Chapter 3

An Approach to Faulty Reader Detection in RFID Reader Network

Hairulnizam Mahdin
University of Tun Hussein Onn, Malaysia

Jemal Abawajy
Deakin University, Australia

ABSTRACT

Radio Frequency Identification (RFID) technology is becoming increasingly popular as an automated tool for object monitoring and identification in a cost-efficient manner. RFID systems are made up of heterogeneous components consisting of both hardware and software. RFID components such as the readers are prone to failures with serious consequences to the overall system. Thus, issues such as reliability and dependability of RFID systems are receiving attention recently. This mandates fault management that includes monitoring the health of RFID readers and accessing the RFID reader configurations remotely. Therefore, an approach that detects the faulty readers with the aim to minimize the impacts of the faulty readers on the system reliability and dependability is of paramount importance. In this chapter, the authors discuss an approach to detect faulty readers in networked RFID system environments. Performance evaluation of the approach against other techniques is presented and shows that it performs reasonably well in the presence of faulty readers.

DOI: 10.4018/978-1-4666-0161-1.ch003
An Approach to Faulty Reader Detection in RFID Reader Network

INTRODUCTION

RFID is gaining popularity as a technology of choice for object identification. RFID automates many tedious processes that were done manually previously (Bradley & Guerrero, 2010). RFID is being deployed in many application areas including supply chain management, military applications, retail store and transportation (Liu, et al., 2010a; Thiesse, et al., 2009; Kim & Garrison, 2010). The market value for RFID is expected to grow up to $26 billion by 2016 (Das & Harrop, 2010). One of the reasons that RFID is in the limelight is because of the advantages it offers as compared to the traditional barcode. RFID can store more data, monitor multiple tagged objects at a time and does not need line of sight for detection (Fu, et al., 2010). Unlike barcodes, it provides a timestamp on each reading which is useful to visualize the object movement. The use of RFID in retail store for inventory-taking saved 87% of time compared to barcode (Thiesse, et al., 2009).

Unfortunately, the RFID system is prone to fault due to the harsh environment and the possibility of hardware malfunction (Fritz, et al., 2010). As RFID is increasingly used in many types of applications, some of which are critical, dependability aspects of RFID (fault-tolerance, reliability, etc.) is becoming apparent. One of the RFID system components that is vulnerable to failure is the RFID reader that can originated from many factors such as power failures, hardware or software defects, misplaced antennas, signal interference, weak antenna electromagnetic fields, and fast moving tagged objects (Kamoun, 2009). RFID reader failure is unavoidable (Rao & Chandran, 2009) and should be detected and as soon as possible to ensure the system reliability.

In many RFID application domains, such as supply chain management and logistics, there are many RFID readers distributed across factories, warehouses, and distribution centres capturing RFID data that need to be disseminated to a variety of applications (Floerkemeier, et al., 2007). For example, networked of readers are used baggage handlings at the airport to help minimize lost baggage (Ouyang, et al., 2008; Saygin & Natarajan, 2010; Johnstone, et al., 2010; Zhang, et al., 2008; Saygin & Natarajan, 2010) and for security reasons (Harrison, 2010; Roach, 2011). Without RFID, the air travel industry made 30 million error in misrouting the destination of the baggage and it have cost the industry $2.5 billion (Flint, 2007). In order to prevent such tragic events and to reduce the cases of lost baggage, RFID is used to track baggage, its owner and destination to prevent misrouting.

In this chapter, we focus on mechanisms for detecting faulty readers in the networked RFID system environment with the aim to minimize the failure effects on the operation and dependability of the system. With RFID’s primary roles in critical applications such as patient monitoring (Corchado, et al., 2008) and assets safeguarding (Dang, et al., 2009), an approach to validate the readers correctness is becoming paramount importance. To address this problem, we propose an approach based on interval fusion algorithm (Marzullo, 1990). The reader’s readings were fused together and generate an interval that is agreed by majority of the readers. Reader that did not agree with the majority is considered as faulty. We also compared the performance of the algorithm with other statistical approach that has been used in literature and experimental results show that algorithm performs better than the others. The next section presents the background information in RFID, faulty detection and motivating application.

NETWORKED RFID SYSTEM ARCHITECTURE

Figure 1 shows a high-level RFID system architecture. The system components are tags, readers, middleware and back-end servers and enterprise applications. In this chapter, we assume that the system is composed of \( R = \{ R_1, R_2, \ldots, R_n \} \) in-