A Location System Based on RFID

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Abstract

Our project is to do a location system based on radio frequency identification(RFID). This location system can locate the item with a high accuracy so that it can locate small items closed to each other.

Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information. Passive tags collect energy from a nearby RFID reader's interrogating radio waves. Active tags have a local power source such as a battery and may operate at hundreds of meters from the RFID reader. Unlike a barcode, the tag need not be within the line of sight of the reader, so it may be embedded in the tracked object. RFID is one method for Automatic Identification and Data Capture (AIDC).

1 Introduction

1.1 System

This project would like to develop a location system based on RFID system in library so that we can use this system to locate the position of books with a RFID reader. To achieve this goal, we have to overcome some difficulties.

The features of this system can be listed as follows:

1. The system require a high location accuracy.

   It means that the target of location is often a small item and targets are close to each other. If the accuracy is too low, we can not locate the position of the target. Therefore, we should select a location method with high accuracy so that we can locate the position of target correctly.

2. The number of targets in this system is large.

   Since this system will be used in library to locate the position of books, the number of targets is very large. It cause many problems:

   First, a large quantities of targets means that the maintenance cost for tag will be quite large if the tag is active tag. Therefore, we have to choose the passive tag to avoid such problem.

   Second, a large quantities of location targets means that we have to use lots of tags to locate the item. Therefore, we should choose the tag with low cost.

1.2 RFID

As it is introduced before, radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects.

A radio-frequency identification system uses tags, or labels attached to the objects to be identified. Two-way radio transmitter-receivers called interrogators or readers send a signal to the tag and read its response.

RFID tags can be either passive, active or battery-assisted passive.

1. An active tag has an on-board battery and periodically transmits its ID signal. A battery-assisted passive (BAP) has a small battery on board and is activated when in the presence of an RFID reader.

2. A passive tag is cheaper and smaller because it has no battery; instead, the tag uses the radio energy transmitted by the reader. However, to operate a passive tag, it must be illuminated with a power level roughly a thousand times stronger than for signal transmission. That makes a difference in interference and in exposure to radiation.

RFID systems can be classified by the type of tag and reader

An Active Reader Passive Tag (ARPT) system has an active reader, which transmits interrogator signals and also receives authentication replies from passive tags.

An Active Reader Active Tag (ARAT) system uses active tags awoken with an interrogator signal from the active reader. A variation of this system could also use a Battery-Assisted Passive (BAP) tag which acts like a passive tag but has a small battery to power the tag's return reporting signal.

In this system, because of the large quantities of tags, we select the passive tag to reduce the cost of system.

1.3 device

The device in this system we use is the Impinj R420, a RFID device developed by Impinj company.

Figure 1 and 2 show the reader and antenna of Impinj R420.

2 Detail

In this section, we will introduce the detail of our system, mainly about the method RFID used.

2.1 Selection of frequency

In order to let system perform better in location, we have to select the frequency of RFID

Figure 1: Inpinj R420 Reader

Figure 2: Inpinj R420 Antenna

first.

2.1.1 UHF RFID System

1. Frequency: 300MHz 1GHz
2. High transmission rate (100kbps)
3. 3 10m read range(passive tag)

2.1.2 Microwave RFID System

1. Frequency: 2.45GHz
2. High transmission rate (100kbps)
3. 2m read range(passive tag)
4. Easily affected by environment

Consider the features of the UHF RFID system and microwave RFID system, we select the UHF RFID system. In UHF RFID system, there exists a standard for UHF RFID system: ISO 18000-6.

Frequency of ISO 18000-6 standard : 860MHz 960MHz.

Use the ISO 18000-6 standard, the RFID can avoid the interference of WIFI, bluetooth and other wireless communications work on 2.45GHz. In this frequency, system will also have a suitable read range.

2.2 Signal collision

2.2.1 Signal collision from readers

When multiple readers read tag simultaneously, the reader cant judge which response is the one it needs.

To solve this problem, we use the ALOHA algorithm. As it is showed in figure 3.

2.2.2 Signal collision from tags

The incidence of multiple responses from multiple tags reaching simultaneously to the antenna prevents it of identifying each response individually.

EPC tags is one of methods to solve this collision.

EPC tag is a read-only tag and can be passively powered. In our system, we only read the tag information and don't need to write information on. Each tags contains the identifying information. Therefore, we can solve the signal collision from tags with EPC tag.

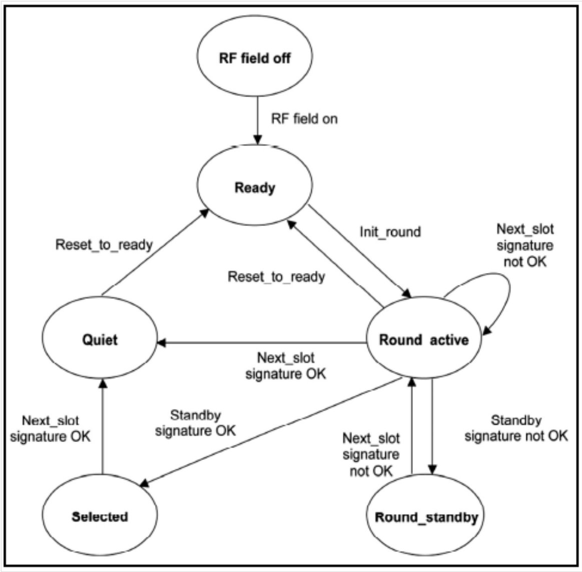

Figure 3: ALOHA algorithm

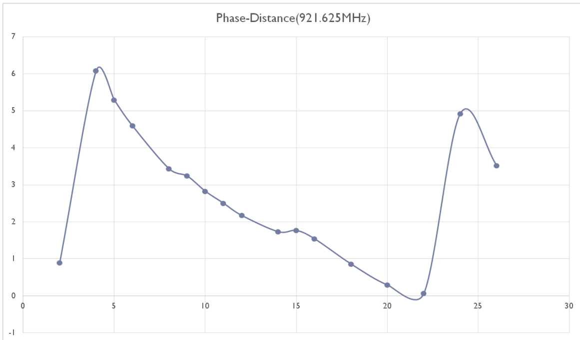

Figure 4: Result

Another advantage of EPC tag is that EPC tag's size is small so that it can be equipped on small tag.

3 Result

We test the RFID location system to locate the tag within one wave length to test the accuracy of RFID.

Figure 4 shows the relationship between distance and the delta phase when the frequency is 921.625MHz

4 Future work

So far, we only finish the RFID location system to located the tag in one wave length. The future work is to finish the located system on any distance in one direction.

A possible method to solve this problem is use two different frequency to locate the tag, with two frequency, we can locate the tag in multi wave lengths.

However when use two different frequency to locate the tag, a small error will cause a huge error when locate the tag in multi wave length.

Therefore, the future work is find a method to locate the tag in multi wave length with high accuracy.

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