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RESEARCH ARTICLE

ARTIFICIAL INTELLIGENCE ROUTING ALGORITHMS IN INTER-VEHICLE MOBILE NETWORKS

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ABSTRACT

Considering the development of communication technology and the dependence of today's society on it, its use in transportation is important. The increase in many problems in urban traffic management, driving and guidance of cars on suburban roads and the heavy financial and human costs caused by these problems have become a big challenge. At the same time, the development of communication and information technology as an advantage clearly shows the need to use intelligent vehicle communication technology in the field of transportation. VANET is one of these technologies proposed in the vehicle transportation network. One of the problems of inter-vehicle networks is routing or packet transfer speed, which routing is done using mobile network. This network is a protocol based on the TORA protocol that performs routing whenever needed. In fact, it is a demand-based protocol, which means that the source node performs a routing before sending the packet, and a route is not created until the route is needed. This protocol is proposed for very dynamic mobile networks, which we have integrated with genetic algorithm to improve packet sending delay. After the initial routing by the TORA protocol, a population of existing routes is created, which we call the initial population in the genetic algorithm. By using the function of fitness, the main path for the transmission of packets is determined from among the created paths. The position of the cars is determined, and then the relationship between the positions is determined, and in the following section, it is determined that the genetic algorithm has shown its efficiency and increases the speed of data transmission in routing. In this context, the radio position is important, it is determined by the necessary forecasts. There is an error in the setting of the radio system because there is also a disconnection. In general, this system can be implemented with a small error percentage.

INTRODUCTION

Today, there are cars that are equipped with wireless receivers and transmitters that can receive and send information. In the future, more cars will have access to these facilities, using which they can communicate with other cars. With the increase in the number of cars, driving is associated with more risks and difficulties. These problems have caused car manufacturers and governments to think of a solution that provides more security and comfort for drivers and passengers. The solution that has been extensively worked on in recent years is the use of inter-vehicle networks. Inter-vehicle networks are a type of Ad Hoc networks in which cars form network nodes. Ad Hoc networks are instant or temporary networks that are created for a specific purpose. In fact, they are wireless networks whose nodes are mobile. In these networks, each network provider and client node can send information packets. The service of Ad-hoc networks can be done by route nodes that have been previously specified by one of the routing algorithms. The noteworthy point is that each node is connected only with nodes that are within its radio radius, which are called neighboring nodes.

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Inter-vehicle networks do not have a central core to control the sending and receiving of data And the transport of information packets is carried out personally by the nodes of a specific and dedicated route. The topology of inter-vehicle networks is variable because network nodes can be mobile and change their place at any moment of time.

Types of vehicle networks based on infrastructure

Inter-vehicle mobile networks: 3G, 4G and GSM technologies are used in mobile networks and mainly mobile phone operators and mobile broadband service providers shown in Figure 1 are the main players in this field. As shown in the figure, there are a series of fixed central stations on the side of the road that can be connected to the Internet and intra-city networks. Cars can connect to these stations through mobile devices and receive traffic or weather information. They can also connect to the Internet and access the workplace or home network through cloud services. The advantage of these networks is the use of ready mobile and broadband infrastructures provided by mobile operators. The big disadvantage of mobile networks is the impossibility of using them for car safety applications due to the inherent delays of these types of networks But such networks are very suitable for

common uses such as using the Internet and entertainment [19-20].

Dedicated car networks: In dedicated networks, a third company can communicate between cars and the outside world by installing fixed equipment on the side of roads or at intersections and creating a series of server stations and installing interfaces in cars. The VICS system in Japan is an example of this type of network that collects traffic information from different vehicles and directs it to a central system ntelligent central system; After analyzing the received information about the traffic situation of different roads and streets, he extracted the information needed by other drivers and sends it again to roadside workstations so that cars can receive this information and make decisions for their next routes [16-26].

Specific inter-vehicle networks: The inter-vehicle network uses radio waves to create a variety of vehicle-to-vehicle V2V1 and vehicle-to- infrastructure communication V2I2 .Cars communicate with each other completely autonomously and create an unstructured wireless network [4].PANET is a mobile network model developed to communicate between vehicles adjacent to the inter vehicle communication IVC3 as well as vehicles with fixed equipment adjacent to the RVC4, which are usually roadside equipment. Traffic warnings, road signs and traffic monitoring that can be transmitted through such networks momentarily. It gives the driver the necessary tools to decide on the best route. Also, multimedia communications and internet are provided in the wireless range of each vehicle. In VANET or Smart Vanet actually represents an intelligent method of using the network between cars In VANET integrates several adhoc networking technologies including IEEE 802.11WiMAX, WiFi802.16, IRA, Bluetooth and Zig Bee. In order To provide easy, simple, accurate and effective communication between cars in a wireless platform. This type of network also uses other existing communication technologies such as DSRC, which is actually a type of WiFi for satellite and mobile communications.

VANET can be seen as part of the intelligent transportation system. Basically, this technology is described in two levels, large and small [4-27].The main difference between VANET networks and mobile and private networks is that no station or node is responsible for network management and control. And the network consists of a series of cars. Here, suppose the network nodes are mobile and do not have a fixed place And none of them play the role of router or access point. The truth is that VANET networks are a special type of MANETS** networks, the nodes of which will be cars. MANET is a collection of mobile or mobile nodes equipped with receiver and transmitter in order to establish wireless communication. The infrastructures in the inter-vehicle networks of the car can identify the cars around it at any moment and form a network by connecting to them and establish the necessary communications. This car will create another network a little later with the new cars around it. The main basis of VANET networks is their unstructured nature and the use of P802.11 and DSRC standards. Therefore, these types of networks can quickly change data topology and create great flexibility. For example, a car can be connected to several VANET networks at the same time and receive the necessary information. The geographical boundaries of VANET network can be circles with a maximum radius of several kilometers and each car can, for example, communicate with the cars in front at a distance of two or three kilometres Decision, high speed driver and continuous movement of cars have created unique characteristics in these networks Therefore, routing for data dissemination in these networks is a fundamental issue. However, this network also has differences with the MANET network.

Protocols: The highly dynamic feature of VANET creates challenges in the process of designing efficient routing protocols Several temporary routing protocols have been proposed in recent years. These protocols make it possible to exchange data between two separate nodes using intermediate network participants to send packets to the destination. In VANET, routing protocols are classified into five categories Routing protocol based on topology, routing protocol based on location, cluster routing protocol, Geocast routing protocol, broadcast routing protocol, these protocols are specified based on the field and application where they are most suitable [8-25].

Foundation topology routing protocols: Foundation topology routing protocols rely on network topology Most of the foundation topology protocols try to use the least computing time to send a packet in the network and create a balance between possible paths These routing protocols use communication line information And that information is stored in the table before sending the data from the source node to the destination node.

Proactive routing protocol: Proactive protocol is also known as the routing table routing protocol These protocols use periodically exchanged topology knowledge for data communication between all network nodes. For this purpose, these protocols use a huge amount of bandwidth to maintain information about periodic to pologyupdates, but do not delay in discovering the initial path [5-24].

DSDV: It is a routing table routing protocol for ad hoc mobile networks based on Bellman-Ford algorithm. In this protocol, the path is maintained through the exchanges of the routing table of the events and the periodic table. Each node maintains a next route table and neigh boring nodes exchange it in the network for updated information. This protocol eliminates path looping and increases integration speed And to reduce the current costs of the control message, it uses the down time Because each network node needs to maintain a complete list of routes that incur higher network current costs, it works a little better in the mobility environment [7-23].

Genetic algorithm: Genetic algorithm, abbreviated as GA, is a search technique in computer science for finding approximate solutions to optimization and search problems. Genetic Algorithm is a special type of evolutionary algorithm that uses advanced biological techniques such as inheritance and mutation. In fact, the genetic algorithm uses Darwin's principles of natural selection to find the optimal formula for predicting or matching the pattern. Genetic algorithms are often a good choice for regression-based forecasting techniques. In artificial intelligence, genetic algorithm is a programming technique that uses genetic evolution as a problem solving model. The problem to be solved has inputs that are transformed into solutions through a process modeled on genetic evolution. Then the solutions are evaluated as candidates by the evaluator function and if the exit condition of the problem is met, the algorithm ends Genetic algorithm is

generally an algorithm based on repetition, most of its parts are selected as random processes [2-22]. In genetic algorithms, we first randomly or algorithmically generate several solutions to the problem We call this set of answers the initial population. Each answer is called a chromosome. Then, using the genetic algorithm operators, after selecting the best chromosomes, the chromosomes are combined together. And we make a leap in them Finally, we combine the current population with a new population that results from combination and mutation in chromosomes [3-21]

The importance of VANET networks: The most important part of the VANET network is the sensors that should be used in different parts of the vehicle and report the condition of the car and the external environment to the driver and controller Or vice versa, apply the driver's commands or information received from other cars. In summary, VANET has three main and distinct uses: Safety, convenience and commercial use. The inherent capabilities of ad hoc networks are short range, high speed in network formation and topology change, and transmission of a signal from the origin to the destination. which creates the best application for car safety and traffic issues. Cars can quickly and in a fraction of a second be informed of an accident within a few hundred meters and change their route, recognize traffic and ask and answer questions from the car in front or behind. or find out about the traffic situation of the street or the side alleys and the intersection ahead. When a sudden event occurs on the street or road, the front or rear vehicles can quickly inform each other and also inform the police or city traffic management by communicating with the central stations. With the information they get from the cars around them, drivers can make more confident and better decisions and experience a safer and more comfortable and enjoyable drive. The applications of VANET networks are more evident in bad weather conditions. In cloudy or foggy weather, cars can guide each other and prevent accidents with their communication.

In these networks, the SVA (Slow/Stop Vehicle Advisor) security program is used to warn, slow down or stop the vehicle. EEBL (Emergency Electronic Brake-Light) for sudden braking, RHCN (Road Hazard Control Notification) is used for traffic control center warnings, PCN (Post Crash Notification) is used to send accident warnings and CCW (Cooperative Collision Warning) is used to announce collisions warning. In the traffic section, CRN (Congested Road Notification) programs for traffic warnings, PAN (Parking Availability Notification) for parking alerts and TOLLs are used to pay tolls without stopping the car. From a commercial point of view, VANET networks can have interesting functions. The RVP/D (Remote Vehicle Personalization/Diagnostics) program can customize the vehicle based on the driver's tastes and needs. Favorite music, general urban information or radio channels, games and other types of entertainment can be transferred to the driver or car through the central roadside stations. Another program called SA (Service Announcements) can select the types of announcements according to the driver's needs and broadcast them in the car. CMDD (Content Map Database) provides the possibility to download all kinds of maps and other secondary information for routes, shopping centers, airports, metro stations, trains and other centers along the route. RTVR (Using Real Time Video Relay) is another commercial service for watching videos that can be used on the platform of inter-car networks and its commercial issues are considered.

Route output according to the mobile network system: Definitely, the output of the movement path according to the mentioned cases is the richest output needed in this regard. Determining the movement between the data is stated in the state that it can be solved. The drawing instructions in the algorithm must be fully followed and the direction of movement of each car must be specified. In the case of turning the car in a specified path, the path is displayed as shown in Figure 1. The direction of movement of a car is shown and network movement is also available. The network connection between all cars can be determined according to Figure 2. According to Figure 2, the cars are identified separately and the possibility of bypassing several cars can be considered. In this case, you can rely on parallel movement. In this case, the security of movement is determined. Cars will move completely parallel to each other.

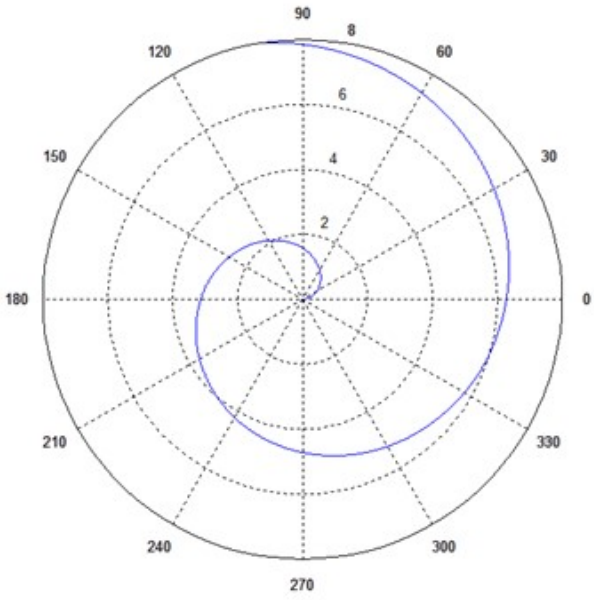

Figure 1. Exit route to bypass the car around the specific point

In the next case, we reduce the obstacles. Due to obstacles, cars had to move for a long time. But this path should be shortened as much as possible. In this way, the arrangement of obstacles is reduced and we find a safe path.

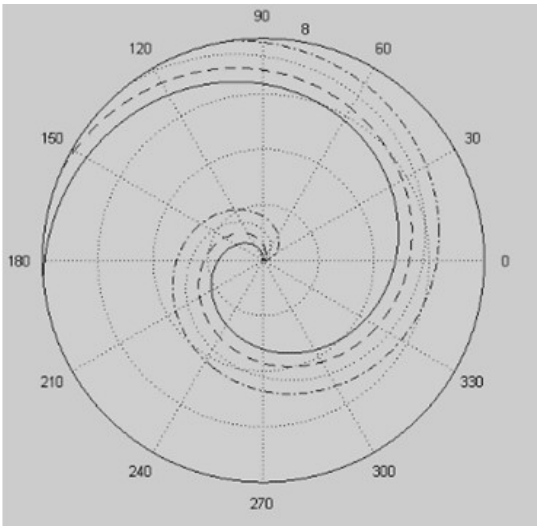

Figure 2. Exit route to bypass the several car around the specific point

After moving the obstacles, the shortest safe path is defined. The fourth car had the goal of moving to another place, which is clear in the figure. The order of movement is also given so that it can be compared to forced movement. In this case, the unsafe route is also determined. Figure 3 shows the unsafe path. After determining the type of movement, we see the danger lurking in the collision of two cars. After identifying the specific routes in this regard, we can emphasize the proper performance of the localization field. In such a way that the current location of all cars is determined along with their direction of movement.

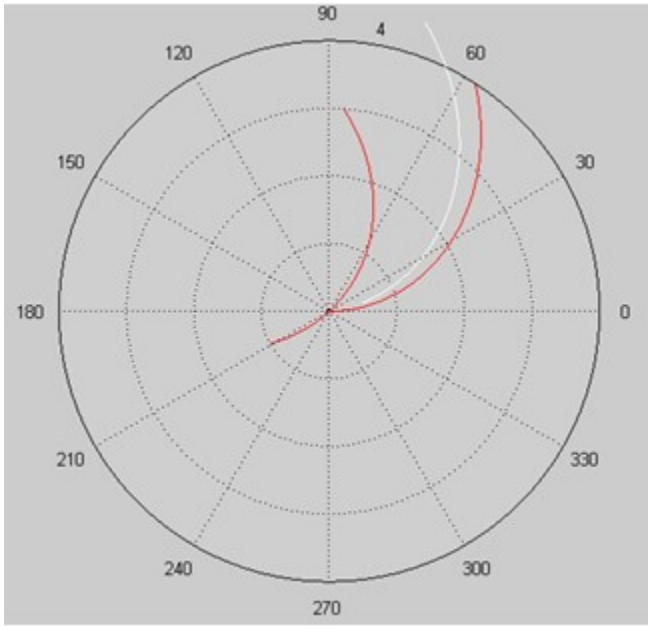

Figure 3. Determining risk in network communication

In this case, the initial identification is done and the ability to check correlation measurement is available. The circuit-based system is determined according to Figure 4. According to Figure 4, the mobile identification network has the ability to determine the cars and can determine the route and coordinates of each one in the form of a mobile network screen. Determining the mobile network is the first step in data detection. Another problem is the speed of movement while recognizing the type of car. In this case, the numbering of each car in the first step is the simplest action of the algorithm.

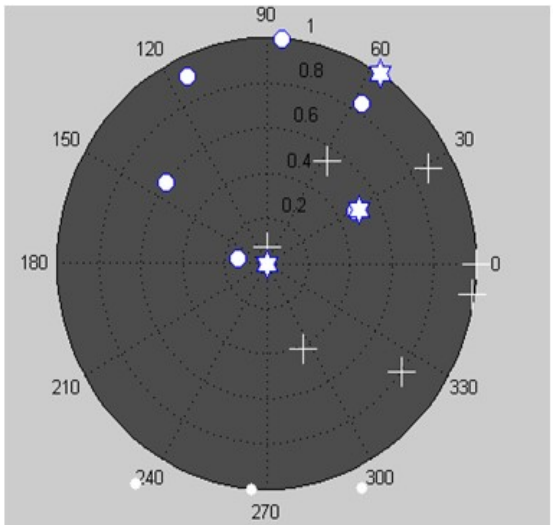

Figure 4. Determining the position of the mobile network of cars

According to the data received, the vehicle type is determined and its speed and direction are presented as text output. This output has the ability to appear on the mobile network page. According to the text output below, the data type is determined and the name of the machines is established in the first line of the output. The second line contains the name of the car, which is set by default. The second line contains the moving speed and the last two lines contain its coordinates. These items can be provided in the form of a mobile network. On the mobile network page, geometric shapes are used to show the type of car.

[1,2,3,4,5,6,7,8,9,10]
[a , b , c , d , e , f , g , h , I , j]
[45 , 66 , 67 , 87 , 45 , 60 , 100 , 120 , 180 , 30]
[30 , 40 , 66 , 77 , 99 , 90 , 77 , 76 , 54 , 34]
[55 , 66 , 55 , 44 , 34 , 32 , 23 , 23 , 45 , 56]

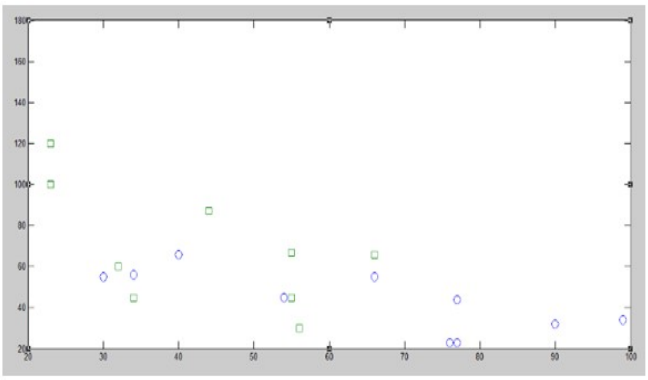

Figure 5. Mobile network page based on car type

Only 3 types of cars have been used, and in general, the database is able to determine its coordinate system. Now a large bank of car information can be used, and its clustering ability is also of particular importance.

Route communications: According to the existing protocol, the Alert system should always maintain its operational capability. This system has the capability of radio communication and maintains the connection between items. In this case, the program system must be installed on all cars. The alert system is a system for quick notification of imminent. This technology is currently the only technology capable of predicting an earthquake moments before it occurs. The increase in population and density of industries in vulnerable areas from the last few decades of the 20th century onwards has shown an increase in the death rate and economic losses caused by natural disasters. And the importance of earthquake alert systems has increased as the most important tool to reduce the severity of the disaster The operation of the new types of the system is as follows: When it occurs, several waves with different speeds are emitted from its center (in any earthquake, 4 main types of Resilient can be felt and are capable of causing damage.) Faster waves of pi waves propagate with a speed of about 7 km/s. These waves generally cause little damage. The destructive waves of the S wave propagate at a speed of about 4 km/s. Of course, the exact and real speed of the primary (P) and secondary (S) waves depends on the density of the ground and the type of rocks in the propagation area. For example: in granite bed, P waves propagate at a speed of 5.5 km/s and S waves at a speed of 3 km/s. While inside the ocean water, the wave propagation speed is P = 1.5 km per second and the propagation speed is zero = S. in the following according to the existing principles,

Table 1. Percentage of alert communication error based on speed and frequency of wavelength

Speed frequency	2	5	10	20	25	30
1	5	10	8	7	9	12
2	3	2	4	2	5	2
3	2	0	0	2	4	7
5	2	3	3	3	2	2

Table 2. Table of Communication length and call length at different times of the day (distance in kilometers)

Check the length of the watch	8	10	12	14	16	18	20	22	24
Length of call	10	14	45	55	44	34	33	50	20
Length of connection	2	4	5	10	5	6	7	5	4
Communication error	0	2	3	4	2	2	1	2	0

Table 3. Table of communications length and call length at different hours of a day (distance in kilometers) – without central station

of the watch	8	10	12	14	16	18	20	22	24
Length of call	4	5	6	13	8	9	11	6	8
Length of connection	2	4	5	10	5	6	7	5	4
Communication error	1	3	3	5	4	4	3	3	2

Table 4. relation between the real and extracted traffic of the algorithm

Item	Connection error	Percentage of usage	Connection maintenance error	data processing	The resolution of the mobile network
Real	1	30	2	340000	340
Simulation	5	34	4	311000	390

Table 5. Real traffic communication and extracted algorithm-after after a phased memory reset

Item	Connection error	Percentage of usage	Connection maintenance error	data processing	The resolution of the mobile network
Real	1	30	2	340000	340
Simulation	1	29	0	342000	393

speed of movement and wavelength, percentage of communication error is evaluated. In this way, user information in Tehran city has been collected and while simulating the program, the error percentage capability has been checked.

Table 1 shows a category of communication error that is designed based on the type of speed and wavelength. According to the figure, the best wavelength model for communication is determined. By adjusting the speed and wavelength, the communication error can be reduced as much as possible. In such a way that the speed of 3 km/s in addition to the frequency of 5 Hz and 11 Hz is working in zero percent error and this problem causes the timely communication of the mobile network. This control reduces the amount of errors and 100% communication between cars. In the next state, it shows the effect of the central station on the communication. To what extent the existence of the central station is able to solve the problem, this case increases the length of calls and at the same time reduces the speed of data processing. The high security of information is debatable in this matter. Another issue is that the absence of a central station by itself increases the speed of data processing and at the same time reduces its security. The existence of the central station is predictable in security operations. The following table shows the available security in this regard. According to Table 2, the length of communication in this mode is long and only a small percentage of the established call length is used for communication. This has consequences that should be eliminated. Table 3 shows the desired information in the state without a central station.

In the second case, it is clear that the call length is reduced in this case. In this way, only if it is used, the connection is established and the cost of establishing the system is reduced many times. The communication error increases in this case. This problem should be reduced with the help of a suitable algorithm. It is important to note that the degree of communication with the specific type of data is available. In this way, examining the relationship between the data and the effort for computational communication is a problem that has been addressed in the genetic algorithm.

The initial guess in the communication between cars is shown by a dotted line and the communication destination is shown as a rectangle. According to the above figure, there is a small gap between the real data and the estimated value, which is less than ten percent. This causes an error. Now, this situation should be re-evaluated and move towards error reduction. In the second case, the communication error is reduced again and tends to an error of less than 5%. Finally, during the third guess, the relationship between the data and the real value will be completely consistent. It is clear that this type of communication reached an error of less than 2% and the targets are completely placed on each other and the item has reliability.

Trust assessment: According to the above table, the amount of communication error and maintaining communication in the real state is small. But in simulation mode, this value increases. In this way, the current algorithm requires a security upgrade system.

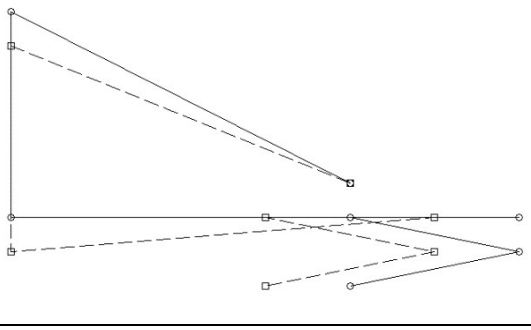

Figure 6. Iinitial communication in determining the algorithm

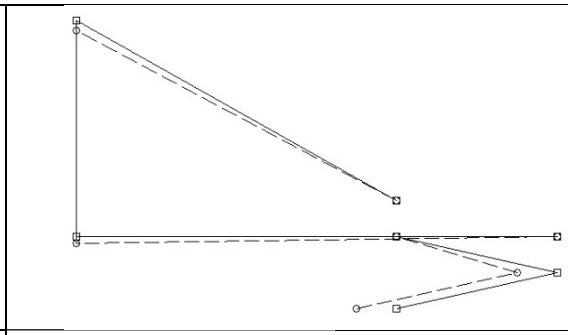

Figure 7. Secondary communication in determining the algorithm

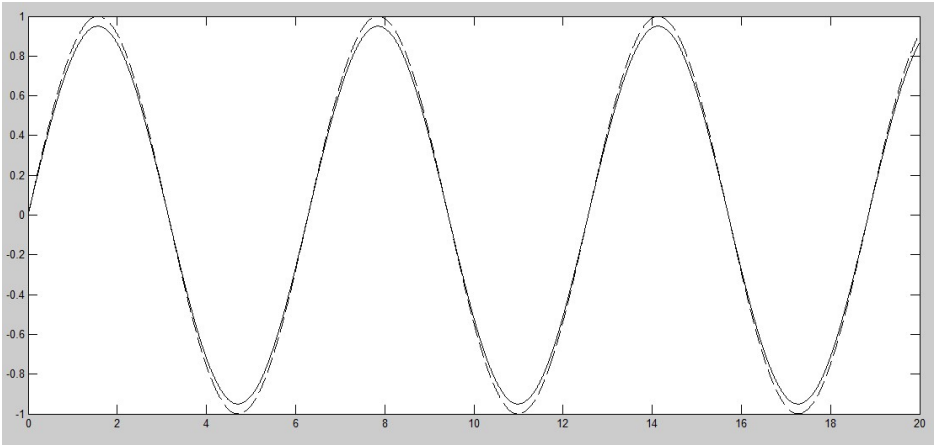

Figure 9. Comparison of actual and determined wavelength frequency

From another point of view, it manages data processing in high volume, and at the same time, the quality of resolution in the form of simulation is generally different from the amount of movement. In this case, emptying the computer memory after each use is significant. To be able to zero the memory in any series of operations, memory is very important. This is done in programming and the results are as described in Table 5. According to the above data, the error rate has been greatly reduced and in some cases it has exceeded the actual value. Data processing is also increased significantly. But the next thing is the amount of mandatory frequency, which can be changed due to environmental conditions.

This sinusoidal frequency has the capability of certain combinations and is able to solve properly in this field. The ability to combine the type of frequency and wavelength is shown in the figure below. In this way, we can determine the wavelength of movement with a small percentage difference. As a result, trust in the current method has been proven. In the part of electromagnetic radiation known as light, the wavelength determines the color of the radiation. By determining the color, energy and wavelength, one wave can be measured in relation to other waves. For example, short wavelengths in the visible spectrum (380 to 750 nm) are in the region between blue and ultraviolet, while red has longer wavelengths. The distance between these peaks of the wave is so small that its unit is given as nanometers ten to the negative power of nine or microns ten to the negative power of six. Electromagnetic radiation includes a long spectrum from long radio wavelengths to short X-ray wavelengths. Because the waveform moves at a constant speed c, it travels a distance of one wavelength in one periodicity period. each wave , In addition to the wavelength has a frequency that is measured in units.

The product of the length of each wave and its frequency is equal to a constant value called the speed of electromagnetic waves. The amount of this speed for all electromagnetic waves in vacuum is not a function of wavelength and is equal to a constant value called the speed of light. Sound waves All forms of moving energy, including sound, light, and heat, travel as waves. All of them have a wavelength, just like the waves of the sea. For example, when sound waves travel through air, they cause a small change in air pressure. The peaks of the sound waves are located at the points where the air pressure reaches its maximum. Our ears receive the change in air pressure and send a message to the brain. Different wavelengths also affect the characteristics of the wave, such as the frequency (the rate of rise and fall of the wave); Because these two are closely related. For example, low-frequency sound waves have a longer wavelength than high-frequency sound waves. Also, the wavelength of red light is longer than the wavelength of blue light. Light is part of the spectrum of energy waves, which includes radio waves, microwaves, infrared rays, ultraviolet rays, X-rays, and gamma rays, all of which travel at a speed of 300,000 kilometers per second. All these together form the electromagnetic spectrum.

Conclusion and suggestion

With the increasing progress of science and technology, societies try to use them to solve problems and optimize processes. VANET is one of these technologies proposed in the vehicle transportation network, which can be of great help to the transportation industry, car insurance industry, road management, and improving the efficiency of relevant institutions. The results in this regard are stated as follows:

- High-speed of data processing is one of the features of the proposed algorithm.
- The ability to communicate quickly in the warning system is one of the capabilities of this plan.
- The mobile network system has the ability to provide appropriate information from all cars within a certain radius.
- Low error percentage in communications is debatable.
- The percentage of data processing is usually small compared to the communication distance.
- The ability to process data online in a short time is one of the features of the algorithm.
- Proper prediction along with proper data processing will be among the reliable items in the system.
- The suggestions are as follows:
- Trust-based routing in delay-resistant vehicular networks with AODv protocol and genetic hybrid algorithm with Greater flexibility in the field of search.
- Analysis and evaluation of cluster-based safety message propagation in inter-vehicle networks (VANET)
- Routing in inter-vehicle networks with meta-heuristic algorithms to increase security.

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