUSIONS

RFIDs and WSNs become the better choices for many applications over traditional wired network. In this review paper, the issue of redundant data in WSN and RFID integrated network is taken into consideration. Literature on WSNs and RFIDs has been thoroughly reviewed. Most existing research is for specific applications which lack generality. In particular, there are no comprehensive algorithms which deal with the problem of redundant data from multiple readers.

Bluetooth and ZigBee technologies can be selected as the communication protocol for WSNs to meet the requirements of large number of sensor nodes, wide areas, and low cost [15].

Redundant Data transmission causes waste of time, energy and other network resources.

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