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Research on An Improved Fusion RFID Collision Avoidance Algorithm

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***Abstract*—RFID (radio frequency identification) technology is one of the most popular technologies for Internet of Things (IoT) in the present. It has broad market prospects, which is to make full use of a new generation of IT technology in all aspects of life. However, the collision problems of multi-target recognition also inevitably happen in the IoT. An improved BTDFSA algorithm is proposed based on the binary algorithm and the aloha-fusion algorithm. The analyzed and simulated results show that the proposed algorithm is more efficient and achieves better performance.**

***Keywords*—RFID system; Fusion algorithm; Tag collision; Internet of Things**

I. Introduction

RFID technology is mainly through radio communication, automatically identify and read the relevant radio frequency information,, passive UHF RFID system' has many advantages: low cost, fast response scanning card, short recognition time, can be used repeatedly, light weight, small size, unlimited shape, generally no wear, no maintenance.

Since the 21st century, many countries have focused on the IoT RFID anti-collision technology, and emerged a lot of improved algorithms from the perspective of engineering applications, there are three types of anti-collision algorithms: binary-tree-based deterministic algorithms, Aloha-based probabilistic algorithms, Aloha-based and binary tree-based algorithms. Convergence algorithm, this paper mainly analyzes and improves the advantages and disadvantages, performance stability and applicable conditions of the fusion anti-collision algorithm based on ALOHA and binary tree..

II. Algorithm Basing

The RFID system tag transponder transmits information on the shared channel. When the time gap Aloha algorithm is adopted, the time gap can be divided into three types: general time slot, idle time system and collision time slot, as shown in Fig.1.

RFID collision algorithm is the most commonly used TDMA (Time-Frequency Multiple Access) method. It is simple, efficient and distributes all communication capacity to multiple users in time, so the RFID system is frequently used in anti-collision algorithms. TDMA works can be divided into two types i.e. tag non-synchronous control and reader synchronization control mode, as shown in Fig.2, the former is based on the reader to set the algorithm in advance, The tag is used for communication; the latter is based on the automatic recognition by tags' communication, while confirming the reader's reading, writing or "sleep" state, the entire identification process in order to avoid collisions occur to form a anti-collision algorithm.

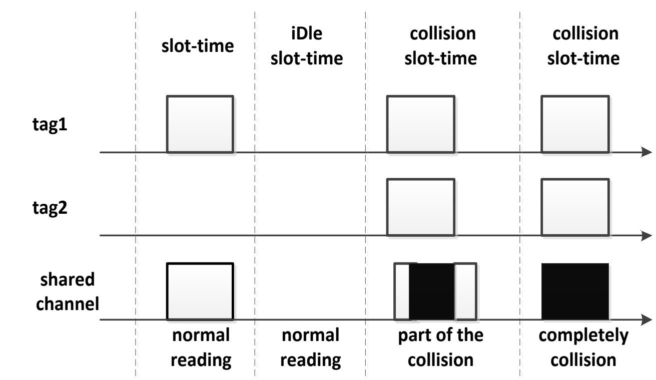

Fig.1 classification of electronic label slot- time

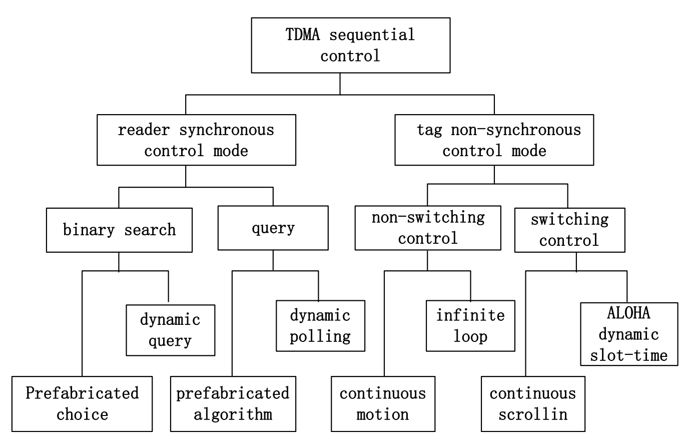

Fig.2 structure diagram of TDMA anti-collision algorithm

Binary tree algorithm is based on the estimated frame length for grouping, because when a large number of tags appear at the same time, the use of lock back binary tree search algorithm , when the corresponding increase in the frame length, tag identification time will be significantly shortened, and take up less storage space. In practical application, the registers in the tag occupy 8 bits. Using the unique UID encoding method, grouping according to the physical tag code and the highest bit of the serial number can be effectively implemented.

Dynamic frame slot-time tag data transmission algorithm, the multiple time period of a time slot, and a number of time slots into a frame, the size of the frame by the RFID system dynamic adjustment, read/write device is randomly generated a slot- time and sent to the tag, at the same time, the tags within the time slot counter will add 1, according to the concrete situation. Until when the slot count value is equal to the number of slots in the frame, the tag starts to send data information. In this process, the collision phenomenon is effectively avoided.

III. Description of BTDFSA

This paper proposed a new algorithm-binary tree dynamic frame slot-time fusion algorithm(BTDFSA), which is in the binary tree and dynamic frame slot Aloha algorithm on the basis of the improved fusion algorithm, the idea is to make sure the estimate frame length, then use a dynamic frame slot-time Aloha to distinguish between idle slot-time and collision slot- time, while using the binary tree algorithm to identify tag information by bit to achieve high system efficiency. Different from the ordinary Schout prediction algorithm, the idle time query time slot number mentioned in the current section, the single tag number and the conflict time slot number are used for prediction, and the next query's tag number is estimated, based on existing numbers. Estimate the query to check the tag number, the algorithm flow diagram shown in Fig.3.

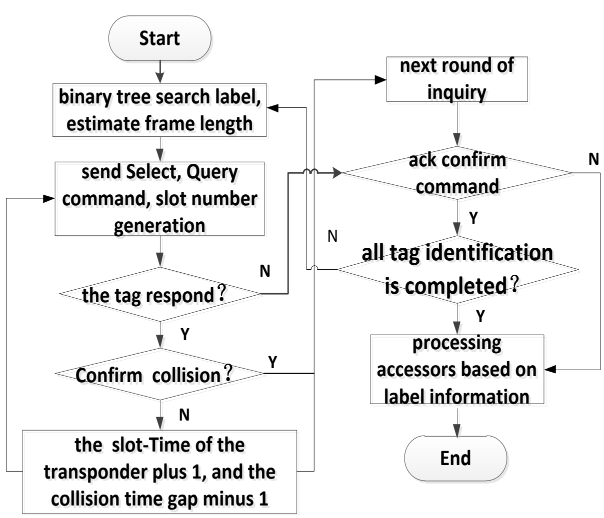

Fig.3 improved fusion algorithm flow chart

The detailed steps of the improved fusion algorithm are described as follows.

Step 1: Initialize the frame length within the query range of the RFID system, use the estimation method to preset the number of tags, and use the binary tree algorithm to use Manchester code (Matchester) , to achieve the estimated frame length .According to a real object tag code and serial number highest bit, ie, the data transmission from the tags to the reader direction. Because of its strong coding error detection capabilities, so the data transmission process is easy to find the tag collision bit.

Step 2: Send query command, query serial number prefix length, and determine whether the tag with 0 added to the prefix is responding. If the response to the next step,or determine whether the label with the last bit of the prefix is 1 responds. If the label does not respond, it enters hibernation.

Step 3: The slot is matched by bits. The tag is used to identify the dynamic frame slot- time, send inquiry commands, select the slot- time , and query in a bit-wise manner to confirm whether there is a collision. If yes, the next inquiry is started. If not, go to step 4.

Step 4: The transponder slot counter plus 1, and the collision slot counter minus 1, enters the next round of inquiries.

Step 5: Sends the confirmation message and the loop instruction until all label recognition is completed, i.e., the idle slot- time and collision slot is 0, then the reader is processed according to the tag information, the process ends.

IV. Algorithm simulation

Using the improved algorithm, the simulation results show that compared with the other three algorithms(DFSA: dynamic frame slot-time algorithm, GDFSA: grouping dynamic frame slot-time algorithm, PGDFSA: predictive check grouping dynamic frame slot-time algorithm), the data of tag communication on BTDFSA is higher. As shown in Table 1, the communication complexity is lower, as shown in Table 2.

TABLE I. COMMUNICATION VALUE OF FOUR ALGORITHMS (BPS)

Tag numbers	BTDFSA	PGDFSA	GDFSA	DFSA
100	6990	6760	3590	2370
300	19790	18920	12350	7380
600	37850	36750	25660	15500
900	68570	60520	46860	26800

TABLE II. COMMUNICATION COMPLEXITY OF THE FOUR ALGORITHMS

Tag numbers	BTDFSA	PGDFSA	GDFSA	DFSA
100	11%	28%	32%	42%
300	21%	30%	41%	45%
600	3	31%	46%	47%
900	31	42%	48%	50%

The trend of system efficiency with the number of tags is shown in Fig. 4.

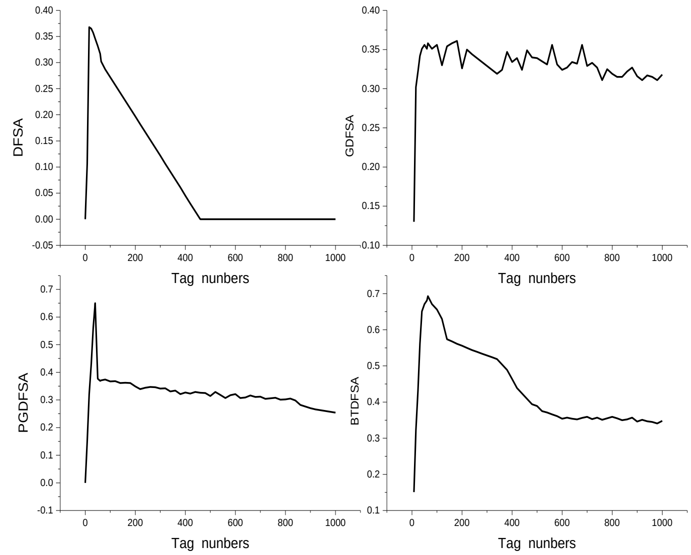

Fig.4 RFID system efficiency comparison of four algorithms

In the RFID system, reader and tags information transmit digital baseband signals through signal coding, digital modulator modulation, demodulation, coding and decoding processes. Using the improved algorithm,experiments show that when the number of tags N is 68, the maximum throughput rate is 0.693. When the number of tags is other values, the throughput rate of the prediction test algorithm can be stabilized at about 0.36, as shown in Fig.5.

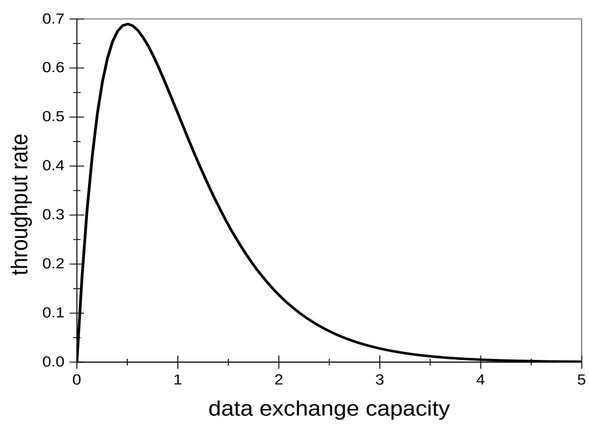

Fig.5 BTDFSA algorithm throughput rate

When demodulating an RFID signal, the correct estimation probability decreases as the SNR decreases, and the estimated performance also deteriorates. The correct estimation probability of the hop cycle as a function of signal-to-noise ratio is shown in Fig. 6.

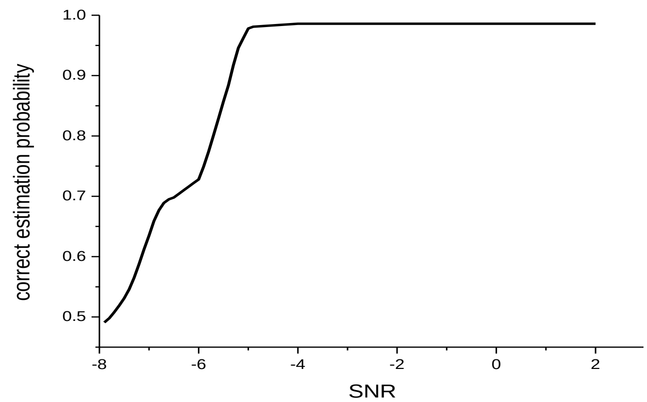

Fig.6 Frequency hopping signal diagram

Through a comparative analysis, the performance of the improved fusion algorithm has been improved, which can effectively solve the anti-collision problem of RFID system tags.

V. CONCLUSION

When the UHF RFID system is actually used in radio frequency cards, successfully identifying multiple physical tags and resolving their collision problems ,which is one of the key technologies of the RFID system and the core link of the development of the IoT. The improved algorithm proposed in this paper identifies the effective encoding of tags and uses binary tree algorithm to perform slot-by-bit matching of tags, which is relatively easy to implement in terms of hardware. In the follow-up work, we will explore how to further optimize the performance of RFID system tags anti-collision inaccuracy algorithm.

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