Survey on Optimization Techniques of RFID for Internet of Things

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ABSTRACT
RFID is a radio frequency identification technology using radio waves to transfer the data between a reader and a tag. RFID allows the sensor to read from a distance without sight contact, a unique code associated with tags. Data stored on a tag is transferred through radio frequency linked by RFID tagging which is a form of automatic identification and data capture technology. RFID is used in wide range of area such as Supply chain management factory automation, traffic monitoring, real time monitoring of health, access control, warehouses, people tracking. RFID is a technology that has the possibility to make great economic impacts on many industries. In this paper, we proposed optimization techniques for RFID in internet of things. Optimization for an RFID reader is a technique to reduce the cost of hardware. There are several techniques which have been proposed like Ant colony optimization, Differential evolution, Particle swarm optimization, Genetic algorithm. In this paper, it will demonstrate and compare all the techniques and give more effectively and efficiently approaches that increase in network system of internet of things.

Keywords
RFID, Optimization techniques, IOT.

1. INTRODUCTION
RFID technology is used radio waves to enable the communication between reader and tags. RFID reader can read the data and write data to the RFID tags. RFID reader can be fixed or static. RFID tags are high-tech and intelligent barcodes, attached the items to allow them to be tracked and makes life easier. RFID tags will communicate wirelessly with an electronic reader that will detect every item. RFID is the technology that automatically tracking and locating or identifying animals, people or an object through radio waves without line of sight. RFID can tell you that what types of an object is this, where it is, and in which condition, which is why it is integral to the development of the Internet of Things—a interconnection between web of objects allowing the physical world itself to become an information system, automatically sensing what is happening between them, sharing related data , andresponding. Firstly, items-tag are scanned by reader. Secondly, in transmitted data coming through antenna (RF-wave) are being

recognized by RFID-base system. There are three component of RFID:

RFID tags: RFID tags are microprocessor chips consist of integrated circuit with memory which store unique code for tag's identification, this unique identification called tag's ID. The microchip is a small silicon chip with embedded circuit. Tags can be classified into two types: Passive tags and Active tags. Passive tags are smaller in size and active tags are larger in size and they are cheaper than active tags that most of applications used for it. It can be detect objects distance up to eight meter in UHF band. Active tags has its own power source to initiate the communication link with the RFID reader.

RFID readers: RFID reader can read or write the data to an RFID tags. Reader can be classified in memory as read only and read-write operations. RFID is a external powered equipment used in RFID system for creating and accepting radio signals. A single reader can operate on multiple frequencies and this functionality depends on the vendor.

Antenna: Antenna use for reading tags; antenna has its own magnetic field and antenna can read only tags within these magnetic fields. Reader works for handling antenna signals and manipulate tags information.

Wireless sensor network (WSN) is wireless network with spatially distributed self organized nodes which is used to observe the physical parameters like temperature ,pressure, humidity etc. Sensor nodes cooperatively collect the information and transfer it to the base station. Each sensor node is equipped with three subsystems: communication subsystem, sensing subsystem, processing subsystem. The communication subsystem has transceiver which is used to exchange the information to the other world. The sensing unit has two several units: sensors and ADC. In processing unit the processor which is used to perform the local computation of the sensed information. Power unit gives power to the sensing unit, processing unit, communication unit.

Internet of things is an architecture that links and communicates between physical objects. In IOT the object communicate and exchange the information through the RFID. RFID a wireless sensor network and an embedded chip.IOT transform the objects from being traditional to smart by exploitation technologies such as ubiquitous and pervasive computing, embedded device, communication technologies sensor networks, internet protocol and applications. The IOT is a recent communication paradigm that visualized a near future in which the objects of everyday life will be equipped with micro controllers, transceivers for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with users, becoming integral part of the internet. Internet of Things in various ways, but the Internet of Things, or IOT, is most commonly depict as an ecosystem of technologies monitoring the status of physical objects, capturing meaningful data, and communicating the information through IP networks to software applications. The recurring topic in all definitions of the Internet of Things include smart objects, machine to machine communication, RF technologies, and a central hub of information. The concept of the internet of things first became popular in 1999, through the Auto-ID Center at MIT and related market-analysis publications. Radio-frequency identification (RFID) was seen by Kevin Ashton (one of the founders of the original Auto-ID Center) as a prerequisite for the internet of things at that point. If all objects and people in daily life were fitted out with identifiers, computers could manage and inventory them. Besides using RFID, the *tagging* of things may be accomplished through such technologies as near field communication, barcodes, QR codes and digital watermarking Typically, IOT is expected to offer advanced connectivity of devices, systems, and services that beyond machine-to-machine(M2M) communications and covers a variety of protocols, domains, and applications.

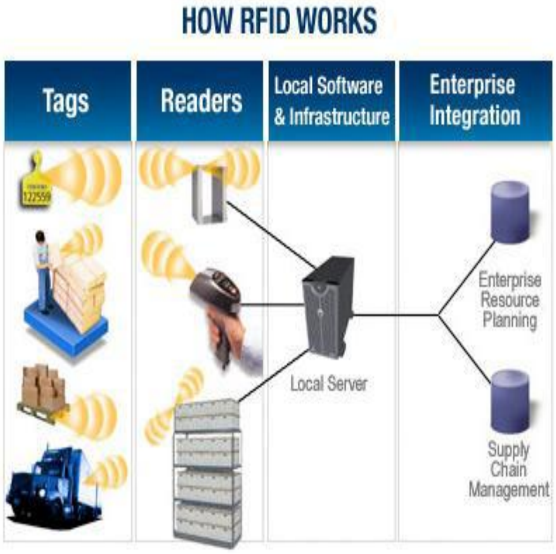

Fig 1. Architecture of RFID

2. OPTIMIZATION TECHNIQUES

Optimization techniques to maximize the communication distance between the RFID tags and RFID reader. The RFID tags must be able to start operate by received weak electromagnetic waves so that the long rang communication is realized. Optimization is a process for making a design, system or decision as perfectly, functional or effective as possible. In other words finding an alternative solution with the most cost effective or highest achievable performance under the given limitations, by increasing the requisite factors and reducing undesired ones. The word optimum means "maximum" or "minimum" of certain factors which depends on application. An optimal solution is reached by selecting an efficient optimizer. So, we maximize the output voltage vout of the circuit include in the RFID tag. The plane wave are incident to the RFID tags, we assume that the reader is sufficiently far from the RFID tag. We maximize the vout of the RFID antenna circuit when the plane wave is incident on the double antenna under the situation that input impedance of back scattering antenna is changed. There are different optimization techniques classified as:

2.1 Ant Colony Optimization

Ant colony optimization is used to solved discrete optimization problems.ACO is the collection of meta-heuristic technique that shown the good performance and robust enough to be applied across a range of combinatorial optimization problems. ACO algorithm is to find the best location for the RFID readers. In this paper, the process and effectiveness for using ACO on real-world problem of designing fixed-length meander line antennas for RFID devices. In ACO, the boundary starting from the source that is point on a grid, each and chooses a direction in which to move one point. Thus neighbors are produced corresponding to the possible horizontal and vertical moves. The mechanisms for finding shortest path using ant colony are shown in Fig.2. (A) Ants in a pheromone trail between nest and food. (B). An obstacle interrupts the trail. (C). Ants find two paths to go around the obstacle. (D). A new pheromone trail is formed along the shorter path.

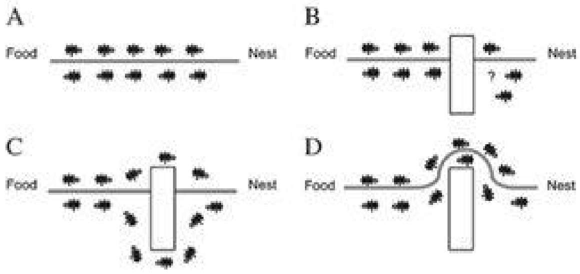

Fig 2. Ant Colony Optimization

If they either take line beyond an end or have already been used as part of the line and reach to the destination. The ACO has three main aspects: (i) the state transition rule provides a way to balance between exploration of new edges and exploitation of a priori and accrued knowledge about the problem; (ii) the global updating rule is applied only to the edges which belongs to the best ant tour; and (iii) while ants construct a solution, a local pheromone updating rules applied.

2.1.1 State Transition Rule

The ACS transition rule, also referred to as the *pseudo-random-proportional* rule, was developed to explicitly balance the exploration and exploitation abilities of the algorithm. $Jk(r)$ is the set of feasible components; that is, edges (r, s), where r is the current node and s is a next node which is not yet visited by the *k-th* ant. (r, u) are the other edges, where u is all nodes not yet visited by the *k-th* ant. The parameter β $(\beta \geq 0)$ controls the relative importance of the pheromones versus the heuristic information

$\eta(r, s)$, which is given by:,

$n(r,s)=1/drs$

Where in the mobile RFID reader, drs is the distance between nodes r and s, and $\tau(r, s)$ is the pheromone trails which refer to desirability of visiting node s directly after r. For implementation purposes, the pheromone trails are collected into a pheromone matrix, whose elements are the all of $\tau(r, s)$.

2.1.2 Global updating rule

The global pheromone update is applied at the end of each iteration to one ant, which can be either the *iteration-best* ant or the *best-so-far* ant. The pheromone updating rules are designed so that they tend to give more pheromone to edges which should be visited by ants.

2.1.3 Local pheromone updating rule

The local pheromone update is performed by all ants after each construction step. The main goal of the local update is to diversify the search by decreasing the pheromone concentration on the traversed edges. Thus, the ant would choose another route to produce different solutions. This would prevent several ants to produce identical solutions during iteration.

2.2 Differential Evolution

Differential Evolution is differ from Ant colony optimization approach. DE is an appropriate method to achieve solution and more effective for grid size antenna in RFID.DE did not use for local search mechanism. DE approach illustrate that it is possible to implement non constructive technique for RFID.DE is a population- based search method suitable for solving the continuous optimization problem in RFID. Differential evolution to solved benchmark continuous optimization function. It maximize the antenna efficiency and minimize the resonant frequency. In DE algorithm, each member of the population solutions is considered as target for replacement in the subsequent generation.

2.2.1 Multi objective differential evolution

DE is a single-objective problems the population of solutions converges to a single location; indeed, this convergence is often a necessary feature of the algorithm that allows it to automatically scale the magnitude of moves it 1At a minimum, one randomly chosen vector component will always come from the initially generated candidate point. makes in solution space. However, this behaviour is not desirable in a multi objective application where a diverse range of solutions spread along the non-dominated front is sought. Mezura-Montes, Reyes-Sierra and Coello Coello categorise DE algorithms for multi objective optimisation into non. The second is most similar to other multi objective evolutionary algorithms, such as Deb et al.'s NSGA-II [5], involving a (_ + _)-selection after all candidate solutions have been produced. Key exemplars of this approach are Madavan's Pareto-Based Differential Evolution (PBDE), which uses a DE/current-to-rand/1/bin algorithm and the non-dominated sorting and ranking of NSGA-II. Multi-Objective Differential Algorithm (MODE), and Iorio and Li's Non dominated Sorting Differential Evolution (NSDE), which is effectively identical to NSGA-II except the mutation operator is replaced by DE/current-to-rand/1.2.

2.2.2 Adaptive Differential evolution

Adaptive differential solver to discrete problem domains is generally a non-trivial task. A naive approach could be treated each discrete decision variable in the optimization problem as a dimension of the continuous space, with continuous values mapped to discrete values by rounding or truncation. Yet in constrained problems this may produce a complex search space where many positions are infeasible. Rather than encode antennas directly in a continuous space, the proposed approach describes the antenna construction process. As noted above the problem has some similarities with the TSP in that a meander line antenna is a sequence of visited nodes. A common approach taken with permutation problems is to order vector components by their value, thereby producing a permutation of the components.

2.3 Particle Swarm Optimization

Particle swarm optimization is the population based optimization technique that develops from nature and evolutionary computations.PSO algorithm to find the minimal number of RFID readers with 100% coverage of tagged items in an /RFID network, There are two values influencing the movement of particles in the stand PSO algorithm i.e, global best (gbest) and personal best (pbest). For all iterations, any particle is updated by following two "best" values. The first one is the best solution (fitness) it has achieved so far, referred to as pbest, and the fitness value is also stored. Another "best" value which is to be tracked by the particle swarm optimizer is the best value obtained so far by any particle in the population, which is called global best (gbest). PSO as the optimization technique to find the optimum placement of RFID reader. The multi-objective functions consisted of the coverage efficiency, overall overlapping, total power radiated by RFID reads network and cost of the network. First create initial particles of PSO for RFID reader then execute PSO and local search around the best readers position of the previous level. In net level conidition will reached if there is full coverage of RFID reader then end. Otherwise iteration is maximum it goesto the level 1 in PSO Fig.3.

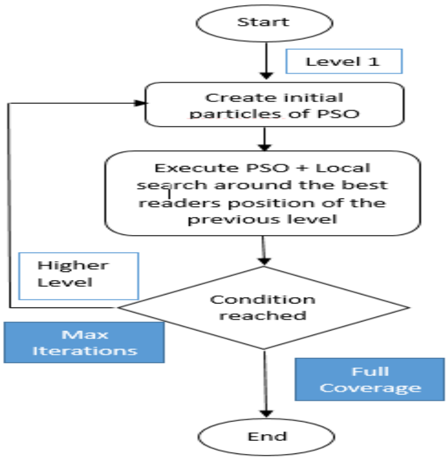

Fig 3. Flow chart of PSO

2.4 Genetic Algorithm Optimization

Genetic algorithm is one of the most appropriate algorithm techniques that can be solved the problem in RFID inspired by the natural evolutionary process. Genetic algorithm search optimizer is a global; optimizer that search the solution space in the parallel manner and does not depend on the initial set of conditions. GA optimizer are non-bias to the solution space and thus survey the entire solution space instead of localizing on an area of interest. RFID having the bowtie antenna with parameter height length, base length, wire thickness, location of microchip. We could fixed the parameters except base length and high length. GA has three major operations: selection, crossover and mutation. In GA, selection process is used, which covers selection and copying, to select better fitness values into the next generation (common mechanisms include roulette wheel and tournament), the crossover process to mix the species in order to produce a better next generation (common mechanisms include a single point, pairs of points and even crossover), and the mutation process to avoid the missing of excellent species. RFID reader deployment may generate large overlapping of the reading area and brings up it mentioned reader to reader and reader to tag interference overlapping of reading area upon deployment. when it is practically difficult to keep all readers from overlapping, the limit to be set for the overlapping ratio to be 25%. That is 25% overlapping of the reading area is allowed.

2.5 Artificial Bees Colony Optimization

In Artificial bees colony algorithm, optimization is represented by the position of food source while the ambrosia amount of a food source corresponds to the objective fitness function of the associated solution. ABC optimization based on the population. The bees colony algorithm mimics the foraging strategy of honey bees is the best solution to an optimization problem. Each candidate solution is thought that as a food source (flower), and a population (colony) of *n* agents (bees) is used to search the solution space. Each time of an artificial bees visit a flower (lands on a solution), and it evaluates its profitability (fitness).The algorithm classified three classes of bees: employed bees, onlooker bees and scout bees. The employed bees look for the food source, the onlooker bees make a decision to choose the food source by sharing the information of employed bees and then scout bees which is used to determine a new food source if a food source is derelict by the employed bees and the onlooker bees.

3. COMPARATIVE ANALYSIS OF OPTIMIZATION TECHNIQUE

In this paper, it evaluated the current state-of-the-art approaches designed to correct the various anomalies and issues associated with RFID technology. It has found that the comparative analysis of optimization techniques of the RFID with the WSN(wireless sensor network). There are various techniques which is to be compare each other and found the best solution for the problems with the techniques. In Ant colony optimization efficiency will be high and frequency will be low in RFID. On the other side efficiency will be low and frequency will be high in WSN. In differential evaluation efficiency will be increase and frequency will be decrease in RFID than the WSN. In particle swarm optimization, velocity and force will be static in RFID and change in WSN. The cost will be reduces in the particle swarm optimization. In genetic algorithm robustness will be high and low in WSN. In artificial bees colony, size will be increase in RFID and size will ne half in the WSN. However, there is the observational table as shown in table 1.comparative analysis in which all techniques will be compare and information in real-time limiting its optimization to a period after the records have been stored.

Table 1. Comparative analysis of optimization techniques in RFID and WSN

RFID and WSN					
	ACO	**DE**	**PSO**	**GA**	**ABC**
EFFICIENCY	Increase in RFID and decrease in WSN	Increase in RFID and decrease in WSN	Increase in both	Increase in RFID	increase in both
FREQUENCY	Low in both	Low in RFID and high in WSN	Low in both	Low in RFID	High in WSN and low in RFID
VELOCITY AND FORCE	Varying in both	Varying in RFID and WSN	Static in RFID and Change in WSN	Change in RFID and Static in WSN	Varying in both
ROBUSTNESS AND FLEXIBLITY	Low in both	Low in RFID and high in WSN	Low in RFID and High in WSN	High in RFID and low in WSN	Low in both
SIZE	Same in both	Maximum in RFID and minimum in WSN	Maximum in both	Minimum in both	Increase in RFID and Half in WSN
COST	Reduce in both	Low in both	Reduce cost in RFID and WSN	High in RFID and WSN	Low in RFID and WSN

4. CONCLUSION AND FUTURE SCOPE

In this paper, discuss the different Data optimization techniques in RFID for internet of things and issues, different types of errors, different types of approaches and comparative analysis of each approach. It explored the drawbacks found in currently explored Approaches and suggested different solutions in the hope of generating interest in this field of RFID study. It characterised these methodologies into ant colony optimization, differential evolution, particle swarm optimization, genetic algorithm, and artificial bees colony optimization. Finally, It explored the approaches and there drawback and suggest the different solutions and comparative analysis.

In future, this paper will try to bring out the multiple optimization technique in RFID and compare their accuracy, with the WSN and overhead requirements for the internet of things.

5. REFERENCES

[1] R. Want, "An introduction to RFID technology," IEEE Pervasive Computing, pp. 25-33, 2006.

[2] R.H. Weber, Accountability in the Internet of Things. Computer La w & Security Review, 27(2), p133-138, 2011. http://dx.doi.org/10.1016/j.clsr.2011.01.005.

[3] Marcus Randall, Andrew Lewis, Amir Galehdar, David Thiel. Using Ant Colony Optimization to Improve the Efficiency of Small Meander Line RF-IDAntennas.// In 3rd IEEE International e-Science and Grid Computing Conference, 2007. http://www98.griffith.edu.au/dspace/bitstream/1007 2/17063/1/47523_1.pdf.

[4] Po-Jen Chuang and Wei-Ting Tsai Department of Electrical Engineering Tamkang University Tamsui, New Taipei City Taiwan 25137, *R. O. C.* [5]. J. Cho, Y. Shim, T. Kwon, Y.Choi,S.Pack,and. Kim, "SARIF:

[5] A novel framework for integrating wireless sensor and RFID networks,"IEEE Wireless Commun., vol. 14, no. 6,pp. 50–56, June 2009.

[6] T. Yashiro, S. Kobayashi, N. Koshizuka, and K. Sakamura, "An Internet of Things (IoT) Architecture for Embedded Appliances", Proceedings of the 2013 IEEE Region 10 Humanitarian Technology Conference, **(2013)**, pp. 314- 319. [15]. T. J. Green, V. Tannen . Models for incomplete and probabilistic Information. IEEE Data Engineering Bulletin , 29(1), pp. 17–24, March 2006.

[7] Gong, Y., M.Shen, J. Zhang, 2011. "Optimizing RFID Network Planning by Using a Particle Swarm Optimization Algorithm with Redundant Reader Elimination." IEEE Transactions On Industrial Informatics, 1-13.

[8] Giampaolo, E., F. Fornì, G. Marrocco, 2010. "RFID-Network Planning by Particle SwarmOptimization." Antennas and Propagation EuCAP Proceedings of the Fourth European Conference.

[9] R. Poli "Analysis of the publications on the applications of particle swarm optimization" Journal of Artificial Evolution and applications, Article ID 685175, 10 pages, 2008.

[10] ISO/ IEC JTC1 SC31 WG4 SG3 18000-6 Proposal, 2002: Information Technology AIDC .Techniques- RFID for Item Management - Air Interface, Part 6 - Parameters for Air Interface Communications at UHF.

[11] Department of Computer Science and Information Engineering, Chung Hua University, Hsinchu, Taiwan chh@chu.edu.tw 2School of Software Engineering, Tongji University,Shanghai, China dqzhang@ieee.org

[12] E. Mezura-Montes, J. Vel_ azquez- Reyes, and C. A. Coello Coello. A comparative study of differential evolution Variants for global optimization. In Genetic and Evolutionary Computation Conference(GECCO'06), pages 485{492, Seattle, Washington,USA, 2006.

[13] J. Montgomery. Crossover and the different faces of Differential evolution searches. In IEEE CEC 2010, Barcelona, Spain, 2010. IEEE.

[14] G. C. Onwubolu and D. Davendra, editors. Differential Evolution: A Handbook for Global Permutation-Based Combinatorial Optimization, volume 175 of Studies in Computational Intelligence. Springer, 2009.

[15] M. Randall, A. Lewis, A. Galehdar, and D. Thiel. Using ant colony optimization to improve the efficiency of small meander line RFID antennas. In Proceedings of the 3rd IEEE International e-Science and Grid Computing Conference, 2007. .

[16] G. Pampara, A. P. Engelbrecht, and N. Franken, "Binary Differential evolution," in *Proc. IEEE Congr. Evol. Comput.*, Jul. 2006, pp. 1873–1879.

[17] K. Deb. Multi-Objective Optimization using Evolutionary Algorithms. Wiley, 2002

[18] Y. Watanabe, K. Watanabe, and H. Igarashi, "Optimization of meander line antenna considering coupling between nonlinear circuit and electromagnetic waves for UHF-band RFID," IEEE Trans. Magn., vol.47, no. 5, pp. 1506-1509, 2011.

[19] J.M. Johnson and Y. Rahmat-Samii, "Genetic algorithms in Engineering electromagnetic ," IEEE Antennas Propagate . Mag., vol. 39, pp. 7-25, Aug. 1997.

[20] Y. Rahmat-Samii, E. Michielssen, Electromagnetic Optimization by Genetic Algorithms. New York: John Wiley and Sons, Inc., 1999..

[21] D. Karaboga and B. Basturk, "Artificial bee colony (ABC) optimization algorithm for solving constrained optimizationproblems," in Foundations of Fuzzy Logic and Soft Computing, vol. 4529 of Lecture Notes in Computer Science, pp. 789–798,Springer, Berlin, Germany, 2007.

[22] R. Storn and K. Price. Differential evolution { a simple and efficient heuristic for global optimization over continuous spaces. J. Global Optimization., 11:341{359, 1997.

[23] D. Karaboga and B. Akay, "A comparative study of artificial Bee colony algorithm," Applied Mathematics and Computation, vol.214, no. 1, pp. 108–132, 2009.

[24] John A. Stankovic, "Wireless Sensor Networks", 2006