Active RFID-based Indoor Positioning System (IPS) for Industrial Environment

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***Abstract*— This paper propose an active RFID-based indoor positioning system (IPS) for industrial environment. The system is quite similar to Global positioning system (GPS). However GPS can only work if the device is directed to the satellite. This work are to overcome the weakness of GPS capability for tracking an objects that did not receive a satellite signal. The methods, technique and technology of tracking system also been discussed in this paper. However, the work mostly focus on Received Signal Strength Indicator (RSSI) technique. Each technique are have their own deficiency. Several step are done to overcome those deficiency. Super High Frequency (SHF) RFID are used in this development of IPS.**

Keywords—RFID; Indoor Positioning System; RSSI; SHF;

I. Introduction

Nowadays there a many research work on Indoor positioning system (IPS) as field of tracking in closed area or didn't receive a satellite signal. The Global Positioning System (GPS) was the most accessible service all over the world as long as there are line-of sight paths between four or more GPS satellites signal and the receiver. However, in indoor scenarios satellite signals suffer attenuation by the construction and multipath reflection off the walls. The GPS service becomes unreliable and sometimes unavailable [1].

There is three major methods of tracking that is triangulation, Proximity and location fingerprinting [1-3]. In Triangulation method, geometric properties of triangles are used [2]. There are two categories of triangulation that is lateration and angulation. For lateration, the position of targeting object are estimated by measuring its distance of multiple receiver. There are several technique in the lateration such as Time-of-Arrival (TOA), Time Different of Arrival, and Received Signal Strength [2] [3].

As everybody know, the most famous indoor tracking technology nowadays was LANDMARC and other than that are VIRE and LEMT technology [3] [4]. LANDMARC is a location sensing prototype system that uses RPID technology for locating objects inside buildings. This system are based on RSS technique such all the RSS value collected by a readers are store and measured to determine the location of the object [2]. The major advantage of LANDMARC is that it improves the overall accuracy of locating objects by utilizing the concept of reference tags [4].

II. Related Works

A. Lateration of traingulation

1) Time-of-Arrival (ToA)

Sometimes called time of flight (ToF), is the time travel of a RF signal from the transmitters to a single remote receiver. Compared to the TDOA technique, time of arrival uses the absolute time of arrival at a certain base station rather than the measured time difference between departing from one and arriving at the other station [1]. The distance can be calculated directly from the time of arrival as signals travel with a known velocity. Time of arrival data from two or more station will narrow a position to a position circle and data from a third base station is required to resolve the precise position to a single point. Many radiolocation systems, including GPS, use ToA [3].

2) Time-Difference-of Arrival (TDoA)

The transmission time and the receiving time is measured and calculated using TOA technique in order to obtain a reference point, followed by sending the signal from the transmitter to the receiver and obtain the new traveling time [3]. The distance between the two end-points can be measured by the time difference of receiving the signal [3] [4].

3) Receive Signal Strength Indicator

In this technique, the assumption is that there is a relationship between radio signal strength and distance [3] [5]. The triangulation based on RSSI need at least three transmitters to locate an object. The transmitter are locate in the same angle and distance between them. The difference value of RSSI measured are calculated and the object will located.

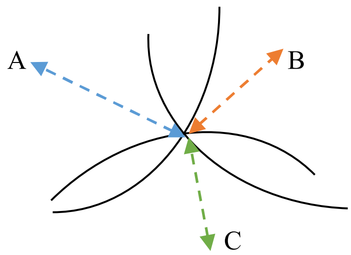

Fig. 1: Triangulation Method

B. Components in developing of IPS

1) 2.4 GHz active RFID card tag

2.4 GHz active tag adopt frequency hopping work mode, has powerful anti-jamming capability It can be read and write the standard data user-defined, the identify range can reach 80m (related on the antenna) with widely work frequency not only conformity with the stipulation of related industry but also can be developed flexible. Storage area provide encrypt read, write, erase and re-write operation.

Active mode tag and passive mode tag are widely used in personnel direction management, car access control and so on. Example of 2.4 GHz active RFID tag

Fig. 2: 2.4 GHz active card tag

2) 2.4 GHz Omni-directional Reader

Example of 2.4 GHz Omni-directional Reader (MR3102E)

Fig. 3: MR3102E 2.4 GHz Reader

MR3001A is a type of non-direction reader, applying in wide alleyway, far distance, quick identification, meeting the special demand of identification, tracking and positioning among many tags simultaneously.

III. System Overview

Based on developed system, the tag are measured by three of an antenna that located in different edge. The data get from antennas are send to the data collector by using 433 MHz wireless connection. Then all the data get are store in the server and calculated to get the location of the tag.

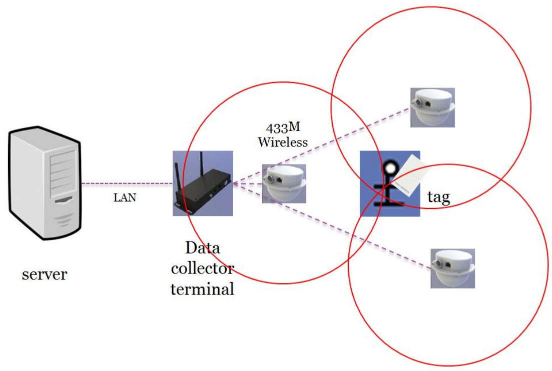

Fig 4: Overview of locating system

IV. Experiment And Discussion

A. Experiment based on RSSI equation

An early experiment to test the accuracy of RSSI equation by using 433 MHz antenna as transmitter and receiver in several point of distance. As show on the table 1, all the measurement and calculation are recorded.

Fig 5: Equipment Setup

Distance (cm)	Max (dBm)	K	Min (dBm)	K
35	-6.90	-16.02	-7.12	-16.25
45	-10.62	-17.56	-11.02	-17.96
55	-14.51	-19.71	-15.05	-20.24
65	-18.07	-21.81	-18.23	-21.97
75	-21.14	-23.64	-21.77	-24.27
85	-23.98	-25.39	-24.22	-25.63
95	-27.05	-27.49	-27.21	-27.65

Tab.1 Experimental result

B. Discussion

Based on the table 1, the value calculated are not constant. This is because the antenna gain for the experiment are weak. To solve the problem above there are several suggestion ether related the equation of RSSI with antenna gain equation or using an equipment that less losses and more constant transmit and receive power.

V. Refferences

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