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Passive Radio Frequency Identification (RFID) Systems

Introduction

Radio Frequency Identification (RFID) technology is widely used in a variety of security and tracking applications. An RFID system consists of an RFID reader that scans tagged objects in non line-of-sight conditions. This method of operation makes them superior to devices such as barcode and infrared tags. This paper focuses on the applications of passive RFID systems, the technology behind RFID systems and methods of implementation.

Commercial Products

RFID systems are gaining popularity as they are inexpensive and reusable. The cost of a fully functional RFID system depends on the type of application, operating frequency, antenna size, reading distances and power. Low Frequency readers from Parallax Inc. are available from $39.99 and passive tags are available from $0.50 [1]. The tags are compact (54 X 85mm) and reusable, which means they can be reassigned to different objects. High Frequency readers with anti-collision functionality, manufactured by Feig Electronics, cost $339 [2]. These products can be purchased ready to use from vendors and thus the production cost is minimal.

Commercial applications of RFID include areas such as transportation, mining, life sciences, product integrity, supply chain management and defense. For example, passive tags operating at ultra high frequency band (~928MHz) are common to supply chain applications because the tag costs low, can be easily integrated and the reading range and rate is suitable [3]. However, the complex information flows that manage objects in modern supply chains are being formalized through the efforts of EPCglobal (Electronic Product Code™) standards. These standards allow organizations to provide richer information sources and increase the efficiency of trading networks [4]. Some of the other emerging applications include automotive assembly, package tracking, reusable asset tracking and gaming. [5]

Underlying RFID Technology

An RFID system consists of a reader, known as the interrogator, and one or more transponders, or 'tags.' An RFID reader transmits electromagnetic waves at a certain radio frequency. The information is transferred to the tags through modulation in amplitude, phase or frequency of the signal. For efficient communication, the RFID tags must be tuned to the same radio frequency as their reader. Every tag contains an antenna and a microchip that stores a unique identification number. Tags within the range of the reader make use of the power received from the interrogator's signal to generate supply voltage for the internal circuitry. The transponder's antenna can then send information to the reader by modulating the input signal back to the reader. The reader then converts the modulated signal into digital bits representing the tag's ID [6].

Typical RFID systems operate in one of four frequency ranges, low frequency (LF): 125 kHz and 134 kHz, high frequency (HF): 13.56 MHz, ultra high frequency (UHF): 868 MHz (in Europe) and 928 MHz (in USA) and microwave: 2.45 GHz [7]. LF systems such as Parallax RFID Reader Module use less power (<1W) and have a smaller range (~ 0.04 to 0.08 m) while UHF systems have longer ranges (> 1m) and use more power (> 1W) [8].

Implementation of RFID technology

RFID readers have to communicate with a device such as a computer or a tablet that can process and interpret the data received from tags. One effective method of communicating is to utilize a reader that can be connected directly to any machine such as a computer or a tablet that has a USB port. The module is powered from the host computer's USB port. A COM port is assigned to the reader, which can be assessed by any software application or interface that provides port connectivity thereby allowing the data stream transmitted by the module to be read [8].

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