JOURNAL OF CRITICAL REVIEWS
ISSN- 2394-5125 VOL 7, ISSUE 15, 2020

Testing Anti-collision Algorithm for Tracking Purpose using RFID in IOT Technology

[1]Ravikuamr.D , [2]R.Kumudham, [3]Ramprasad.S, [4]E.N.Ganesh, [5]V.Rajendran and [6]V.Devi

[1,4,5] Professor, Department of ECE, Vels Institute of Science, Technology & Advanced Studies, (VISTAS) Chennai, Tamilnadu, India
[2]Asst. Professor, Department of ECE, Vels Institute of Science, Technology & Advanced Studies, (VISTAS), Chennai, Tamilnadu, India
[3] UG Scholar, Department of ECE, Vels Institute of Science, Technology & Advanced Studies, (VISTAS) Chennai, Tamilnadu, India
[6]Professor Department of computer application Gurunanak college Chennai ,india
[1]ravi.se@velsuniv.ac.in, [2]kumudham.se@velsuniv.ac.in, [4]enganesh50@gmail.com, [5]director.se@velsuniv.ac.in,[6]vdevi78@yahoo.com

Abstract:
The tracking system based on long range Radio Frequency Identification (RFID) has been deployed in warehouse. There are many goods pass through the gate of the factory warehouse. In order to increase the number of RFID tags detection, the anti-collision technique is applied in RFID reader and tag. In this paper, the comparative analysis results of the selective three slotted-Aloha anti-collision protocols, Q, QT and FQT-Algorithms are presented. The modified RFID tag based on FQT Algorithm has been combined in the warehouse. The goods tracking system has been implemented and showed the real-time stock via the mobile application.

Keywords: RFID, Anti-collision protocol, Warehouse, Tracking system, FQT-Algorithms, IoT

1. INTRODUCTION

The wireless communication channel is shared among the tags thus the signals collide. When more than one reader is applied to communicate in the same frequency and in the same time, the reader collision definitely occurs. Another reader collision is readers try to query the same tag simultaneously. The reader collision is easy to solve by having readers operating on different frequency or times. In this paper, the tags collision is investigated when the several tags try to respond to the reader on the same time. Reader starts to broadcast a request message, many tags send back the answer when the request message is heard. The messages are therefore collided and the reader cannot get the identification. In the manner of RFID [1], they cannot communicate to each other and having no channel sensing power. So the anti-collision algorithms are very important management techniques for the RFID system especially in the applications which using a large number of tags.

There are two groups of tag anti-collision algorithms, ALOHA based algorithms and tree-based algorithms. The Aloha based algorithms such as slotted aloha [2], Frame Slotted Aloha (FSA) [3] and dynamic slotted aloha [4]. These can perform well if the number of tags is small. Because of the stochastic mechanism, aloha based algorithms cannot prevent the collision completely. While the tree-based algorithm seems to be a good answer, tag cannot be identified for a long time will not happen. Tags that transmit in the same time will be grouped as a set. When a set collision occurs, the set will be split into two subsets. Then algorithm recognizes two subsets one after another. However, this process increases the identification delay and power consumption. The example of tree-based algorithm used case is Binary tree algorithm [5]. It becomes a standard anti-collision in ISO/IEC 18000-6 protocol.

RFID technology has been widely used and research more than ten years. When the Internet of Things (IoT) enables the automated remote communication between objects, machines and people to exchange the data, RFID is reborn. While the RFID is also transforming itself to be one component in an IoT implementation. Since we are aiming to apply a massive number of RFID tags in IoT, the development of anti-collision algorithm is reconsidered.

The rest of this paper is organized as follows. Section II introduces how to apply RFID technology in Internet of Things (IoT) applications. Section III presents the state of art of anti-collision algorithms in RFID, Q, QT and FQT algorithms. Section IV introduces the performance analysis of the selective three anti-collision algorithms using network simulator (NS-2). Section V explains the warehouse system and its application. Finally, Section VI concludes this paper.

2. RFID IN INTERNET OF THINGS APPLICATIONS

The concept of global network connectivity, named Internet of Things (IoT) has become a key technology nowadays. The IoT abstract architecture as shown in Figure 1 is generally divided into three layers, connecting (connected things), Cloud (common data layer) including platform and Applications layer.

Figure 1. Internet of Things - Abstract Layer

The core layer of IoT is connected devices which provide all data from various sources to the pool or may called data lake. Big Data from the physical world can be any types of technologies such as Wireless Sensor Networks (WSN), RFID tags, iBeacon, Near Field Communication (NFC), LoRa and BLE and so on.

When the technology is more possible in an industry or commercial sectors, a massive number of devices is also required gradually. RFID is one of the most needed devices. The examples of RFID applications in IoT are logistics and supply chain, manufacturing, agriculture management, Health care and medicine, marine terminal operation, military and defense, payment transactions, environment monitoring and disaster warning, transportation and retailing, warehousing and distribution system and education.

The challenges of RFID technology in IoT world are how to improve the performance and combine RFID as a thing. The warehouse and goods tracking system is our concerned. The information of goods tracking system and warehouse management is able to help the logistic and supply chain in the big city.

3. ANTI-COLLISION ALGORITHMS IN RFID

In general, the reader has to detect the status of each slot. For example, when there is no tag responds, the status will be *idle*. If only one tag responds, *readable* status is detected. Finally, the status is set to be *collision* when multiple tags respond. Moreover, *bit tracking technology* is adopted to allow the reader to detection the locations of collided bits. Normally, bit tracking technology is based on Manchester code [6].

The tags may collide and reader may not identify tags or may suffer from a long delay because of a shared

wireless communication channel. Anti-collision algorithm has to respond as fast as possible even if the number of tags is increasing. The algorithms have been classified into two groups, aloha-based (probabilistic) algorithm and tree-based (deterministic) algorithm.

The aloha-based or probabilistic algorithms such as ALOHA, slotted ALOHA and frame slotted ALOHA, tags transmit their own ID at the distinct time. The transmission time is chosen randomly by tags when the ALOHA algorithm is applied. In slotted ALOHA, tags will transmit at certain of time period. Tag sends its ID only at a single timeslot in every frame in frame slotted ALOHA which is the best selective anti-collision algorithm with a small number of tags. The system which the number of tags is not known, the probabilistic algorithm cannot recognize all tags in a certain time period.

The tree-based or deterministic algorithms such as binary tree or query tree algorithms. When the collision occurs, the reader splits a set of colliding tags into two groups until tag is able to be identified. This can avoid the tag starvation problem.

3.1 Query Algorithm (Q-algorithm)

Query algorithm or Q-algorithm [7] allows the tags to choose a reading slot number dynamically corresponding to Q values (integers between 0 and 15). Reader starts to send a *query* command (session number and Q parameter). The initial value of Q is 4. Tags within identification process will select a random value between 0 and 2^Q-1 and store the value in slot counter. When tag randomly selects value 0 for slot counter, it will move to *reply* state. Tags suddenly reply with 16-bit random number to reader. Another tag will move to *arbitrate* state. *Query Adjust* command is used to modify Q value if there is a collision. If tag replies, Q value will not be changed. All tags decrease their current slot counter by 1 when receiving the *Query Rep* command. Tags start to communicate when the slot counter is 0. If there will be collision, the slot counter decreases to 7FFFh. *ACK* command is transmitted when tag responses successfully. Tag replies with its PC, EPC and CRC values. Tags will be reset and move to *Arbitrate* state when reader sends *NAK* command.

3.2 Query Tree Algorithm

In Query Tree (QT) [8] algorithm, the prefix is sent out in each iteration. When the prefix matches the parts of tag's ID, tag will respond with its ID. The reader will expand the prefix by one bit if the collision is detected. Tags will check their own prefix with the prefix from the reader. If tag has the same prefix getting from reader, tag will send its ID and wait for *ACK* from reader.

QT algorithm is a memory less on tags. Tags only need to store their IDs. However, the time overhead is increased corresponding to the length and distribution of tag ID and the number of tags. Prefix-randomized Query Tree (PRQT) algorithm has been introduced to solve this problem. It allows tags to choose the prefix randomly.

3.3 Fast Query Tree Algorithm

Fast Query Tree (FQT) [9] algorithm was introduced to improve the speed of anti-collision algorithm. Moreover FQT was proposed to improve the identification performance of the data transmitted. However, the system must trade-off between speed and memory because of counter and point requirements in tags. The query prefix is stored in stack. Reader gets the last bit of the current prefix. When reader receives Tag's response, each tag has to maintain a state counter (SC) and pointer.

In FQT algorithm, LIFO (Last In First Out) stack is built on reader side to store the prefix. There are three cycles, *Identified, Reader's operation and Collision*. Identified cycle means the pointed bit of tag's ID equals to the reader's query bit. Thus only one tag responds in this time. Reader's operation is reader can use the ID (prefix + received ID) for future exchange with the identified tag. Reader will send feedback before the end of this cycle. In collision cycle, more than one tag responds in the same time. The flow diagram of FQT algorithms are illustrated in the Figure 2 and Figure 3 respectively.

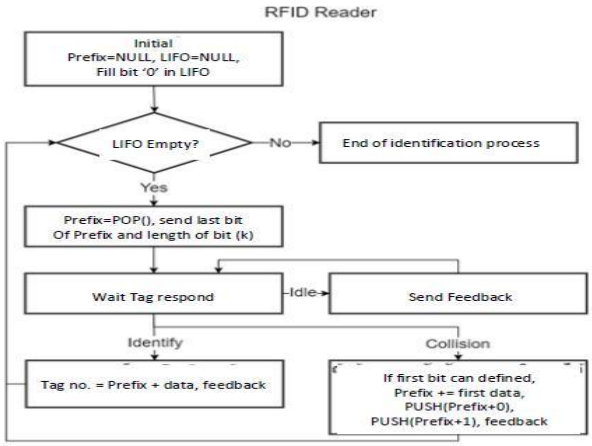

Figure.2 FQT Algorithms at Reader

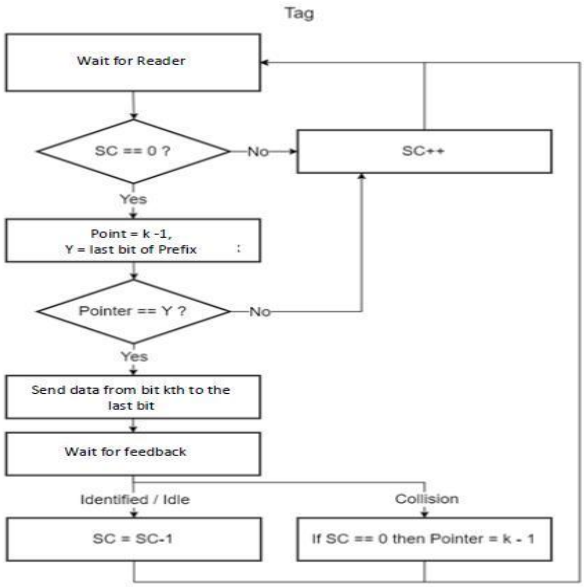

Figure.3 FQT Algorithm at Tags

4. PERFORMANCE OF ANYICOLLISION ALGORITHMS

Although RFID technology is not new, the network simulator software (NS-2) has not much supportive for RFID anti-collision algorithms or protocols. Therefore, we have to implement our selective three anti-collision
algorithms, Q, QT and FQT algorithms for NS-2 to study the latency for each algorithm.

RFID system contained a single reader communicate with *n = 50, 100, 200… 900* Tags is considered in the simulation. The data rate is 40 Kbps and the communication frequency between reader and tags is 866 MHz. The length of tag ID is 96 bits. The tag IDs is defined uniformly. In Q algorithm, the initial Q value is 4 with constant c = 0.1 and slotted time equals 1 millisecond.

Algorithms are compared by evaluating the latency defined as the duration of algorithms execution in seconds. Each algorithm is simulated and resulted by averaging over ten runs. The latency result has been plotted as shown in Figure.4. FQT algorithm gives the best performance among the selective algorithms using a shortest time in tag identification process. In contrast, Q algorithm (based on slotted aloha) gives the worse result.

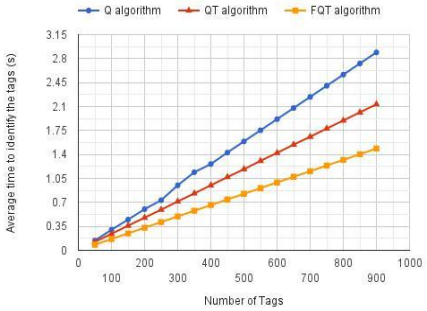

Figure.4 Algorithm Latency

However, Q algorithm may be the good choice if tags less than a hundred are deployed. The reason is Q algorithm has less complexity and resource overhead. Therefore, the FQT algorithm was chosen to implement in RFID Reader and Tag.

5. TRACKING SYSTEM IN WAREHOUSE

Long range RFID tags based on SIC8630 chip from Silicon Craft Technology Company who is our industry partner are modified by uploading the FQT algorithm in the RFID tag. The frequency is set to 433 MHz and work together with RFID reader based on CC1110 chip from TI. The RFID Tags have been attached to the goods. The system consists of Web Server and MySQL data based is implemented on cloud. The back-end application, front-end application and mobile application are developed for the warehouse tracking system was shown in Figure.5.

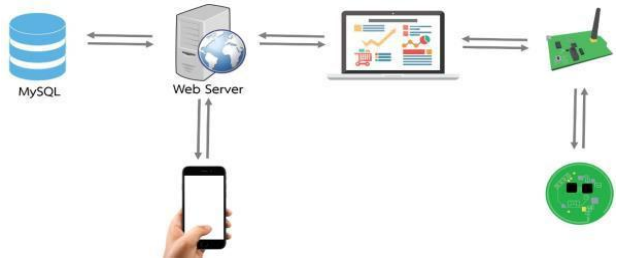

Figure.5 Tracking system in warehouse diagram

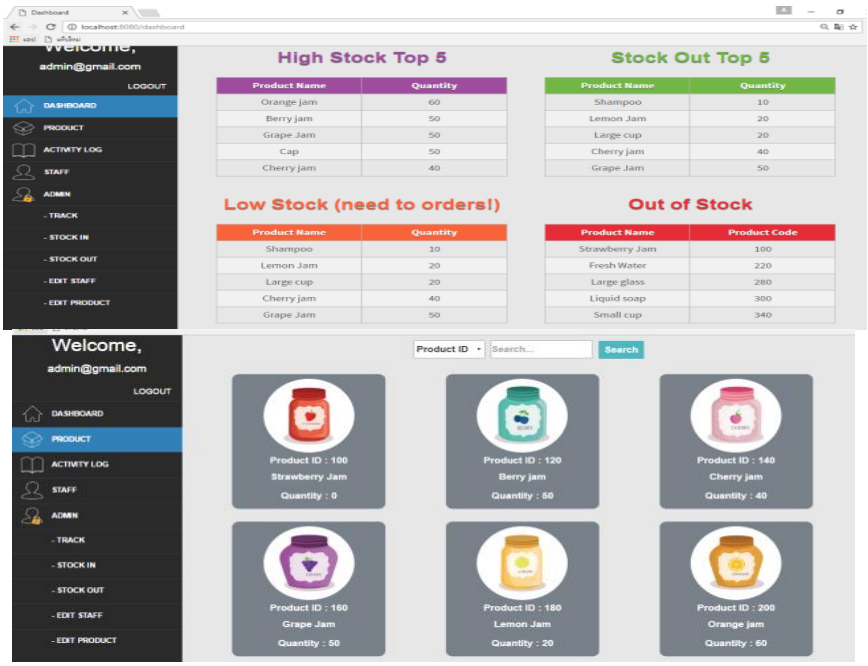

Figure.6 Dash Board of warehouse (Stock)

The dashboard of warehouse is also developed as shown in Figure.6 in order to monitor the amount of each product real-time. The threshold has been defined to warn the administrator when the products are running out of stock. The information of current stock of each product is also reported real-time. All log-file has been kept in order to track the life-cycle of each product in the warehouse which is very useful for the business analysis.

6. CONCLUSION

Internet of Things (IoT) uses a various sensing devices and technologies. RFID is therefore become alive and attractive in IoT application because of its cost and size. This paper presents the performance of the anti-

collision algorithms for a massive number of tags. The best algorithm in term of least latency is chosen to implement on the RFID reader and tag. The tracking and warehouse system is developed in order to show the possible RFID technology based on IoT. The information from warehouse system such as the current stock of each product and the life-cycle of each product can be analyzed for business planning. For instance, the favorite products (top-best seller) are known. Thus we will know the amount of goods should be ordered or produced. We can also observe which goods are running out; the purchasing system can be managed automatically.

REFERENCES

[1] EPC global, Inc., "EPC radio-frequency identity protocols Class1 Generation-2 UHF RFID protocol for communications at 860-960
MHz version 1.2.0", Oct, 2008.

[2] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

[3] Z.Chen, D.Qin and H.Wang, "Study on the improved Framed Slotted ALOHA Anti-collision algorithm," 4th *International Conference on Wireless Communications, Networking and Mobile Computing,* pp. 1-3, 2008.

[4] J.Su, Z.Sheng, D.Hong and G.Wen, "An effective frame breaking policy for dynamic framed slotted ALOHA in RFID", *IEEE Communications Letters*, vol.20, no.4, pp.692-695, 2016.

[5] Y. Cui, "System efficiency of collision recover binary tree algorithm in RFID," *IEEE International Conference on RFID-Technologies and Applications*, pp.408-412, 2012.

[6] K. Finkenzeller, *RFID Handbook: Radio-Frequency Identification Fundamentals and Applications*, 2nd edi., NewYork, USA: Wiley, 2003.

[7] M. A. Bonuccelli, F. Lonetti, and F. Martelli, "Exploiting id knowledge for tag identification in RFID networks," *Proc. 4th ACM Work. Perform. Eval. Wirel. ad hoc, sensor, ubiquitous networks*, pp. 70–77, 2007.

[8] K.W.Chiang, C. Hua, and T.S.P.Yum, "Prefix-Randomized Query-Tree Protocol for RFID Systems," *IEEE International Conference Communications (ICC)*, Istanbul, 2006.

[9] G.Wang, Y.Peng and Z.Zhu, "Anti-collision algorithm for RFID Tag Identification using fast query tree", *International Symposium on IT and Medicine and Education (ITME)*, pp.396-399, 2011.

[10] K.Sasikala, D.Ravikumar, S.Satheeskumaran, "ASIC Implementation of an Adaptive Noise Canceller for ECG Signal Processing Applications", in International Journal for Science and Advance Research in Technology - Vol 1, Issue 9, 2395-1052, Sep 2015.

[28] N.Shanmugasundaram, K. Sushita,S. Pradeep Kumar and E.N. Ganesh "Genetic algorithm-based road network design for optimising the vehicle travel distance", Int. J. Vehicle Information and Communication System, Vol. 4, No. 4, 2019

[1] [29] N.Shanmugasundaram, R.Vajubunnisa Begum "Implementation of Tracking System Using IOT for Smart City" International Journal of Management, Technology And Engineering Volume V, Issue XII, December/ 2018, ISSN NO : 2249-7455 PP NO 5347-