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ANALYSIS OF RFID SYSTEMS IN LOGISTICS

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The application of radio frequency identification is constantly expanding. The technology is sought in industries where control over the movement of objects, intelligent automation solutions, the ability to work in harsh working conditions, trouble-free operation, speed and reliability are required.

By applying RFID, it is possible to track the movement of goods in real time, speed up the process of receiving and sending goods, increase the reliability and transparency of operations, and reduce the influence of the human factor.

Keywords: *RFID, radio frequency identification systems, transport, logistics*

Introduction

Radio Frequency Identification (RFID) is a technology that identifies objects using radio frequency technology. In its general form, RFID needs two components. The first component is a Radio Signal Transponder, or this is a tag that attaches to the object. The tag has an embedded chip that contains identification information about the object to which it is attached and an antenna to transmit that information via radio waves. The second component is a reader device that creates a radio frequency field that picks up radio waves. When the tag passes through the radio frequency field generated by the corresponding reader, the tag returns identification information about the object to which it is attached to the reader and thus identifies that object. Therefore, in an RFID system there is no requirement for visual access when identifying objects because RFID tags do not need to be visible to the scanner to be identified [1, 4, 6, 7, 9, 10].
The basic schematic of an RFID system is shown in Figure 1 [2].

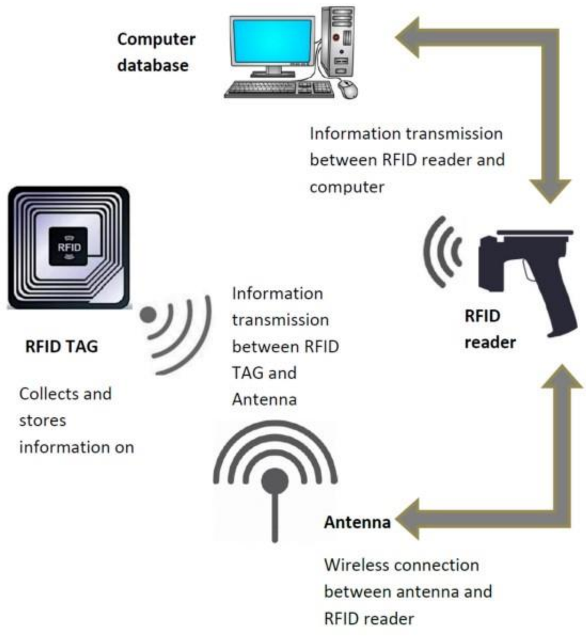

Figure 1. Basic radio frequency identification (RFID) system

Types of RFID tags

There are three types of RFID tags which are passive, semi-passive and active

- Passive - They do not contain a power source and receive the energy needed to operate from the request signal itself. The RFID reader must first query a passive tag, sending out electromagnetic waves that form a magnetic field when they "come into contact" with the RFID tag's antenna. Subject to all applicable authorization, authentication, and encryption, the tag will then respond to the reader, sending over radio waves the data stored on it. Currently, depending on antenna size and frequency, passive tags can be read, at least theoretically, from a distance of up to thirty feet [8]. There are three main frequencies within which passive RFID tags operate. The frequency range, along with other factors, strongly determines the read range, mounting materials, and application possibilities [3].

125 - 134 KHz - Low Frequency (LF) - an extremely long wavelength with a typically short reading range of about 1 - 10 centimeters. This frequency is commonly used in animal tracking as it is not affected much by water or metal.

13.56 MHz - High Frequency (HF) and Near Field Communication (NFC) - Medium wavelength with a typical read range of about 1 centimeter to 1 meter. This frequency is used in data transmission, access control and passport security applications - applications that do not require a long read range.865 - 960 MHz –

ultra-high frequency (UHF) – a short, high-energy wavelength of about one meter, meaning a long reading range. Passive UHF tags can be read from an average distance of about 5 - 6 meters, but larger UHF tags can achieve up to 30+ meters read range under ideal conditions. This frequency is typically used in race timing, IT asset tracking, file tracking, and laundry management, as all of these applications typically need more than one meter read range[3].

As a general rule, higher frequencies will have shorter wavelengths with higher energy and in turn longer reading ranges. Also, the higher the frequency, generally speaking, the more problems an RFID system will have around non-RFID materials such as water and metal[3].

Semi-passive — A semi-passive tag, like a passive tag, does not initiate communication with readers, but they do have batteries. This on-board power supply is used to control the chip's electrical circuitry, storing information such as ambient temperature. Semi-passive tags can be combined, for example, with sensors to create "smart dust" - small wireless sensors that can monitor environmental factors[8].

Active — Active RFID systems use battery-powered RFID tags that continuously emit their own signal. Active RFID tags are typically used as "beacons" to accurately track the real-time location of assets or in high-speed environments such as billing. Active tags provide a much longer read range than passive tags, but are also much more expensive[3, 8].

There are two main frequencies used by active systems – 433 MHz and 2.45 GHz. Companies generally prefer RFID systems that operate at 433 MHz because they have a longer wavelength, which allows them to work slightly better with non-RF materials such as metal and water[3].

Active RFID systems have three main parts – a reader or interrogator, an antenna and a tag. They have their own power source – an internal battery that allows them to have extremely long read ranges as well as large memory banks[3].

An example of an active RFID tag is given in Figure 2 [3].

Figure 2. Active RFID tag

A battery powering the active tag lasts between 3 - 5 years, but when the battery fails, the active tag will need to be replaced. As the active tag market matures, replaceable batteries will be a cost-saving option. The functionality of the system depends entirely on the type of tag selected for the application.

Conclusion

In the study and analysis of RFID systems, we came to the conclusion that to implement the project for continuous cargo tracking, it is necessary to use active RFID systems with a larger range of tags or high-frequency passive tags that can be tracked by RFID readers built into the toll system, which serves to track and control vehicle traffic.

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