Implementation of a RFID-based System for Library Management

Kiyotaka Fujisaki, Department of Advanced Information Technology, Kyushu University, Fukuoka, Japan

ABSTRACT

Using electromagnetic coupling, an RFID tag can get power supplier by a reader and communicate with it for data exchange. Because the RFID system enables non-contact communication, various services and applications including the management of a library catalogue are possible. However, the system is affected easily by neighboring environment and the resonant frequency, thus the communication performance is degraded. In this paper, is used 13.56MHz RFID system for the management of the library. The authors evaluate the influence that papers or other RFID tags give to the resonant frequency of an RFID tag.

Keywords: Automatic Identification, Radio Frequency Identification, Resonant Frequency, RFID

INTRODUCTION

The progress of the radio technology allow us to use many wireless services, for example, TV, Radio, mobile phone, etc. Recently, using a radio wave technique to get the information from goods without direct contact is very important. This technique is called Radio Frequency Identification (RFID) (Finkenzeller, 2010).

The RFID technique uses electromagnetic coupling for data exchange between the reader/writer and the tag. The RFID system using this technique can be applied in the case that a large quantity of goods is managed. For example, in the library, by using RFID system, we expect the efficiency of the following services: 1) rental of book and the return, 2) collection inventory, 3) search of the book, 4) access control of users (Fujisaki, 2003; Sing, 2006). Furthermore, if RFID system is integrated with smart phones and sensor networks (Xu, 2007; Yang, 2010), as new services for the library system to trace books and users, the system may send useful information to users.

A lot of applications using RFID are proposed (Symonds, 2010, Prasad, 2012, Zhonga, 2013, Ha, 2014). Moreover, the development of RFID devices and performance evaluation using RFID system are performed to realize reliable RFID systems (Balomey, 2010; Cantatore, 2007; Fujisaki, 2013; Serkan, 2005; Uysal, 2008; Potyrailo, 2009; Li, 2011; Kuoa, 2011).

At Kyushu University Library, we have implemented a RFID system. For the evaluation of usefulness of RFID system, we carried out experiments at Chikushi Library of Kyushu University, as a joint study with Mitsubishi Materials Corp. and Checkpoint Systems Inc. (Fujisaki, 2003). In these experiments, we found that the performance depends on the reading range of RFID system. Especially, when tags get too close, the performance largely decreased.

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The performance of the tag system changed by the distance of bookshelf or desk. The main reason of this problem is the shift of the resonant frequency by the influence of other things.

In this paper, to confirm this situation, using 13.56MHz RFID system, we evaluated the influence that the paper or another RFID tag give to the resonant frequency of the RFID tag.

The paper structure is as follows. In the next Section, we present the RFID system. Then, we give the evaluation of 13.56MHz RFID tag. Finally, we conclude the paper.

RFID SYSTEM

An RFID system is contactless ID system using wireless communication. It is one of the technique used for the automatic identification. The automatic identification means to “automatically input bar-code, magnetic-card, RFID data, etc. with the use of hardware and software and not human intervention in order to recognize the content of the data”. Also, the biometrics, OCR, the machine vision are included in this technique.

An RFID system is made up of two components as shown in Figure 1 (Finkenzeller, 2010). One is the RFID tag, which is located on the object to be identified, and another is the reader/writer. The RFID tag normally does not have the power supply to work, so the reader/writer not only exchange the data, but also supply the power and clock signal to the RFID tag. To do this, the RFID tag has an antenna or a coil as a coupling element for the communication, as shown in Figure 2. Figure 3 shows a practical example of label type RFID tag using 13.56MHz. The small black box inside the coil in this figure is an IC chip. The RFID tag has various shapes, for example, label, card, coin, and stick.

RFID systems are classified according to the operating frequency, the physical coupling method and the communication range. For example, available operating frequency is 135 kHz, 13.56 MHz, 900 MHz, and 2.45GHz. The operating frequency is used properly depending on a purpose.

Figure 1. Basic concept of RFID system

![Figure 1. Basic concept of RFID system](image1)

Figure 2. Basic layout of RFID Tag

![Figure 2. Basic layout of RFID Tag](image2)
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