International Journal of Computer Science
and Engineering (IJCSE)
ISSN(P): 2278-9960; ISSN(E): 2278-9979
Vol. 6, Issue 4, Jun - Jul 2017; 31 - 38

International Academy of Science,
Engineering and Technology
Connecting Researchers; Nurturing Innovations

COMPREHENSIVE REVIEW OF SWARM INTELLIGENCE TECHNIQUES FOR LOCATION BASED NETWORKS

YELURI LAKSHMI PRASANNA[1] & E. MADHUSUDHANA REDDY[2]

[1]Research Scholar, Department of CSE, JNTUH, Hyderabad, Telangana, India

[2]Professor, Department of CSE, DRK College of Engineering & Technology, Hyderabad, Telangana, INDIA

ABSTRACT

The research on Location based networks is tremendously increasing now-a-days which focuses on the security and privacy issues. Also, the constraints or parameters affecting the performance of the network such as energy, bandwidth, and transmission time and so on, are also being considered. Still, there is a need for a lot of research that is to be carried out in this field, where many of the recent activities focus on the techniques of the Swarm Intelligence algorithms. Swarm Intelligence algorithms work on the principle of decentralized, self organizing behavior of swarm agents such as animals. This review paper focuses on these approaches, which are meta heuristic in nature that provides an improvement in the performance of the location based networks in relation to the behavior of the swarm agents.

KEYWORDS: Anonymity, LBS, Nature Inspired Algorithms, Privacy, Swarm Intelligence

INTRODUCTION

Nodes in the Location based Services are very tiny and small devices with the capability of self-organization among them. But, these nodes have a very limited energy, computation power, transmission range and memory. These nodes in the location based applications request the server in the form of queries. In order to establish the communication between the nodes and the Location based Server, there is a need or requirement of the trusted third party server. The trusted third party server is also known as location anonymizer, which is responsible for blurring the user locations in a number of cloaked areas that satisfy the privacy metrics specified at the time of issuing queries. The primary concern that is to be addressed here is if the communication channel between the anonymizer and the location based server is not secure, then there is a chance of leakage of information between the nodes which poses a serious threat. Also, there is a chance of any malicious node within the CR which results in the loss of information unintentionally or accidentally, termed as data leakage. Due to the constrained and limited resources of the node capabilities available in the location based networks, there is a chance of attacks related to the privacy and location information of the users. But all these means of providing security can be achieved only if the nodes are strong enough to deal and which is also difficult to achieve in the resource constrained environment. An important issue to be considered here is to identify or look for any malicious nodes within the cloaked region, which affects the performance of the network in terms of energy, bandwidth and so on.

Several research is being carried out successfully focusing on improving the performance of the Location Based Services and various privacy and security measuring techniques are also being developed. The work that is being carried out on the anonymity techniques proved to be useful for providing privacy to the user related to their location information. Also, there is a need to address the performance issue in these locations based networks where optimizing the utilization of resources in these networks can also be considered. Now-a-days, recent research in this regard is being carried out using

Swarm intelligence techniques. There are several swarm intelligence algorithms that are being designed to assess the optimization of these networks. The concept of Swarm Intelligence has evolved from the work employed on the artificial intelligence techniques. The approach or methodology used in the SI is suitable for location based networks. The decentralized and self organizing behavior of the agents in SI is similar to that of the nodes in the location based networks. Optimality is another important related aspect which deals with the behavior of the agents [4].

RELATED WORK

Criteria's and Challenges of LBS

LBS can be used in a variety of contexts, such as health, indoor object search, entertainment, work, personal life, etc. The basic criteria for the Location based Services are identified as

- Ability to personalize and customize the data by providing guidance to the user needs based on the location at any given time.
- Information provided should be real-time, up-to-date, correct, accurate, complete, and relevant to maintain reliability and consistency of the location based services.
- An enhancement towards security and personal safety of the users who are utilizing the services.
- Energy management, which results in cost efficiency of the service.
- There should be interoperability between the resources or services that are being shared.
- The quality of the location based services has to be maintained in various aspects such as content and context.

Several challenges that are to be considered are identified for these services [5] are

- To protect the identity of the user location information by using anonymity techniques.
- To provide security to the user data with the help of cryptographic measures.
- To improve the performance of the location based network by ensuring proper bandwidth.
- To safeguard the network as fault tolerant against the attacks.
- To provide reliability by employing proper recovery mechanisms in the case of any data leakage.
- To optimize the utilization of resources by choosing appropriate techniques.

With these criteria and challenges of the location based services, there are several solutions or applications that are developed. Many researchers have There are several optimization algorithms developed for distributed problem solving in these location based networks which are based on the techniques of the Swarm Intelligence. These algorithms are developed based on the intelligent behavior of swarms. Research on SI focuses on the reverse engineering adaptation of collective behaviors observed in the natural systems of the swarms with the aim of designing efficient algorithms for distributed optimization.

Swarm Intelligence

Swarm Intelligence (SI) is a collective behavior of decentralized, self-organizing system that emerges either from the natural or artificial agents. It consists of typically a population of simple agents interacting locally with one another and

their environment. SI paradigms depend upon the nature of computational problems which are more efficient than conventional problems. Evolutionary techniques in SI make use of these simple agents to evolve into robust solutions which are used in solving complex problems. The simple and individual agents involved in developing complex distributed problems interact with each other using simple rules where the interactions among the agents are either direct or indirect. Direct interactions happen with the help of the sounds made by the individual agents where the indirect interactions take place with the help of environmental changes. The indirect type of interaction is known as stigmergy, often comes from the physical or chemical laws [6].

Examples of SI techniques include natural systems such as ants, birds, bees, animal herding, fish, bees, etc. Nature has inspired many researchers in many ways and thus these techniques became a great source of inspiration. This inspiration gave rise to various problem solving techniques or methods such as Genetic Algorithms, Ant Colony Optimization, Particle Swarm Optimization, Artificial Bee Colony, BAT Algorithm, Firefly Algorithm, Ant Lion Optimizer, Grey Wolf Optimization and many more. These larger fractions of the nature inspired algorithms are bioinspired which are inspired by swarm intelligence. These algorithms mimic the foraging behavior of the agents which proves to be adaptive to environmental changes, robust, fully distributed and scalable [6]. These individual agents collectively discover and establish paths in the search of a source of food, which in turn can also be effectively used by a single or individual agent in the group. These are also can be termed as the metaheuristic algorithms focusing on the development of solutions using a fitness function that can be used as an optimization measure. Swarm Intelligence techniques can be classified as nature inspired and bio inspired algorithms. Bio inspired algorithms relies heavily on the behavior of biological objects, whereas the nature inspired algorithms are those that take inspiration from the nature. Thus, the SI can be treated as a subset of Bio-inspired techniques which may be treated as a subset of nature inspired algorithms. All the metaheuristic algorithms are not bio-inspired; they also often come physical and/or chemical laws. These algorithms are developed by mimicking certain physical and or chemical laws. On the other hand, if the focus and idea of perspective is on the trajectory of a search path, the algorithms are classified as trajectory based and population based. Simulated annealing is a good example of trajectory based algorithms. Particle Swarm Optimization is an example of population based techniques.

Some of the key concepts of the Swarm Intelligence techniques are [7]

- Adaptability
- Decentralized
- Simple and scalable
- Flexible
- Fault Tolerant
- Heterogeneous

Algorithms in Swarm Intelligence

Swarms are abundantly found in nature where animals form into swarms in search of food, to build nests, to hunt, etc. These algorithms make use of stochastic operators which make them distinct from deterministic approaches [3]. Stochastic optimization algorithms are also known as metaheuristic refer to the family of algorithms that involve stochastic

operators. Randomness is the main characteristic of stochastic algorithms. Here we discuss some of the popular metaheuristic techniques which can be used to solve the performance issues in the location based networks.

Particle Swarm Optimization

A SI approach which is a population based algorithm that applies the concept of social interactions for the solutions of hard and optimization problems [7]. This algorithm was developed by James Kennedy and Russell Eberhart. It maintains a swarm of particles known as particles. These particles flow through the multidimensional search space where the current position of the each particle is determined by the behavior of its own experience and that of the other particles [4]. Fundamentally, this approach focuses on the position of the particles and its velocity at a given time. The searching process depends on these two parameters locally as well as globally. The algorithm runs iteratively for obtaining the optimal solution [7]. Every particle moves with an initial velocity without including any collision by observing its neighboring particle's position and its best position [5] [7]. For each and every particles the best value is obtained after subsequent iterations by using an objective function where these functions are updated accordingly. Merging Particle Swarm Optimization, with other optimization techniques yield better.

Ant Colony Optimization

This metaheuristic approach was developed by Marico Dorigo in 1991 inspired by the collective behavior of ants. The basic principle involved simulates the behavior of ants to find the shortest path in search of food. Ant Colony optimization is inspired by the Ant System [1]. In Ant System there is no central dictation for any target and of the next goal to achieve. The communication between the agents of the ants happens in an indirect way with the help of stigmergy. Participation of the Swarm of ants in search of food sources and finding the shortest path makes this process as a multi-objective combinatorial optimization problem [5]. Ants as individuals are just simple and small, but they are smart enough and capable of responding immediately when working with colonies [2]. With the help of pheromone released by the individual ants, path selection of the ants is determined. By exploiting the density of the pheromone, optimization of the path is done. This behavior of the individual ants is used for modeling the probabilistic path selection in ACO by using artificial ants. These meta-heuristic approaches are suitable for the problems where optimized multi path selection is desired. ACO algorithms can be used to solve many real time complex problems in various domains [6].

Artificial Bee Colony

These are dynamic, intelligent and efficient swarms capable of dividing various tasks among the other bees. Various activities that are performed by bees are foraging, storing, retrieving and distributing honey, collecting pollen, communication, predator evasion and adapting themselves to environmental changes in a collective manner [1]. Bees are very organized in such a way that they are classified as employed and unemployed bees. Employed bees are the experienced bees where the unemployed are called as onlooker bees and scout bees. The experienced bees go in search of the food source randomly. Once it is found, they come to the hive and communicate to the onlooker bees through a waggle dance. This waggle dance determines the quality of the food source and also conveys information such as direction and distance of the food source from the hive [4]. Scout bees also look for a different source of targets and once found they also returns to the hive and perform a waggle dance. Thus the worker bees which are the forager bees decide the best path of the source and collect the food source from the appropriate location. Thus the higher the quality of the food source more will be the number of bees sent to the collection of the food source.

Ant Lion Optimizer

Antlions are a family of insects belongs to Myrmeleontidae. The family Myrmeleontidae is part of the order Neuroptera (net wings) [2]. The name Antlion best describes this insect's predacious larvae stage, which resembles a matte gray or brown creature as shown in the figure below.

Figure 1: Antlion Larva

Since it preys primarily on ants, the Antlion is best known as a lion among ants. The antlions dig a shallow cone-shaped pit and wait at the bottom for an ant to fall into the pit. These pit-digging antlions are called doodlebugs in the United States because of the designs they make in the sand.

Figure 2: Sand "Doodles" Created By an Antlion Larva

An interesting behavior is that the relevancy of the size of the trap depends upon the level of hunger and the shape of the moon. They tend to dig larger traps in these cases. The main inspiration for this algorithm comes from the foraging behavior of antlions larvae. ALO algorithm mimics the behavior of antlions and the ants in the trap. The interactions between the ants and the antlions can be modeled as follows: [3]

- Ants move towards the search space using different random walks which are affected by the traps of antlions.
- Antlions are allowed to hunt them by building the pits related to their fitness and become fitter using the traps (the higher the fitness, the larger the pit).
- Each ant is being caught by an antlion in each iteration and the elite (fittest antlion).
- The range of the random walk is decreased adaptively to simulate the sliding ant towards antlions.
- If an ant is caught and pulled under the sand by the antlion, then it becomes fitter that an antlion.
- Then the Antlion updates its position to the latest caught prey and build the pit to improve its change of catching another prey after each hunt.

Exploration and Exploitation of the search space are guaranteed by the randomness of the antlions and the movement of ants towards the pits. Effective areas of the search space can be saved as the antlions update their positions to the best which results in optimization. Hence this algorithm can be best suited across the location based networks where optimization is needed.

CONCLUSIONS

Techniques that focus on the behavior of nature inspired animals are being used to improve the performance of the location based networks. These nature inspired techniques are also known as meta heuristic approaches, which deals with the problems related to optimization. In recent years, a lot of study is being concentrated on these techniques. In this paper, the need for performance optimization of the location based services is identified and the techniques that are developed toward SI approaches are studied. The most well known meta heuristic approaches such as Particle Swarm, Ant Colony, Bee Colony and Antlion Optimization techniques are reviewed in relation to the location based networks.

REFERENCES

1. S. Sendra, L. Parra, Jaime. L, S. Khan, "Systems and Algorithms for Wireless sensor Networks based on Animal and Natural Behavior", International Journal of Distributed Sensor Networks, Vol. 2015, doi: 10.1155/2015/625972, pp. 1-19, 2015.
2. Waleed Yamany, Alla Tharawat, Mohmed Fawzy, T. Gaber, A. E. Hasaanien, "A New Multilayer Perceptrons trainer based on Ant Lion Optimization Algorithm", Research Gate.
3. S. Mirjalili, "The Ant Lion Optimizer", J. Advances in Software Engineering, Vol. 83, pp. 80-98, 2015.
4. Z Ali, Waseem Shahzad, " Analysis of Routing Protocols in ADHOC and Sensor Wireless Networks based on Swarm Intelligence", International Journal of Networks and Communcations, Vol.3 (1), doi: 10.5923/j. ijnc. 20130301.01, pp. 1-11, 2015.
5. S.Jabbar,Rabia Iram, Abid Ali M, Imran Shafi, Sh. Kalid, Mq. Ahmed, " Intelligent Optimization of Wireless sensor Networks through Bio-Inspired Computing: Survey and Future Directions", International Journal of Distributed Sensor Networks, Vol. 2013, doi: 10.1155/2013/421084, pp. 1-13, 2013.
6. S. Keerthi, Ashwini K and Vijaykumar M.V., "Survey paper on Swarm Intelligence", International Journal of Computer Applications, ISSN: 0975-8887, Vol. 115, Issue 5, pp. 8-12, April 2015.
7. Waqas Tariq Dar, "A Systematic Literature review on Swarm Intelligence", Research Gate Publications, DOI:10.13140/RG.2.1.1477.7443, pp. 1-10, July 2015.
8. M. Saleem et al., "Swarm Intelligent based routing protocol for wireless sensor networks: Survey and Future Directions", Information Sciences (2010), doi: 10.1016/j. ins. 2010.07.005,2010.
9. Rajeev Kumar, Dilip Kumar, "Hybrid Swarm Intelligence Energy Efficient Clustered routing Algorithm for Wireless Sensor Networks", Journal of Sensors, Vol. 2016, doi: 10.1155/2016/5836913, pp. 1-19, 2016.
10. H M Zawbaa et. al., "Computational Intelligence Modeling of the Macromolecules Release from PLGA Microspheres – Focus on Feature Selection", PLos ONE 11(6): e0157610. doi: 10.1371/journal.pone.0157610, pp. 1-17, July 2016.
11. M. Bhuvaneswari, S. Hariraman, B. Anantharaj, N. Balaji, "Nature Inspired Algorithms: A Review", International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE), ISSN: 0976-1353, Vol. 12, Issue 1, pp. 21-28, December 2014.

12. Iztok Fister Jr., Xin-She Yang, Iztok Fister, Janez Brest, Dusan Fister, " A Brief Review of Nature Inspired Algorithms for Optimization", Publications in cs.NE, arXiv, doi: 1307.4186v1, Vol.80 (3), pp. 1-7, April 2013.

13. Binitha S, S Siva Sathya, " A Survey of Bio Inspired Optimization Algorithms", International Journal of Soft Computing and Engineering (IJSCE), ISSN: 2231-2307, Vol. 2, Issue 2, May 2012.