Chapter VI
Automated Data Capture Technologies: RFID

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ABSTRACT

In this chapter we provide an introduction to RFID technology. We discuss the main components of the RFID technology, which includes RFID transponders, RFID readers, RFID middleware, and RFID labels. A detailed classification and explanation for each of these components is provided, followed by the benefits and applications that can be achieved by adopting this technology. After discussing all possible applications, we describe the business benefits and how stakeholders can benefit. This is followed by a detailed outline of the adoption challenges, where we discuss issues like the security, privacy, cost, scalability, resilience, and deployment and some existing solutions. Once the issues are discussed, we divert our attention to some successful RFID deployment case studies to describe the adoption of RFID technology that has already begun and how many big organizations across the world are showing interest in this technology. Since this chapter takes into consideration a variety of audiences like researchers, business executives, business consultants, hobbyists, and general readers, we tried to cover material relevant to each target audience. For business executives and consultants interested in knowing who can offer complete RFID solutions, we allocated a dedicated section for RFID vendors where we provide a comprehensive list of RFID vendors across the globe. For researchers, we listed some open issues in the section of adoption challenges. For advanced users, in-depth technical details are provided in the section where we discuss security and privacy enhancing protocols.

INTRODUCTION

Automated data capture is an important aspect in supply chain management and logistics. In the last decade, automated identification and data capture (AIDC) has revolutionized the overall supply chain management process. AIDC includes technology to identify objects, and automatically collects data about them and updates the data into software systems without human intervention. Some examples of AIDC technologies include bar codes, RFID, smart cards, voice and facial recognition, and so forth.

An automated inventory control systems (AICS), which forms the backbone of the modern supply chain, is a software application used in a warehouse to monitor the quantity, location, and status of inventory. Modern AICS heavily relies upon *barcodes,* for automated data capture.

A barcode basically is a machine-readable visual representation of information printed on the surface of objects. There are several different kinds of barcodes, for example, barcodes which store data in the widths and spacing of printed parallel lines, and those that store data within the patterns of dots, or concentric circles, or even hidden within images. This encoded data on the barcodes is read by barcode readers, which update the backend ERP, SCM, or WMS systems. However there are some inherent issues with using a barcode, for instance, barcodes become ineffective in rain, fog, snow, dirt and grime, and so forth (Tecstra, n.d.). Since barcodes rely on optical sensors, any minor change on the barcode print can make it difficult to read. This can be commonly seen at point of sale (POS) in the supermarkets, where the POS operator scans the barcode several times because it is either wet or not aligned properly.

To overcome these issues the industry is now looking at the possibility of using new generation AIDC technology like the RFID. A radio frequency identifier (RFID) system is basically composed of an RFID transponder (tag) and an RFID interrogator (reader). The RFID transponder or the RFID tag (which is how it is often called) is a microchip connected to an antenna. This tag can be attached to an object, which needs to be uniquely identified, for example, it can be used in a warehouse to track the entry and exit of goods. This tag contains information similar to the barcode, which stores the unique properties of the object to which it is attached. An RFID reader can access this information. The RFID reader communicates with the RFID tag using radio waves. The radio waves activate the RFID tag to broadcast the information it contains. Depending on the type of tag used, the information transmitted could be merely a number or detailed profile of the object. The data fetched from the reader can then be integrated with the backend ERP or SCM or WMS systems (Tecstra, n.d.).

There are two fundamental differences between the conventional barcodes and the contemporary RFIDs. First, RFIDs do not require line of sight—that is, objects tagged with RFID can be sensed in a wide area, and there is no need to individually scan all the objects in front of an optical scanner. Second, RFIDs offer item-level tagging—that is, each item within a product range can be uniquely identified (e.g., "109839 is a bottle of orange juice manufactured by ABC Company"). However barcodes do not identify individual items; they can only identify that "this is a bottle of orange juice manufactured by ABC Company."

Some other points could also be considered. RFID has a longer read range compared to barcodes. The amount of data stored on barcodes is limited and often cannot be updated once it is printed. In comparison, RFID tags offer a considerably large amount of data storage capacity as well as reprogramming capabilities, which means the data on the tag can be updated effortlessly. These changes can be done without physically identifying the tag because the RFID reader can uniquely query the desired RFID tag and make the changes. From the security perspective RFID tags can be placed inside the objects, however