A new way of routing, traffic-conscious and energy consumption on the Internet of Things

Mohammad NADERLOO, Mohammad Hossein SHAFIABADI

Department of Computer Engineering, Islamshahr Branch, Islamic Azad University, Tehran, Iran

Corresponding Author:

Mohammad Hossein SHAFIABADI

Shafiabadi@iiau.ac.ir

Abstract: The Internet of Things, or IoT, is a system of interconnected computer equipment, mechanical and digital machines, objects, animals, or individuals, identified by unique identities, and with the ability to transfer data over a network without the need for human-to-human or computer-to-human interaction. One of the most important technologies in this field is the use of sensors in the context of this type of network. A wireless sensor network includes sensor nodes located in geographical areas and their job is to monitor phenomena such as humidity, temperature, vibration and earthquake. These wireless sensor nodes are actually located at the edge of the IoT networks and the information is sent to the IoT network through these nodes.One of the challenges in the field of devices used in IoT is the energy consumption of the network edge device. It is very important to manage energy and reduce energy consumption in this area, because most of these devices are wireless, therefore, in this study, a solution based on ant algorithms has been proposed. In order to do the best clustering in this type of network, to reduce the energy consumption of devices at the edges of the network, the results of the proposed algorithm show the efficiency of the proposed method and the energy improvement in the ant algorithm is between fifteen and twenty percent less than the compared algorithm.

Keywords: Internet of Things, Sensor Networks, Ant algorithm, Routing, Energy Consumption.

1. Introduction

With the widespread advancement of technology and the growing popularity of digital tools and infrastructure, the communication needs of societies have undergone dramatic changes. These changes have affected the quality of life and employment processes and various aspects. Therefore, the technology required for the development of these applications requires structured communication. The Internet of Things is a new concept in the world of technology and communication. In short, "Internet of Things" is a state-of-the-art technology that allows any entity (human, animal, or object) to send data over communication networks, whether the Internet or the intranet. The Internet of Things is known as a potential scenario for influencing human life which can integrate modern technology with future life [1].

The Internet of Things is a global issue today and due to the increase in its defined applications, it has also produced a LoT of data. The data to be processed must first be transferred to target servers. This data transfer from the source to the destination must reach the destination correctly and without error and delay the loss of network time. This transforms the routing in this network [2].

The process of sending data in IoT technology is such that the subject is given a unique identifier and an Internet Protocol (IP) that sends the necessary data to the relevant database. Data will be visible to various devices such as: mobile phones and a variety of computers and tablets.

The process of sending data in IoT technology will not require "human-to-human" or "human-to-computer" interaction and the data is sent automatically and based on the settings, and is sent at specific times (usually permanently and instantly). The advance of the Internet of Things is one of the thousands of results of the spread of the Internet and, of course, the development of wireless technologies and micro-electromechanical systems. Due to the many capabilities available in "machine-to-machine" interactions in IoT technology, to date, this phenomenon has been widely

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used in industry, especially in manufacturing plants, energy and gas. Other smart products, products that have the ability to communicate "car with car", such as smart labels, smart meters also benefit from IoT technology.

However, the Internet of Things technology has been around since the early 1990s but the term "Internet of Things" was coined by Kevin Ashton in 1999. It is interesting to know that one of the developers of Internet of Things technology is an Iranian researcher named Reza Raji. Mr. Raji is a serial entrepreneur, consultant for well-known companies and an electronic engineering graduate and resides in the Gulf of San Francisco area of the United States.

IoT technology plays a very important role in the world of entrepreneurs. Numerous businesses have been set up on this technology while this concept and this technology are at the beginning of the path and every day more and more new changes and developments occur in it. Using this technology is a valuable opportunity for Iranian entrepreneurs and creative researchers which can help improve the business environment and job creation in the country. Nowadays, when it comes to the Internet, most people think of computers, tablets, or ultimately smartphones, but in the context of the Internet of Things, there will be a world in front of us where everything is intelligently connected and interconnected. In a word, we can say that with Internet of Things technology, the physical world around us will become a very large information system. In this world, physical objects will be connected to the Internet one after another and will be connected to other objects. When objects can present themselves digitally, the connection between objects will no longer be limited to us, and all the tools around us will automatically connect with each other and bring us a completely intelligent environment. In this study, most of our focus in the field of Internet of Things has been on the design feature of the communication layer, routing protocols, and its users, which are often discussed separately [6].

The Internet of Things in general refers to the many objects and devices in our environment that are connected to the Internet and they can be controlled and managed by apps on smart phones and tablets. The term Internet of Things was first used by Kevin Ashton in 1999 and he described a world in which everything, including inanimate objects, has a digital identity of its own and allows computers to organize and manage them.

Despite advances in this type of network, network nodes still rely on low-power batteries to supply their energy due to their large size, small size, and placement [3].

Also, it is usually not possible to recharge or replace network nodes due to the use of such networks in harsh and inaccessible environments. Therefore, one of the most important issues in Internet of Things networks is the issue of severe energy constraints [4, 5].

Restrictions and Challenges of the IoT network, as the most important subset of the Internet of Things, distinguish it from other distributed structures. These limitations also have implications in network design, including various protocols and algorithms from other IoT categories. Therefore, some of the most important routing limitations of these networks include, briefly, the following: energy efficiency, data flow management, scalability, mobility, two-way linking and the rate of use of the radio transmitter. The number of restrictions mentioned is much higher than these but basically [8]. The use of such networks can be done “well” when we have the correct knowledge of the application of these nodes and understand the problem well. The battery life used in these nodes, as well as the amount of updating the nodes and their size, are among the main design considerations in this field.

Equipping the Internet of Things with wireless nodes reduces a lot of data transfer costs, network layout becomes more regular, resulting in increased parallel processing and flexibility in these networks. As mentioned, the dual direction of the smart network is one of the important features of this network, customers will report the amount of energy they produce and the amount of energy they consume to the network. This relationship can be defined within a country. In wireless networks where information is exchanged bilaterally, they also have the ability to monitor, repair and maintain in real time. An Internet of Things network can contain several hundred to thousands of network nodes, each node being able to record and transmit physical or environmental changes. Therefore, it is used in various types of projects, including wind or solar power plants.

The Internet of Things is a type of technology that is currently used in three main areas: production, distribution, and power consumption in smart electrical networks [9].

As mentioned, two of the challenges of IoT networks is data flow management and traffic flow control. Information management and categorization are becoming more and more important. Nowadays, the amount of information transmitted in these networks has increased and the income is irregular. This reduces overall performance and network life. In fact, network load control in an unstructured flow of data transmission is one of the most important aspects that affect the quality of network service as well as the average lifespan of a node; As a result, it is important to provide methods for optimizing network performance and increasing the average lifespan of networks with high data transfer rates.

One of the key challenges in IoT networks is the efficient use of limited energy resources in the network node battery. Because nodes are used in inaccessible environments, it is difficult to replace or charge the power supply in these networks.

One of the best techniques to increase network life is to use hierarchical routing. In this type of routing, nodes are placed in separate groups called clusters. Member nodes send their data to the source, upon receipt and aggregation of the data, the headers are sent to the base station, called a well, as a one-step or multi-step process. Clustering nodes can be considered an effective factor in reducing energy consumption and subsequently increasing network life as well as increasing expandability.

In clustering methods, the most important thing is to choose a cluster head. Selecting a hedge allows network nodes to communicate with the central station to transfer their data to the nearest hexagon instead of making a direct connection that requires higher energy consumption and transfer data to the central station through multi-step communications between different headers on the network. Therefore, the energy consumed by the node is saved and the life of the network is increased. The main drawback of clustering is that there is no control over the distribution of cluster heads on the network. In addition to the problem of producing unbalanced clusters, almost all routing protocols are designed for a specific application domain and in most clustering methods, only the criterion of the amount of red energy or the distance of the members to the cluster is considered. Therefore, in this study, an energy-based adaptive routing algorithm and network traffic using meta-algorithmic algorithms are presented to solve the challenge [7]. The proposed method selects the best path and transfers the data packets from the source to the sink using the average energy consumption criteria, the rate of receiving the packets.

Due to the comprehensiveness of the Internet of Things, many network protocols may not be able to meet routing needs. Therefore, in this study, an algorithm is presented that is based on quality and energy consumption and is one of the classic methods in routing. The classic methods of mobility, link failure, noises, which are among the challenges in routing, are examined.

2. Background

Shokouhifar et al. [10] proposed a clustering method to achieve a reduction in the energy consumption of nodes due to the energy limit of the nodes and the difficulty of replacing them with batteries. In this paper, a fuzzy routing protocol based on information-based intelligence (called SIF) is proposed in other to overcome these problems. In SIF, the c-means fuzzy clustering algorithm is used to cluster all nodes sensitive to balanced clusters, and then the appropriate headers are selected through the Mamdi fuzzy inference system. This strategy not only guarantees the production of balanced clusters in the network, but also has the ability to determine the exact number of clusters.

Sankaran et al. [11] proposed a routing protocol due to bandwidth limitations and energy consumption in the IoT network. The proposed method uses a FLOODING routing protocol using the Markov chain. The proposed method, using the Markov chain, examines the possibility of receiving and sending data, predicts energy consumption, and then performs the transfer operation.

Vijeth et al. [12] proposed a method for consuming large amounts of energy and using Internet of Things objects. The proposed protocol is provided using SSGW technology, the simulation results show that; the average energy consumption, the average network penetration and the average closed delay compared to normal routing have decreased.

This method provides a routing protocol for reducing energy consumption in IoT networks. The proposed protocol is called EECBR, which transmits information to the network using a virtual topology. The simulation results show that; Energy consumption has decreased in the proposed method [13].

Allaoua et al. [14] presented a clustering-based routing protocol in the wireless network to control energy consumption. In the proposed method, due to the limited energy of the battery in the nodes, the power supply is faced with challenges such as reducing the overall life of the network. In this paper, the focus is mainly on clustering as a hierarchy based on the LEACH protocol. The proposed method reduces energy consumption.

Han et al. [15] provided an algorithm that focused on the network router due to issues related to wireless network design, lack of energy resources, and overload. This article mentions that; Data flow on a wireless Internet network is unbalanced and network data management issues have become a challenging issue.

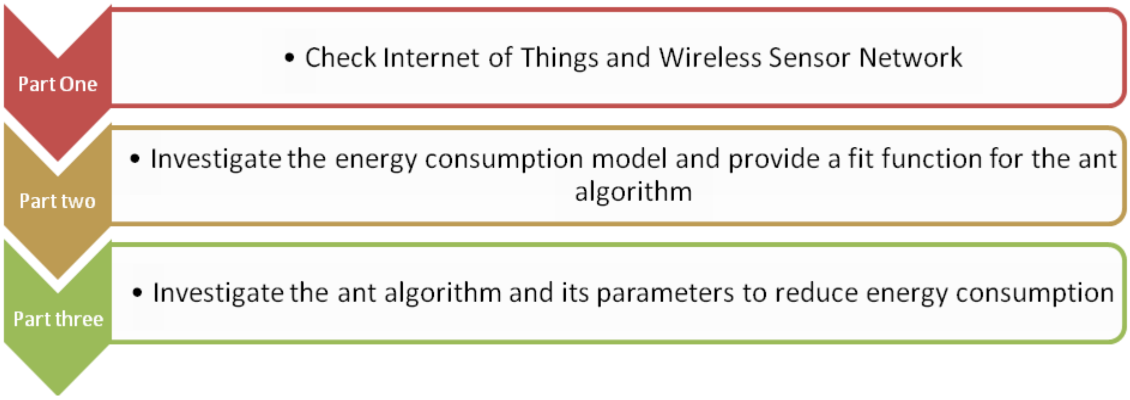
Wei et al. [16] proposed a distance-based whitehead selection algorithm. In this method, they proposed a distributed clustering algorithm called effective energy clustering (EC). Depending on the hop distance to the data destination, it determines the appropriate cluster sizes, while achieving approximate equality over the life of nodes and reduced energy consumption levels. In addition, a data collection protocol suggests a few simple jumps with simple effective energy in order to evaluate the effect of EC and calculate end-to-end consumption of this protocol; EC is still appropriate for any data collection protocol that focuses on energy conservation.

Alexs et al. [17] proposed a way to control the flow of network information with a static coordinator within the Internet of Things in the smart home environment which discusses network data flow management that can respond to a data flow programming task while balancing the energy of the node in the network is also considered.

Kaur et al. [18] proposed an algorithm due to the energy constraints of nodes in IoT networks: a cluster-based hybrid protocol using ant colony algorithms and particle optimization. The proposed method divides the network environment into sections and identifies the cluster head for each section with the combined ACOPSO algorithm. The proposed protocol significantly increases the lifespan of the network more than other techniques.

3. Material and Methods

In this section, the research steps are shown as follows. Based on these sections, the proposed algorithm can be implemented, the wireless sensor networks and their application in IoT will be examined first, the energy model used in these networks will then be examined, and finally, the ant algorithm will be examined for this purpose.



3.1. Internet of Things and Wireless Sensor Networks

In the Internet of Things idea, various devices have the ability to communicate wireless to track and control the Internet, or even a simple smartphone app that describes the term Internet of Things. Items in this category can range from light bulbs to home appliances (such as tea makers, dishwashers) or even cars. The Internet of Things is used in the medical, healthcare, and even public transportation systems. In other words, the Internet of Things refers to a network in which each physical object is identified by a single sensor and forms a network with other objects. These objects can communicate with each other independently and exchange information. The Internet of Things is made up of a combination of three components: sensors, actuators, and communication devices. On the Internet of Things, wireless sensor networks play an important role in sensing and collecting information due to the presence of sensors. Due to the increasing need for dynamism, the use of equipment such as mobile phones, laptops and devices such as wireless sensor networks is required. Also, if applications need to have data and information available on the move at all times, wireless sensor networks are a good answer for them. Therefore, energy-conscious routing can be very helpful because energy-conscious routing can also be effective in improving network traffic.

3.2. Clustering on wireless sensor networks based on IoT

Clustering involves grouping nodes into clusters and selecting a cluster.

- Members of a cluster can communicate with their cluster head directly or in multiple steps.
- The cluster head can send the collected data forward through other cluster heads or directly to the sink node.

In the high-level method, clustering algorithms have three main steps: Cluster formation stage, construction stage (selection of cluster heads) and maintenance stage (management of resources within the cluster, adaptation to external disturbances and then breaking or rotation). Also, the time interval for the manufacturing stage is much shorter than the maintenance stage. Figure 1 shows a simple model of clustering in a wireless sensor network In fact, the nodes of the sensor network are considered as the edges of the IoT network.

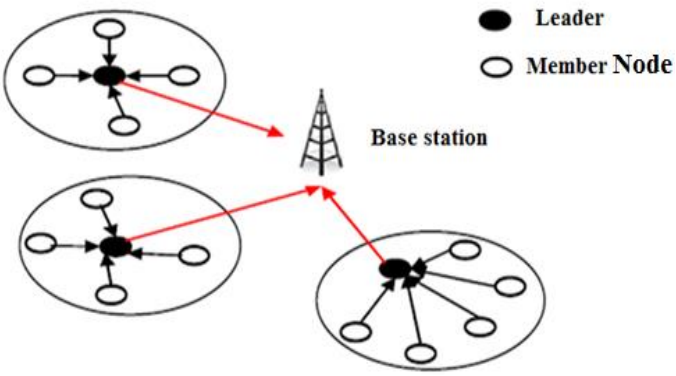


Figure 1. Simple model of clustering in wireless sensor network

3.3. Wireless sensor network modelling

Recent advances in wireless communications and embedded systems have led to the development of wireless sensor networks and the use of wireless sensors in most electronic devices has made it possible. A wireless sensor network consists of a large number of sensors that have computational power, and are connected to radio frequencies (RF) and they are used in tasks such as: identifying and collecting information, and controlling the situation. Wireless sensor networks are used in fields such as: military, health, Environment, industry, agriculture, entertainment etc.; they have attracted the attention of many researchers and created a small revolution in the evolution of information.

The architecture of sensor networks is such that the sensors are randomly (or uniformly) scattered over an area and they identify, control, and process events, and then report to a station called sink.

Some WSN protocols use clustering to meet the needs of sensor networks. In this way, the sensors are divided into areas where each area has a cluster head and after an event, the sensors in each area send their information to the cluster and the head of the cluster informs the sink directly of this information.

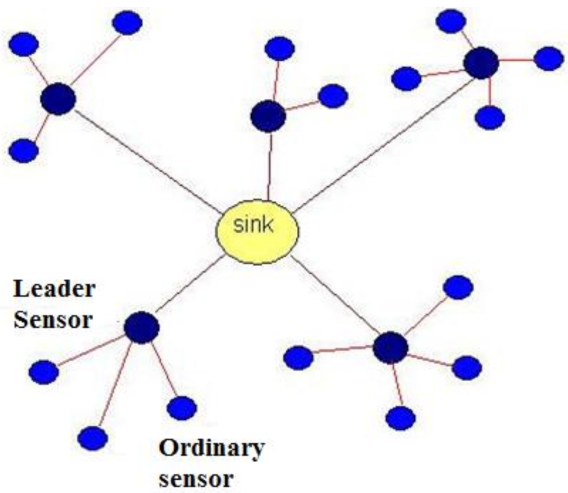


Figure 2. Clustering in wireless sensor networks

An important feature of wireless sensor networks is that they are self-organizing in the environment and with a short range and multi-step routing, they communicate with each other. Also, these networks have variable topology due to failure, energy limitations, and memory and communication power.

Consider a wireless sensor network with fixed nodes. Each sensor can transmit data with nodes in its radio board. The power of the sensors varies and the maximum radio range of the sensor nodes is the same. The energy consumption pattern is calculated according to Equation 3-1 and 3-2, and in fact this relation is a function of the fusion algorithm of the ant combination.

$$E_r = E_{elec} \times l + E_{amp} \times l \times d^2 \quad (1\text{-}3)$$

$$E_R = E_{elec} \times l \quad (2\text{-}3)$$

In this case, E_r is the energy consumed by the data sending node. E_{elec} is the energy required to send or receive a bit of information that does not depend on the distance. E_{amp} is the energy required to amplify the signal sent over the desired distance. l is the length of the message. d is the distance to the node receiving the information. E_R is the energy consumed for the node receiving the information.

The purpose of this study is to classify sensors in a way that leads to an increase in the most important parameter in this type of network, namely the lifespan of the network. For this purpose, the wireless sensor network is considered as a graph and a unique number for each node. The ants' algorithms will be described below.

Figure 3. The relationship between two nodes

3.4. Ant algorithm

In nature, each ant secretes a substance called pheromone on the ground on its way back and forth to the food source. If an ant encounters a trace of a pheromone in its path, it will taste it. The higher the pheromone concentration in a path, the more likely it is that the ant will choose that path and the pheromones in the pathways evaporate over time, reducing their concentration. In this way, the routes that are less travelled will have less Pheromone and the chances of their selection by ants will be reduced. Over time, this behavior reduces the amount of pheromone in the shortest path between the food source and the nest and weakens it in other ways and ants move from the shortest possible route on the way to the nest and vice versa. The following are the basic steps of the ACO algorithm:

Step 1: *Set parameter*

Step 2: *Initialize phermon trails*

Step 3: *While termination condition not met do*

Step 4: *Construct ANT Solution*

Step 5: *Evaluation Solution*

Step 6: *Update Phermon*

Step 7: *End while*

Figure 4. Algorithm steps

Based on the figure, 3-3 in this algorithm, after the initial value is given to the parameters that are done randomly, three operations are performed for each repetition of the loop. First, a solution is created for each ant, the solutions found are then evaluated and at the end, according to the quality of the solution found by each ant, the amount of pheromone is updated for the components of that solution.

3.5. The proposed method based on the ant algorithm

The performance of the proposed algorithm is given in the form of Flowchart Figure 3-4. According to this flowchart, the necessary parameters are first defined and quantified, including the number of ants, the pheromone vector and the hydraulic vector. In each network call, the number of ants is equal to the number of live sensors. There are 2 conditions for terminating the algorithm.

The algorithm will continue to work as long as none of the above conditions are met. In this case, the work begins with calling a function called Head selection. The function of this function is to select a number of sensors as cluster heads and form a solution for each ant. The pheromone and the value of the fit function are guided by this choice, based on the relationship of 3-1 and 3-2 in the dominant heuristic vector. The length of both vectors is defined as the total number of sensors provided for the network. The pheromone vector is updated during each step. Heuristic vector is also updated at each step based on the relationships mentioned.

Solutions for each ant will include the number of sensors as the head of the cluster. At this time, the members of each cluster are performed with another function called Member selection. In fact, it can be said: Each of the remaining sensors must select one of the cluster heads as its head. This selection is based on two criteria that can be defined as follows:

1. The maximum number of authorized members for each source is calculated based on the following relationship:

(Maximum number of members head cluster = number of live sensors / number of clusters) (3-3)

In which, / represents the division. Innovative numbers have been added because the number of sensors close to one end of the cluster may be greater than the average number of members allowed for each cluster head in a recent relationship. Membership of these additional sensors at the head of the said cluster can consume less energy and increase the life of the network than membership in clusters that are relatively far away from that sensor.

2. Sensor distance to each cluster head: in order to select the cluster head for each sensor, first the distance of the desired sensor to the whole cluster head of current solutions is calculated and stored in the appropriate length. The vector will then be arranged in ascending order, according to which the current sensor will be covered by the head of the cluster at its first location. If the number of previous members covered by the selected cluster head is equal to the maximum value (based on Equation 3-3), the head of the cluster located next to the sorted vector will be selected. This may be repeated several times to select the appropriate cluster head.

Then the quality of the configuration found should be examined and accordingly, the pheromone vector Should be updated while the next step is to implement the ant colony algorithm. The quality of each configuration is calculated on the basis of 3-2 and 3-1. To update the pheromone vector, the sum of the values obtained in these two relations is added to the previous value of the pheromone vector. It should be noted that the ant colony algorithm will use a method based on two proposed vectors to achieve optimal solution. The effect coefficient of these two vectors can be obtained by assigning two values of α and β for these two vectors with the relation β=1-α. In the proposed algorithm, they are considered. If the number of sensors that can be selected is equal, then first the P_1 criterion as a collective criterion for this number of sensors is obtained as follows:

$$P_1 = \sum_{i=1}^{k} \left(phermon(i)^{\alpha} + \frac{1}{hurstic(i)^{\beta}} \right) \tag{3-4}$$

To select one of these sensors, a random number is first generated in the range [0.1]. The value of P_2 for the sensor with the same number as in Equation 3-4 will be obtained as follows:

$$P_2 = phermon(m)^{\alpha} + \frac{1}{hurstic(m)^{\beta}} \tag{3-5}$$

The ratio of P_2 to P_1 determines the probability of sensor selection. This number is compared to a random number in the range of zero and one and if it is larger than that, this sensor is selected as the next sensor. Otherwise, this sensor will be released and another sensor will be lucky at this stage. Heuristic vector values are obtained on the basis of relationships 3-1 and 3-2, and the higher they are, the lower the quality. Using a factor of 1 in relational forms covers 3-4 and 3-5.

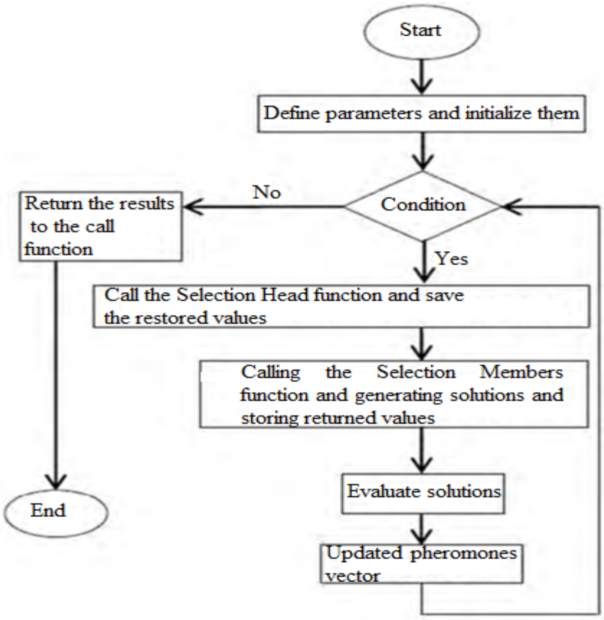


Figure 5. Proposed ant algorithm steps

4. Results

4.1. Network assumptions

The network assumptions are as follows:

1. The sensor nodes are randomly located.
2. All sensor nodes and base stations are fixed after the deployment step.
3. The nodes are able to adjust the transmission power according to the distance from the receiver node.
4. All sensor nodes have the same energy at the beginning of the deployment.

MATLAB is a high-level language with an attractive environment, which was originally developed based on the C programming language. MATLAB is a software environment for performing numerical calculations and a fourth generation programming language. The word MATLAB means both the digital computing environment and the language of the program itself, which is a combination of the two terms matrix and laboratory. The name refers to the program-based matrix approach, in which even individual numbers are considered matrices

It is very easy to work with matrices in MATLAB. In fact, all data in MATLAB is stored as a matrix. In addition to the many functions that MATLAB itself has, the programmer can also define new functions. Creating a user graphical interface, such as dialogues in visual environments such as Basic and C, is possible in MATLAB. This feature provides a better connection between applications written with MATLAB and users. In this research, the MATLAB 2017 b version has been used for programming. In this research, a computer with the following specifications has been used to perform the experiments.

Table1. Computer specifications used

Specifications	Part Name
Intel ci7,12 core, 15 meg cach	Cpu
16 Giga Byte DDR4	Ram
1 terabyte	HARD

4.2. Evaluate the proposed method

To evaluate the proposed method, the results were first tested using the proposed algorithm and then using the bee algorithm [1] and based on the tests performed, the results have been compared in the charts of 4-1, 4-2, 4-3 and 4-4. The bee algorithm is part of the new transcendental algorithm. The data used in this study are based on the data in the article [1] in which nodes are placed in random places and the number of nodes is considered to be two hundred.

The parameters used in the bee algorithm are as follows:

- Pop_size: The initial population is 100 bees;
- Generation: The number of repetitions is considered to be 100, 200, 500 and 1000;
- Count cluster: The number of clusters is considered to be 10;
- Nod count: considered as 200;
- These parameters play a decisive role in the result of this algorithm.

To test the proposed solution, the ant algorithm parameters are defined as follows:

- nAnt: The number of ants is equal to 50;
- MAXIT: Maximum number of repetitions of the algorithm;
- Rho: Evaporation coefficient equal to 0.1;
- Q: The update factor is 1;
- Count cluster: The number of clusters is considered to be 10;
- Nod count: considered as 200.

$$E_r = E_{elec} \times l + E_{amp} \times l \times d^2 \quad (4\text{-}1)$$

$$E_R = E_{elec} \times l \quad (4\text{-}2)$$

$$\text{cost} = E_R + E_r \quad (4\text{-}3)$$

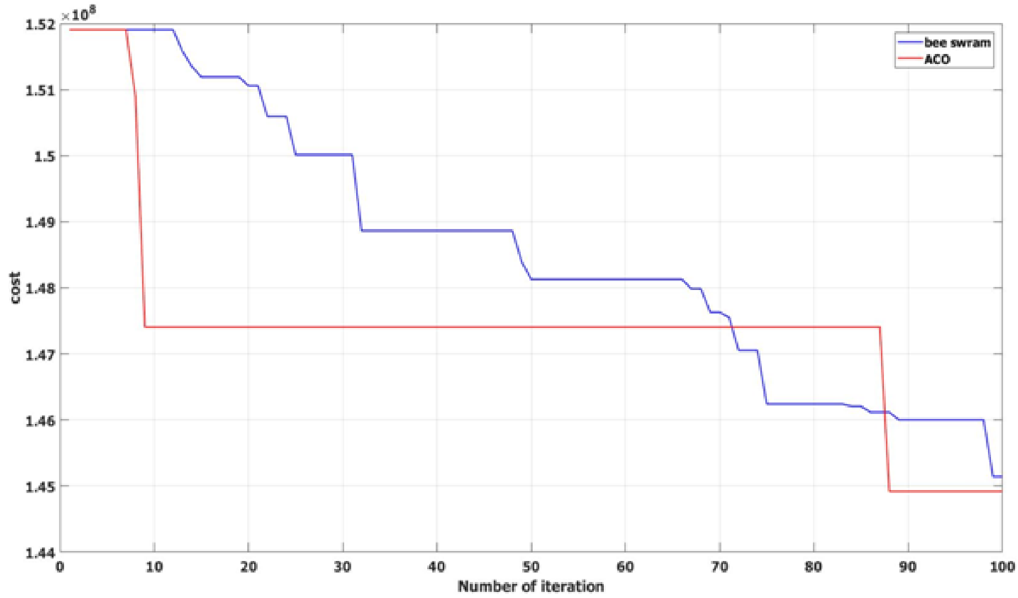


Figure 6. 100 repetitions

Given the above diagram, it can be clearly seen that it was done in 100 repetitions. The best result is finally obtained by the combined algorithm. In this way, the downward trend of the proposed algorithm from the 8th generation onwards has begun and finally, these results are shown in the best possible way. In this diagram, we can clearly see the declining trend of the ant algorithm and compared to the bee algorithm, it has a better downward trend.

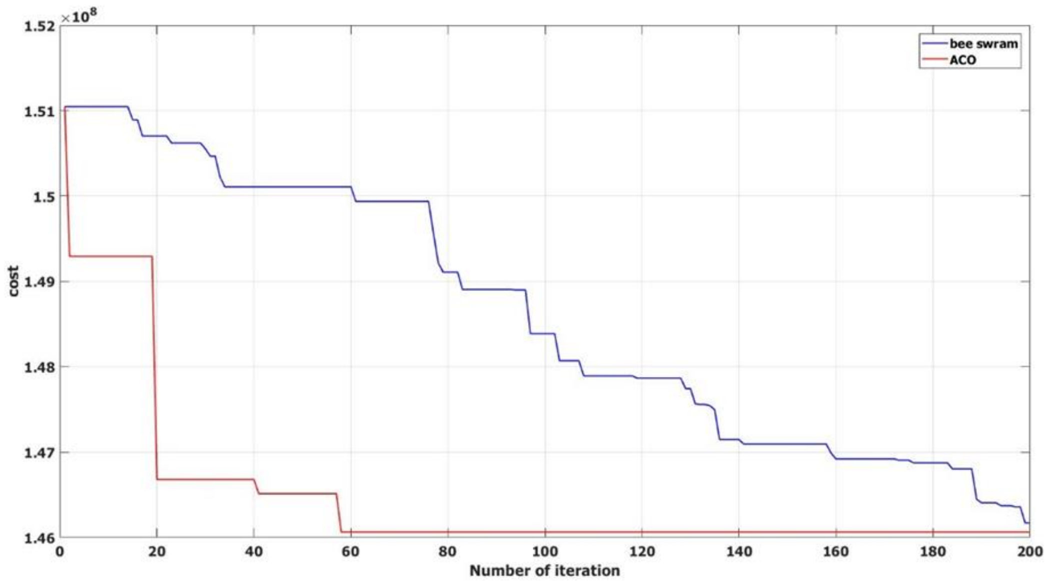


Figure 7. 200 repetitions

In this diagram, like the number of repetitions, 100 combined algorithms have better performance and although the bee algorithm has a good downward trend but in the end, it failed to achieve the best amount of fit. In this number of repetitions, the ant algorithm was able to achieve the best possible result in repeating fifty-eight and the original bee algorithm has been declining in various repetitions, and the good performance of this algorithm can be clearly seen.

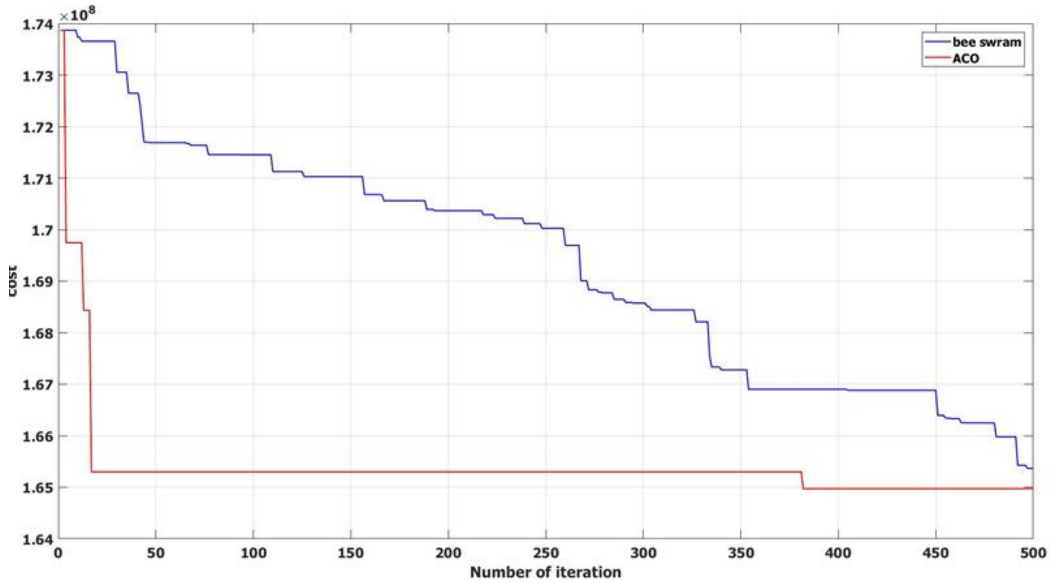


Figure 8. 500 repetitions

In this number of repetitions, it can be clearly seen that the proposed algorithm diagram has achieved a better result. In this number, repeating the ant algorithm has been able to achieve the best result in repeating three hundred and eighty. The important thing about this chart is that the ant algorithm, with a few big jumps, has moved quickly to the absolute optimal and has been able to achieve the best results with high speed.

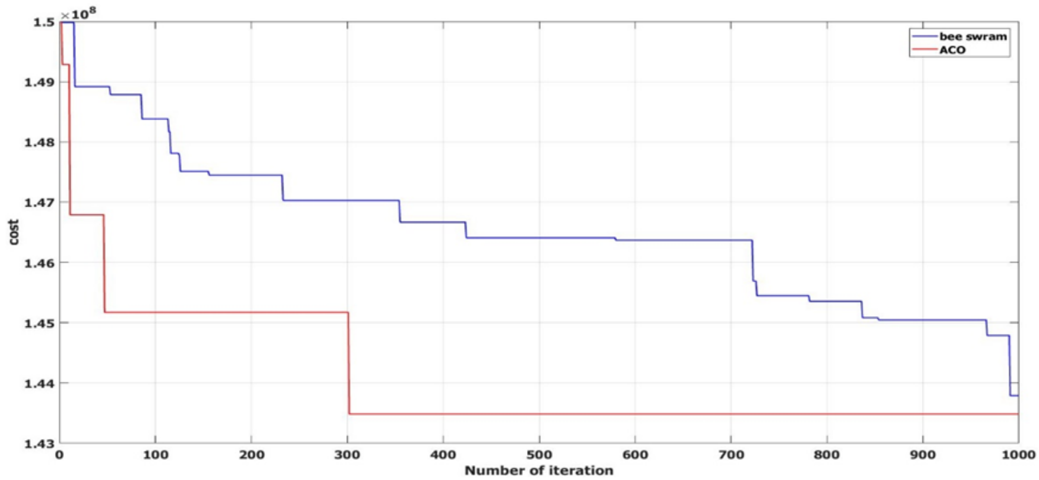


Figure 9. 1000 repetitions

In this number of repetitions, it can be clearly seen that the proposed algorithm diagram, like other algorithms, has achieved the desired result with an acceptable non-negotiable path. Although this is the highest number of repetitions in these tests but again, the hybrid algorithm has shown better results.

According to the tests performed, several points can be mentioned:

1. The ant algorithm uses a more efficient search space.
2. The ant algorithm works much better on routing issues than any other algorithm that has performed well in tests.
3. The ant algorithm has more flexibility than the bee algorithm by using more parameters.

5. Conclusion

Devices in the IoT platform have many limitations, including energy and traffic. One of the most commonly used types of devices in this platform is wireless sensors. Each sensor network consists of a set of small nodes, each of them having a wireless sensor In addition; each sensor network has a central base station that collects environmental information. The sensor network interacts with the physical environment. Each node has the ability to understand physical environment information including temperature, humidity, pressure, smoke, and so on and finally transmit the data to the central base station. The sensor nodes are wireless and the nodes communicate with each other and the base station via radio frequency. Wireless sensors are physically very small and have limitations in processing power, memory capacity, power supply, and more. These limitations have created challenges that are the source of many research topics in this field.

In this study, an ant algorithm was used to cluster wireless sensors. For this, the mathematical model and the relations of the laws of wave physics were first discussed, then, the method of calculating the fit function was examined, then, the ant algorithm was investigated to reduce energy and network traffic, of course, the emphasis of this research is more on energy reduction, because a decrease in energy consumption indicates a decrease in traffic load on the network, in this way, based on the steps of the ant algorithm, the initial ants were initially randomly created for each person, based on clusters and nodes and then each ant moves according to its parameters such as the amount of pheromone and the amount of evaporation to the better food source, which is the value of the fit function. Based on the experiments, the ant algorithm achieved clustering with the best coverage and the least energy, which is an indication of the superiority of the proposed algorithm.

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Mohammad NADERLOO is Master of Software Engineering, Department of Computer Engineering, Faculty of Islamshahr, Islamic Azad University of Islamshahr, Iran. His general research interests are: computer networking routing, grid computing and cloud computing, peer-to-peer systems, data aggregation, and information Network routing and classification techniques. A new way to detect traffic on the Internet of Things.

Mohammad Hossein SHAFIABADI received his B.S. in computer engineering from Shahid Beheshti University, Tehran, in 2002, the M.S. in computer engineering from Amir Kabir University of technology, Tehran, in 2004 and received PhD degree in computer engineering from IAU University, Tehran. He is Faculty Member in the Department of Computer Engineering at the IAU University. He is the author/co-author of more than 50 publications in technical journals and conferences. He served on the program committees of several national and international conferences. He is research interests are in the areas of computer hardware design, Digital Circuit Design, Asynchronous or synchronous Design, Globally Asynchronous Locally Synchronous (GALS), many core or Multicore, Power Optimization, Energy Reduction, GPU, Nano Electronic, Networking, Cloud Computing, Internet of thing.