On the Applications and Techniques of Vehicular Ad-Hoc Networks

Mohsen Norouzi[1*], Ali Arshaghi [2], Navid Razmjooy[3,] Mohsen Ashourian[4]
1- Faculty of Computer, Network and Communication, Imam Hossein University, Tehran, Iran.
Email: m.norouzi@ihu.ac.ir (Corresponding author)
2- Faculty of Computer, Network and Communication, Imam Hossein University, Tehran, Iran.
Email: ali.arshagi.eng@iauctb.ac.ir
٣- Department of Electrical Engineering, Ardabil Branch, Islamic Azad University, Ardabil, Iran.
Email: N.razmjooy@iauardabil.ac.ir
4- Department of Electrical Engineering, Majlesi Branch, Islamic Azad University, Isfahan, Iran.
Email: ashourian@iaumajlesi.ac.ir

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ABSTRACT:
Vehicular Ad-Hoc Networks (VANET) models are derived from Mobile Ad-Hoc Networks that possess an impressive role in the intelligent transportation system today and also in the future. So scientists are always looking for the best theories in hope of grasping the fastest and safest connections between vehicles, to provide traffic and accident news in real time. The high number of nodes is one of the significant features of this network that results in an increase of the number of transmitted packets in the network. Distributed system and high mobility of the nodes are the other most important attributes of Vehicular Ad-Hoc networks. In this paper, we aim to review the studies and improvements of vehicular Ad-Hoc network in the fields of safety and traffic management. In addition, we introduce the most common challenges of this network and gather latest methods for resolving those problems. Multi agent systems will be one of the newest and suitable tools in this system. The main purpose is arranging safe connection between agents. Fixing agreements and removing the disputes are not detachable from functional system. It is like group associations and societies which require human collaborations and cooperation. Development of science resulted in utilization of these systems in various aspects like VANET. Nowadays scientists and researchers are interested to make use of these methods for improving the role of vehicle networks in the field of traffic management, safety and entertainment, we will review them in the following paragraphs.

KEYWORDS: Vehicular Ad-Hoc Networks, Multi Agent System, Clustering, Traffic, Routing

1. INTRODUCTION

Each year, a high portion of assets in each country is used for the compensation of injuries and which come from the traffic collisions, and many problems of traffic situations in urban and intercity areas. For solving them, there is an urgent requirement of some new informational infrastructure in hope of receiving and analysing data from vehicles, also to transfer the useful data back to them. Intelligent Transportation Systems have good plans for improving the traffic problem.

In Fig1, we introduce the different parts of Intelligent Transportation System (ITS) and different applications of it. In this paper, we aim to assess one of the important parts of this system that is called vehicular Ad-Hoc network.

VANET works via wireless connection between vehicle to vehicle, and vehicle to infrastructure. Three important applications of this system are safety, traffic management, and the infotainment. The first category aims to avoid the risk of vehicle accidents, make driving safer, and the basic idea is to broaden the driver's range of perception, to react much quicker, and to be more receptive to alerts. The second category focuses on optimizing flows of vehicles by reducing travel time and avoiding traffic jam. Applications like route navigation, traffic light scheduling and merging assistance are some examples of them. And finally, comfort applications aim to provide traveller with entertainment to make the journey on the road more pleasant with internet different and kinds of music, and a variety of games.

Fig2 depicts the structure of VANET researches in these three various applications. It briefly shows the different contexts of researches in these applications:

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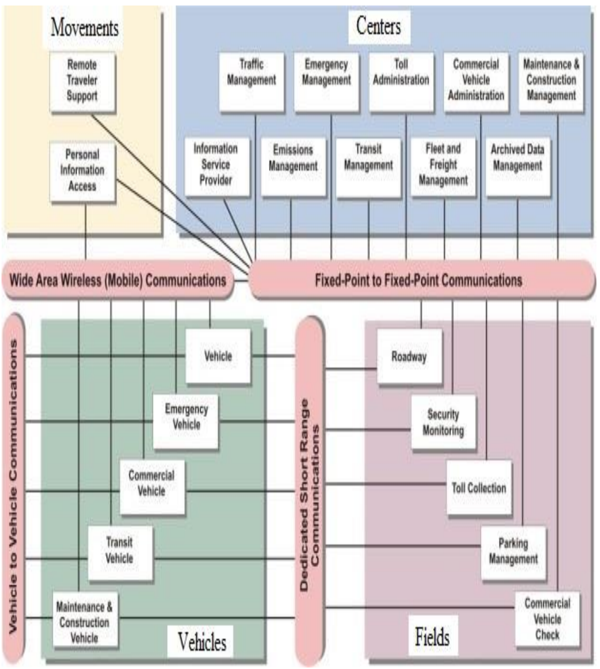

Fig. 1. Structure of ITS [33].

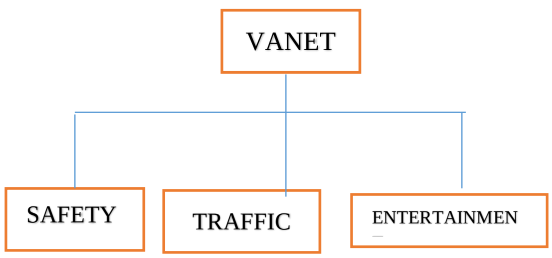

Fig. 2. Variety of Context researching in VANET.

Since the wireless infrastructure and VANET concepts do not adapt to these Three groups completely, some of industrials in different countries create a variety of project like DSRC in the United States, PREVENT in European Union, VICS in Japan, and NOW in Germany to increase technology in several parts of this network.

We can divide all researchers in two category: Application and Approach. Application mentions some works that with some changes or basis improve the quality of network in different views. But approach based researches use some techniques or tools for improving or boosting network. In the Fig3 we show it.

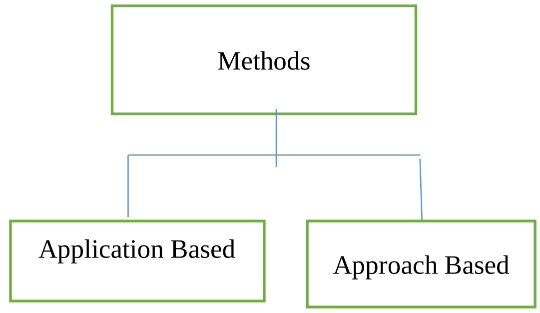

Fig. 3. Category of methods in VANET in two parts.

This paper is organized as follows: Section two, we review structure and feature of VANET and check the important challenge of this network. Section three, we review the associated work about safety application and traffic management, and in section four, we suggest multi agent systems and consider the usage of this technology in the VANET and in end comes the conclusion and future work section.

2. VANET AND CHALLENGES

Automotive electronics development somewhat lagged behind because the auto-makers pay more attention to the crafting of the engine, chassis, and designing the room, etc. The widespread use of electronic devices that is used today in vehicles, is not considered. With the advent of technology related to the world of the vehicles, the vehicle companies, try to make vehicle communications equipment to enhance safety, reduce congestion. After using the seat belt and air bag systems, death and damages stats decreased, but the statistics say it still seems to be remarkably high [37].

The initial idea of VANETs was introduced for the first time in 1998 by a group called Delphi Delco Electronics Systems Engineering in collaboration with IBM. VANET creates using radio communication network of the vehicle to vehicle (V2V) and vehicle to infrastructure (V2I). Fully autonomous vehicles communicate with each other and create a network of wireless non-structured.

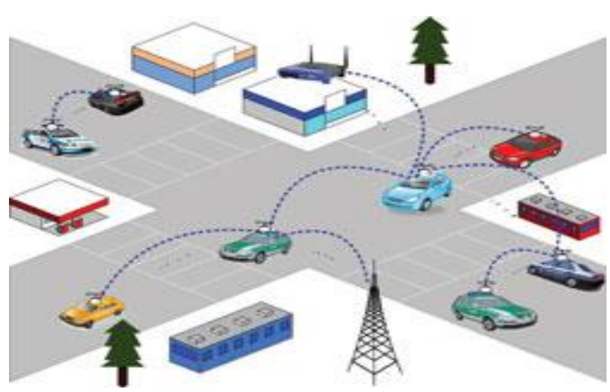

Fig. 4. Vehicular Ad-Hoc Network.

The main difference of VANET networks with specific cellular networks is that no central station, or node, is responsible for the management and control of the network and the mobile network is made up of a series of vehicles that do not have a location place and none of them cannot play the role of router or access point. In fact, VANETs use the vehicles instead of MANETs nodes. Each node can detect surrounding vehicles at any time by connecting to a network. They create and establish the necessary connections. Next the vehicle connects with new vehicles and then it will create another network. The main basis for VANET Unconstructed is their networks and the usage of DSRC standard “p802.11”. Thus, this type of network topology can quickly change the fact that the energy consumption and computing resources are not a problem, creating a great deal of flexibility. For example, a vehicle can be connected simultaneously to several VANET networks and receive information. VANET networks could be geographic circles with radiuses of a few kilometres and each vehicle can be communicated with the front vehicles within two or three kilometres.

Therefore, it is a characteristic of this type of short-range networks. VANET networks can connect to the central stations (BS) or the Internet and share information with them, but the main basis of network is communication. VANET is one of the main components of intelligent transportation systems (ITS). Many researches and studies have been done on VANET in recent years. The importance of this type of networks is associated with vehicle and traffic safety [18].

Institute of Transportation Engineers America, traffic engineering is defined as the application of scientific and technological concepts for planning, activation and management of transportation equipment in different designs, to provide momentum for a safe, fast, convenient, desirable, economic and sustainable environment for people and goods [42]. Based on this definition, one of the basic goals is safety. Studies have shown that 69% of accidents are due to lack of necessary information and appropriate timing for the drivers to react [1]. That's why safety systems were introduced.

Active safety systems, such as cameras and radars, are able to provide data from aerial view and obstacles behind them. VANET is a communication system, so it has solved the problem. VANET vehicle can indirectly help make contact with other vehicles. To increase safety, several collision avoidance systems have been presented based on communication between vehicles [20]. In addition to these studies, extensive researches has been conducted on factors affecting quality and safety applications [2]. To view the network performance in the vehicles, the acceptable number of vehicles equipped with the necessary equipment and devices of VANET.

The biggest problem is the lack of networking between the vehicle case communications between vehicles that are on either side of a barrier. VANET networks with infrastructure, as a new part of the technology, may have provided it until the vehicle is connected to the infrastructure installed at the edge of the road and thus help infrastructure Information to be indirectly received by vehicles. The high cost of installation is a downside of VANET infrastructure. For this reason, they can be connected to the Internet for entertainment, network games, banners and file sharing purposes, and to reach the VANET. This service can be considered as creators of these networks draw. Traffic safety requirements are free in different traffic services. Safety in traffic, the main demand, is fast and secure dissemination of information in the shortest possible time in a small range around a given point. As for safety of communications, safety of information for each vehicle in the network must ensure to be maximum and sent at the least expected time. VANET networks are a subset of mobile networks. VANET network components or nodes are on vehicles. Features such as high-speed nodes, rapid changes in network infrastructure, lack of memory problems and capability of transverse and longitudinal movements with relatively well-defined positioning systems (the road) make an independent investigation in the design of protocols forming VANET.

The content of the messages published in the VANET in most applications for all nodes in the network are useful and necessary. It is the latest in a broadcast network VANET done. Messages are exchanged between the vehicle in terms of the nature and timing of the publication can be divided into two categories [47].

Messages period, the message will be played alternately by each vehicle in the network. Messages containing the status of each vehicle in the direction of the movement. In other words, these messages are called Beacon.

In general, for a safe and secure communication networks VANET (Which is the basis for important safety messages) it is necessary to overcome problems such as the weakening of the signal saturation channel productivity and mobility management network nodes that need to be distributed. Challenges in a variety of network designs VANET articles listed below will be referring to them.

1) A case of poor communication between the vehicles was bothering during the development phase of the project. For example, when the bandwidth DSRC technology and the number of vehicles equipped GHz 5.9 to experiment with it, the results of these tests represent a clear challenge to the connection between network nodes.

On the other hand, when the penetration rate increased, as well as more vehicles equipped in the network, the system bandwidth DSRC inter-vehicle network GHz 5.9 Despite a few scenarios to support a high volume of messages between nodes in a small area seem alarming. In this case the numbers of packet collisions have risen sharply and backup safety system was faced with a problem.

In such circumstances, feasibility of right time to deliver messages securely rate for the control channel and determine the number of nodes that need to be in a certain range, can be effective to improve the challenge [43].

2) Another natural immune network problem that can affect the vehicle case is the existence of hidden nodes. Hidden nodes as a new factor have emerged. Because of the variable attenuation due to transfer messages in different aspects. Hidden terminals may be what we expect our network to move resources closer.

Hidden nodes in the mechanism of CSMA / CA in IEEE 802.11p protocol used to transmit a message of cooperation between nodes in the network are formed and created. According to the terms stated can be seen that the number of packets hostile to the increase in the number of network nodes and increase channel productivity are rising rapidly.

The following figure will be displaying this problem and is very simple:

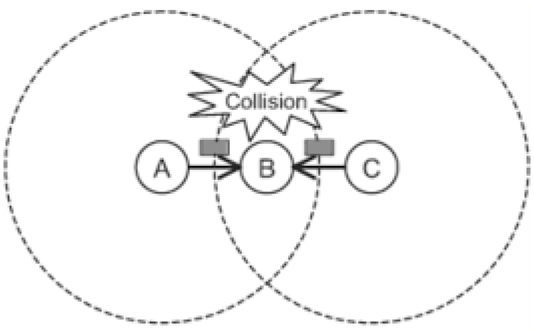

Fig. 5. Hidden node, node A receive the message from node B and C in the same time.

Two nodes B and C due to the limited range are unaware of each other in a communication network. If the two nodes send the packet to A, the two packages collide and fail to return [12].

To solve the problem of hidden nodes of a handshake before each write operation, called RTS / CTS is used. Unfortunately, the use of RTS / CTS to send the broadcast is almost impossible because in this case should target a large number of nodes simultaneously is received. The majority of broadcast communication network begins between vehicles and hidden node problem and different packages.

As shown in the figure4, an RTC itself suffers from the problem of unexpected collisions due to hidden node problem which is a top priority and is why it is used in long messages. The same can be seen that the short messages handshake CTS / RTS increased overhead in the network.

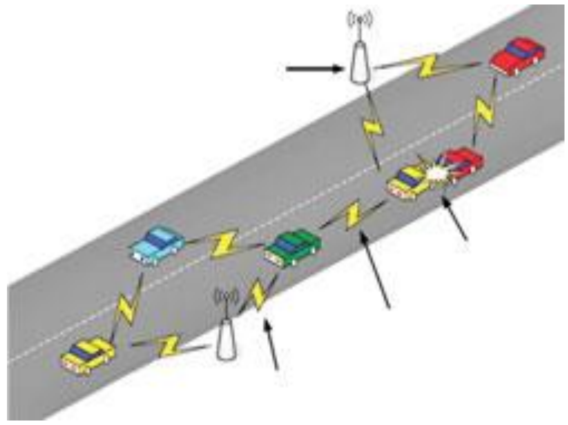

Fig. 6. RTS/CTS messages in VANET

3) One of the most important factors is, that there are differences among vehicles with many other mobile networks which are based on the high-speed nodes in VANET. For example, assume two vehicles on a highway each in the opposite direction have the speed of 120 km/h. Reliable connection is to a range of 500 m and 7.5 seconds for the transmission of information.

Mobility in moving vehicles due to the limitations, is one of the challenges that researchers face with it in this area.

4) It is clear that this level of mobility between vehicles or nodes in a large area covered by the network between the vehicles would be an impossible issue of centralized management. That is why there is the need for cooperation among network nodes in distributed resource allocation, especially in conveying the message to the public with the network, resulting in channel management using distributed algorithms [36].

5) Another problem is that by broadcasting the VANET, there is no certainty about the messages which are sent by the receivers. Because they do not receive the broadcast frames in the process of acknowledgement. In addition, the probability of packet failure is increased with the increase of distance from the message sender's [35].

The following section provides an overview of the activities have been intended to solve these problems and improve the efficiency and effectiveness of the final output VANET network of automotive safety applications.

3. APPLICATION BASED METHODS IN VANET

All of the researches that we review in this section would be through in aim of resolving one of the challenges in the system, or improving the network parameters which come in this section. We classify the papers based on the key point of those. And we are to introduce every single of them shortly.

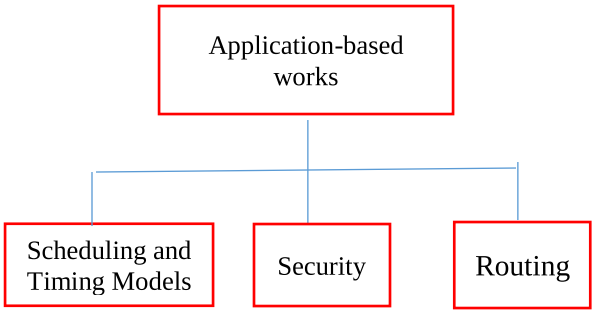

Fig. 7. Classification of application based methods in VANET

3.1. Scheduling and Timing Models

As it has been started, in order to avoid collision algorithms in CMSA family before each message seizes the channel and checks whether it is free or not, so it can upload. On the other hand, there are algorithms with upload timing for every node, decision making could send that message in special period of time for each node. These algorithms are known TDMA.

With regard to the connection between the vehicles, fast changing position of nodes cannot be used in TDMA mode. In [24] a static method called LCA is used to assign the range of messages. Each vehicle within a predetermined geographical period can be used to send the message to other nodes. This can be only a limited and earlier solution. In a more advanced method called VeSOMAC network nodes to determine the range of your posts were not compete. Each node includes a large cycle delay. To avoid this delay a relatively high overhead must be borne; the cycle is divided into the sub circles.

As suggested in this paper [32] writing in different channels at 802.11p is used. The proposed algorithm consists of three protocols. The vehicles move in a direction in which are grouped into cluster and for each cluster head node is selected. Traffic and safety messages within cluster are in two independent vehicular channels of 802.11. The cluster head connects clusters only through a dedicated channel. The communication by TDMA (non-competitive) will be [38] to prove the sustainability of cluster configuration, and the fixed position of the vehicle connected to other ones in ODBC. But it may not be possible in all states of motion [33]. The extensive research has been done on the VANET clustering is due to the lack of a sustainable and appropriate way to manage the overlapping nodes in the cluster, but they cannot achieve a comprehensive model.

3.2. Security Models

This paper presents an intelligent model to protect user's valuable personal data. Preserving proprietor's data and information in cloud is one of the top most challenging missions for cloud provider. Many researches fanatical their valuable time's to discover some technique, algorithms and protocols to solve secrecy issue and develop a full-fledged cloud computing standard structure as a newest computing to all cloud users [51]. Some studies came forward with cryptography technique, cyber middle wear technique, noise injection and third party layer technique to preserve privacy about data in cloud. It proposed a hybrid authentication technique as an end point lock. It is a composite model coupled with an algorithm for user's privacy preserving, which is likely to be Hash Diff Anomaly Detection and Prevention (HDAD). This algorithmic protocol acts intelligently as a privacy preserving model and technique to ensure the users data are kept more secretly and develop an endorsed trust on providers [52].

Different components in a vehicle have to constantly exchange available information with other vehicles on the road and cooperate for the purpose of ensuring safety and comfort using a Vehicular Ad hoc Network (VANET). Critical information like navigation, cooperative collision avoidance, lane-changing, speed limit, accident, obstacle or road condition warnings, etc. play a significant role for safety-related applications in VANET. Such kind of critical information gathering and dissemination is challenging, because of their delay-sensitive nature. This paper proposes an agent based model that consists of heavy-weight static cognitive and light-weight mobile agents. Proposed model executes gather and store operations on information gathered based on information relevance, criticalness and importance [55].

An important feature of VANET security is the Digital Signature as a building block [72]. Whether in inter-vehicle communications or communications through infrastructure, using signatures (authentication) is a fundamental security requirement since only messages from legitimate senders will be considered. Signatures can also be used to guarantee data integrity. While fundamental to secure communications in many other networks, message confidentiality remains an option in VANETs depending on the specific. For instance, safety related messages do not contain sensitive information or data and thus encryption is not needed [72].

The unique properties of vehicular networks given in [71], have an impact on attack effectiveness. First of all, attacks that target in exhausting the node battery are not applicable here. Vehicles have the ability of constantly charging their batteries. Moreover, the vehicle's power supply is more than enough to support energy demanding computational systems. Consequently, authentication processes do not have to be light-weight.

However, vehicular networks could suffer from other types of attacks. Specifically, in this paper [73] proves that the probability of end-to-end connectivity decreases with distance, for one-dimensional network topologies. This implies that it now becomes much easier for a malicious attacker to partition the network. This effect can potentially be addressed by maintaining multiple forwarding nodes for each packet.

3.3. Routing Models

Anchor based street and traffic aware routing (ASTAR) proposed [64]. This paper follows street awareness for efficient routing. ASTAR also follows traffic awareness. A city environment consists of roads and junctions that can accommodate more vehicles. As the density increases, connectivity also increases. City traffic has regular fleet of buses. Weight is assigned to each street based on the number of bus lines it serves.

The Connectivity Aware Routing (CAR) protocol proposed in this paper [65]. It has four segments namely: Destination location and path discovery, Data forwarding along the path, path maintenance with the help of guards and error recovery. CAR uses PGB in data dissemination mode to identify the destination location. CAR shows suitable PDR and lesser routing overhead when compared with GPSR. The average delay of the data packet is much less in CAR than GPSR due to the connectivity between source and destination nodes and also shows higher level of tolerance in short term disconnected networks.

Road based using vehicular traffic information (RBVT) [66] protocol presented in this work. It uses real time traffic information to create path either proactively or on demand. In RBVT-R, paths are created on demand using connected segments which are paths between adjacent inter segments thereby ensuring network connectivity.

Beacon less routing algorithm for vehicular environments [BRAVE] [67] follows spatial awareness and opportunistic forwarding. The trajectory of the packet is not computed beforehand by the source instead during hop by hop forwarding every node computes the trajectory so that change in the route may occur at any intermediate vehicle and not necessarily at the junctions. To decide the next junction Dijkstra’s shortest path algorithm is followed. Irrespective of the density of the network BRAVE shows well packet delivery ratio as well as lesser packet drops in case of high density. In connected networks it has a reasonable end to end delay but in disconnected networks it was able to deliver messages but at a much higher end to end delay when compared with protocols such as GSR, SAR, GPSR, ASTAR and GeOpps.

The Cross Layer Weighted Position based Routing (CLWPR) [68] follows minimal weight hop based routing periodically broadcasted by each node. The messages contain positioning information such as position, velocity and heading and other necessary information such as this protocol calculates the distance to be travelled to reach the destination. To make this possible, e-maps are to be imported on the vehicles. This protocol provides better PDR and End to end delay when compared with GPSR. Prediction based approach helps in achieving better PDR and reducing network overhead.

Mobility aware Ant Colony optimization Routing (MARDYMO) [69] protocol uses Ant colony optimization in the existing dynamic MANET On demand (DYMO) protocol which is a reactive protocol. In order to predict the mobility, position, speed, displacement and time stamp are added to the Hello message and are sent in an aperiodic manner using which the nodes will have updated information on their neighbours.

Geographic Stateless VANET Routing protocol (GeoSVR) [70] proposed in this research. This paper routes data using node location and digital map. This protocol consists of two main algorithms namely, optimal forwarding path algorithm and restricted forwarding algorithm. The main issue in forwarding data is the local maximum and sparse connectivity problem. Optimal forwarding path algorithm eliminates the problem of sparse connectivity by considering the vehicle density. GeoSVR has outperformed GPSR and AODV in packet delivery ratio and also shows very low latency when compared with AODV where the latency is almost equal in case of GPSR.

3.4. Concluding of VANET development

According to the research conducted in various areas of networking between the vehicles and the progress in this area, there are still weaknesses that need to be addressed. Some of the most important problems mentioned in this section are as following:

- The lack of an effective solution to identify and estimate the required network antenna location, especially on twisty roads and environments.
- The volume of messages transmitted on the network to identify and initialize coordination of vehicles, leads to a sharp decline in the effectiveness of the model.
- In the model proposed single-lane streets, sometimes considered to be one direction that is different from the actual models.
- All papers overlook the overlap situations. This is a weak point for all of them.
- Failure to provide a systematic protocol that could very well be considered how to communicate and transfer message between vehicles and be equipped to manage the network.

Given the importance of networking of vehicles in near future and expansion of capabilities of network to improve safety and traffic management play a crucial role in saving lives, and also due to some of the weaknesses mentioned in the paper researches scholars use the powerful platform of the communication between the maximum common factor necessary for the network environment on their vehicle.

The following section will provide a brief introduction of multi-agent systems and their capabilities as well as some of the best works in this field.

4. APPROACH BASED METHODS IN VANET

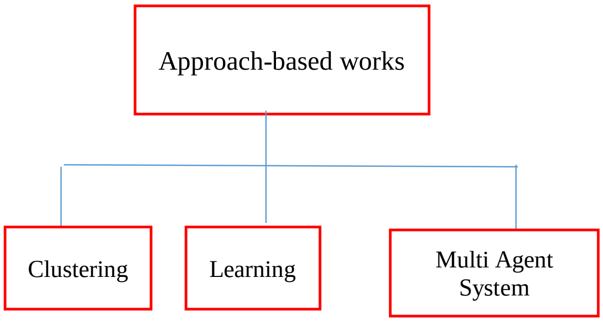

Fig. 8. Classification of approach based methods in VANET.

This research study focuses on the learning and multi-agent systems approaches and seeks to answer some of the challenges in the field of traffic safety and their pickup. In recent years with the increase in traffic volume of streets and increase of the time wasted in traffic jams and street network, traffic control problem is one of the most important and challenging issues in the field of transport systems (ITS). Classical and application solutions such as the development of traffic infrastructure can provide a complete solution to the problem of traffic congestion in networks and we need a system that makes it possible to control adaptively and is adjustable to different circumstances and can manage traffic costs. Using various techniques of artificial intelligence including clustering, multi-agent systems and learning processes in the field of traffic control or safety of network in recent years are widely considered. Multi-agent systems are also one of the most versatile and the most suitable model, which will have numerous applications in Vehicular Ad-Hoc networks. Some of capabilities of multi-agent systems such as autonomy, accountability, social distribution, and also negotiation and cooperation between the agents are acceptable solution for VANET network.

4.1. Clustering models

The increasing number of vehicles will conclude a delayed network for the messages. Moreover expanding the scope of a network allows messages to be played in a number of subsequent steps in the entire network, for safety of the message, for the better clustering neighbouring vehicles, and for setting the cluster limits.

Many studies have been done on clustering MANET networks, but due to the different types of mobility VANETs independent designers in this field are required. [11] A new method for clustering LPGs is suggested that acts in two ways: static and dynamic. In another research, problems of clustering have been explained at the application layer for the communication between the vehicles [49].

The need to improve the road safety has led to a new routing technique called the hybrid swarm routing protocol [9]. This protocol takes into account the dynamic changes in the environment that accounts for one of the important features of VANET [26]. Based on the density of the vehicles. It mentions that the area is subdivided into smaller areas and is applied based on the density routing algorithm. In this protocol each node maintains its own routing table that contains routes to the destination [45].

If vehicles in this model has the same direction with regard to the speed of vehicles and the possibility of linking up with each cluster algorithm, after the formation of clusters, clusters have a vehicle that has spent more time considering the vehicle speed will be chosen as cluster head. Static and mobile platforms are responsible for the task of creating a knowledge base as well as controlling and coordinating the activities of agents. This factor measures the speed of your vehicle and cluster and existing of vehicles is forecasted by the agent. One of the tasks of mobile calculation is the speed and location of each node of neighbouring vehicles using the knowledge base. The agent also has the task of forming and maintaining clusters. This agent distributes vehicles and cluster head [25].

4.2. Learning models

Some vehicular network applications in particular use broadcast communications extensively. This paper proposed using the distance-to-mean method to facilitate these applications. The performance of this method depends heavily on the value of the decision threshold, and it is difficult to choose a value for that threshold that results in good performance across a wide range of network scenarios. Node density, spatial distribution pattern, and wireless channel conditions all affect the optimal statistical threshold value. VANETs exhibit wide ranges of these factors, so protocols designed to support these applications must be adaptive to those variations. In this work they address this design challenge by using black-box optimization algorithms based on machine learning techniques such as genetic algorithms and particle swarm optimization to automatically discover a decision threshold value for the distance-to-mean method that is simultaneously adaptive to node density, node distribution pattern, and channel quality [57].

This paper [58] presented new technique. FlexRay is a popular communication protocol in modern automotive systems with several computation nodes and communication units. The complex temporal behaviour of such systems depends highly on this configuration and influences the performance of running control applications. In our previous work, we presented a design framework for integrated scheduling and design of embedded control applications, where control quality is the optimization objective. This paper presents our extension to the design framework to handle FlexRay-based embedded control systems. Our contribution is a method for the decision of its parameters and optimization of control quality.

A lot of related work has been done in recent years in the design of cooperative adaptive cruise controller (CACC) systems. Regarding the vehicle-following controller, this paper [60] did some research as part of the CarTalk 2000 project. These authors worked on the design of a longitudinal CACC controller based on vehicle-to-vehicle communication. They showed that inter-vehicle communication can help decrease instability of a platoon of vehicles. In the same vein, another research [61] worked on designing a longitudinal controller based on fuzzy logic. Their approach is similar to what we did with reinforcement learning for our low-level controller. This work has presented a longitudinal reinforcement learning controller [59] and compared it to a hand-coded following controller. He showed that the hand-coded controller is more precise than its RL controller but less adaptable in some situations. However, Forbes did not test explicitly communication between vehicles to improve its longitudinal controller to a multi-vehicle environment. Our approach will also integrate our low-level controllers with a high-level multi-agent decision making algorithm, which was not part of it.

Regarding the reinforcement learning in a vehicle coordination problem, this study [63] have used multiple stochastic learning automata to control the longitudinal and lateral path of a vehicle. However, the authors did not extend their approach to the multi-agent problem. In his work presented a distributed variant of Q-Learning (DQL) applied to lane change advisory system that is close to the problem described in this paper [62]. His approach uses a local perspective representation state which represents the relative velocities of the vehicles around. As a result, this representation state is closely related to our 1-partial state representation. In contrast to our algorithms, DQL does not take into account the actions of the vehicles around and updates Q-Values by an average backup value over all agents at each time step. The problem of this algorithm is the lack of learning stability.

4.3. Multi Agent System models

Multi-agent systems are one of the main branches of artificial intelligence. Multi-agent system simply consists of a number of factors and mechanisms to coordinate the behaviour of these agents. In environments with features with high dynamics, uncertainty and complexity in which the concentrated solution seems impossible, environment in which tolerance for error is needed, and areas where parallel programs are needed to be asynchronous, Multi-agent systems and networks are one of the best environments for the implementation of the model. The following paragraphs are an overview of the work to be done in this area.

The purpose of this work is to adapt a multi-agent system of Holon on network traffic and provide a good learning process for operating the system, using co-operation in the system can be a good solution for adaptive traffic control and proportional achievement.

Another work introduces a model for learning in multi-agent system's Holon was due to a special place and reinforcement learning of organization Holon also has a large-scale distributed systems modelling. This model is important step in the development of the organization. The proposed model is consistent with the principles of Holon in any area that is Holon modelling agencies can be used. One application of the Holon is in the modelling and control of urban traffic which also yielded satisfactory results.

Some of the articles in this area investigate the applications of multi-agent systems and learning process in the management of network traffic vehicle deals. The issues of usage of smart traffic management systems have been done in different sectors and with different approaches. In [3] the author and his colleagues used a method based on reinforcement learning to formulate adaptive traffic control. In [46] the method of learning in a multi-agent system, for training controllers of traffic lights are used in order to reduce waiting times for vehicles at the network level. The vehicle-based functions is used to estimate the amount of time of the vehicle. Article [4] has proposed a method in [46], to be extended in addition to some of tacit coordination among factors. In both methods, the optimal operating is measured according to the local state. In [27] a multi-agent system with the learning process is used by the aid of graphs that coordinate actions to control the traffic lights. In this way, in addition to being at each intersection, a learning process is use to control the traffic lights payments locally; also some coordination is added between neighbouring operating systems. It is common practice to estimate the optimal coordination through the use of algorithms achieved via Max-plus. In the article [34] distribute artificial intelligence methods are used for traffic control and synchronization of the traffic lights and switching them in order to maintain the desired speed. In [8] learning in the form of a neuron-fuzzy method is used to control traffic lights but the low sensitivity of this method makes it possible to explore the limits and outside the line of approach to updating the values; limited success in this regard has been obtained. In [16] different ways are explained based on the same information.

Intelligent cars are presented as a promising domain for multi-agent applications as modelling, simulations and coordination algorithms. AgentDrive coordination platform is introduced to illustrate possibilities in development of such applications. AgentDrive allows development of coordination algorithms and their validation via simulation. The coordination algorithms notion covers some of the following tasks: dynamic routing, trajectory planning, or collision avoidance and cooperation. Simulation can be performed in an arbitrary level of detail by using various external physics simulators [56].

In [5] a method based on multi-agent systems is proposed. In this way each intersection has an independent intelligent agent. All of these factors are involved in a dynamic multi-agent environment. In this environment, in addition to local goals and objectives, each of the factors, propose a general system which is generally considered to be consist of all the factors needed towards achieving the moving target. In this way, main concept of evolutionary game theory can be used. The role of a traffic control manager is also considered to be deciding on the policy of traffic control and management. It is responsible for tactical and strategic level and its duty is to control traffic on the operational decisions of the independent agent. In the proposed method [40] non-resident aspect of the issue has been dealt. In this way, in order to detect changes in traffic flow, a detection algorithm is designed to be capable of learning and is based on different traffic flows, and applies the appropriate policies. This method has the advantage over previous methods based on different traffic flows in the early busy hours of the day, adapted to adopt appropriate decisions. Paper [21] also dealt with the problem of learning traffic signals. In the method presented in this paper, a smart learner is used which tries to use the process of learning to learn, the optimal control of traffic lights and to take action to solve the problem. In [6] the factors discussed in small groups, then were appoint an observer to be supervised by in each group to apply a reinforcement learning agent. In [31] of a Q-learning with Multiband model is used to realize the adaptive control and coordinate traffic lights. In this way the reinforcement learning phase optimum time and the offset is used to adjust the lights. Multiband is a linear programming model of correction that can be solved by the usage of branch-and-bound. In [17] a method based on hierarchical multi-agent systems for urban traffic control system is presented. In this system, the first level was crossing, with a local operator in control of their intersections. Local patterns obtained from this intersection may just have a good performance in a range of local intersection But when these models are tested simultaneously across the entire network may not achieve the desired result, so an observer coordinator is considered to be a higher level as local patterns of the entire network weighting them proportion to the general conditions of the environment, taking into account local conditions at the crossroads of change. In this paper, development of systems for implementing multi JACK is used, in addition to the for large-scale traffic simulation environment to a degree that is less close to real-world results. In [7] paper examines the problems and challenges in the field of traffic engineering, especially the field of controllers that deals with traffic lights. The potential expression of multi-agent systems and the process of learning in the field of traffic control use in this area diversely.

The first approach made in the application of multi-agent systems in the automotive networks, focuses on increasing the efficiency and reducing delays in the system in the traditional traffic lights. In one of the tasks, the interaction between the agents is allowed to act autonomously and share the data collected. The interactions can use this information to predict the near and far distances jams. In this model, vehicle control was human controlled and only parts of internal control was sent to the transfer agent. This work aimed to evaluate the effectiveness of three different internal control policies which are: the crossings, traffic lights and storage systems. The results show that based on storage, systems that allows traffic through the internal mechanisms are more efficient than operation of traffic lights. A research shows that the proposed model is based on two to three hundred times better than an agent can run in simple traffic lights. This improved efficiency is calculated based on the vehicle and the delay time of each node. This model can control slowly in heavy traffic. The limitations of this study include inability to turn vehicles and their speed limits change of when the vehicles are running in various sectors [23].

This paper describes a global database recorder architecture following a multi agent system philosophy to provide a specific global database information service. The global database stores relevant information of vehicles, occurred in relation of trip data and risky situations. Trip information and risky situations details are gathered and used to show traffic hotspots in a graphical representation. In our work, each vehicle has a local database managed by an on-board system. This local database is fed by a pre-collision system and a perception system that identifies traffic hazards. The global database can automatically collect all vehicles' local databases and is then exploited for a novel report system that shows traffic hotspots as highlighted points in a geographic map [18].

Another method uses a hierarchy of articles in different parts of the network between the vehicles. In the article [28, 29], the authors have presented a distributed algorithm structured topology. The self-organizing algorithms, aims to provide reliable environmental impact on hierarchical topology to minimize the interactions between members of the network nodes. D-CUT clustering algorithm optimizes the network where the nodes of each cluster of other groups have the maximum possible distance. This help category of each cluster make stronger relationships and interactions between clusters to be reduced. This method locates each vehicle in the cluster as well as other vehicles in the cluster which can be very strong in organizing the network and collaborating with other vehicles and to achieve acceptable performance in this way [24].

An allocation mechanism is used for the prevention of accidents at intersections. This way, each square has a controller and the vehicle for crossing the intersection sends a request to control agent, if the request is accepted, the security vehicle passes the intersection else they would have to wait. The idea in [13] improved complexity, such as the possibility of bypassing vehicles, accelerating at intersections and being examined. Then, in [14] the proposed system is further strengthened by the search and identification of potential and suitable areas for the use of the learning process, to improve the operating efficiency of the system which will be discussed. In [15] improvement systems, ideas and policies are provided and discussed to move towards a fully automated vehicles in ideal harmony to vehicles at intersections and significantly reduce delays when crossing intersections.

In three layers of Ad-Hoc network architecture, the conditions were created looking to increase and improve the flexibility, versatility and the ability to keep more than their automotive emissions of data traffic between networks. In this study, we tried two intelligent agents called a distributed and mobile agent (mobility) and how cooperation and coordination should be used. VANET disadvantages in conventional networks, are network management, service provision and distribution of information that arise because the network is dynamic, central driven and its solution have been defined on this basis. The advantages of operating in the automotive networks that can be used to improve the flexibility, versatility, maintaining proper routes messages, the ability of fault tolerance are mentioned in these studies [44]. The data needed by these applications can be obtained by processing suitable queries in the vehicular network. However, a number of difficulties arise from the point of view of data management. An important challenge is how to communicate a query to the relevant vehicles, retrieve the relevant data from such a distributed and highly dynamic network, and bring back those data to the vehicle that originated the query. In this proposal, we will study the suitability of mobile agent technology to accomplish these tasks, as mobile agents could help thanks to their adaptability to mobile environments and other features, such as their mobility, autonomy or intelligence [54].

In this paper, we use an organisation called holonic multi-agent system (HMAS) to model a large traffic network. A traffic network containing fifty intersections is partitioned into a number of regions and holons are assigned to control each region. The holons are hierarchically arranged in two levels, intersection controller holons in the first level and region controller holons in the second level. We introduce holonic Q-learning to control the signals in both levels. The inter-level interactions between the holons in the two levels contribute to the learning process [53].

In this paper, vehicles that move along the same road are able to communicate either directly to the destination or by using an intermediate node, such as a router. Therefore, designing an efficient routing protocol for all VANETs scenarios is very hard. A lot of researches about routing in VANETs are considering DSDV routing protocol as the most suitable protocol for mobility environment. But DSDV generates a large volume of control packets and takes up a large part of available bandwidth. In this paper an improvement on DSDV routing protocol based on multi-agent system approach is proposed to solve the performance problems mentioned above. Experimental results seem to be promising regarding the adoption of the proposed approach [19].

In [32] a self-configuring, self-organizing and decentralized management system and a group of base stations in wireless networks are proposed. In the article [13], we tried to use applied technology of multi-agent systems.

In this paper [14], a model of multi-agent systems based on dynamic cluster networks between vehicles should be provided. The model simulates the vehicles in a street between two intersections with regard to speed, direction, and temperature and movement pattern connecting each vehicle with other vehicles network. In this paper, both mobile and stationary platforms are used for the rapid transmission of messages in the network.

In the final part of this section, we aimed to gather all information and present comprehensive classification about all papers. Table 1. The table summarizes the classification of the research covered in this survey. Also, include in the table, each paper is utilized in which application vehicle network. Also, we mentioned to the fundamental method of that paper so that appropriate consideration is shaped for future research.

Table 1. Classification of papers in different areas.

Research	Model	Safety	Traffic	Entertainment	Adv.	Dis.
Application	Timing methods	✓		✓	-The simplest way for cooperation between vehicles	-Increase Overhead of Network but not improve quality enough
	Routing methods	✓	✓		-Decrease the average amount of delay and messages in network	-Guaranty of link connectivity between vehicles, efficiency and reliability is very hard
	Privacy methods	✓	✓		-Design secure and confidential protocol and environment for vehicle and driver privacy	-It avoids to response real time to requests of network -Increase complexity of usage for drivers
Approach	Clustering	✓	✓		-Decrease overhead of messages and increase performance of data aggregation	-Supporting and handling stable clusters are very complicate and vital -overlooking overlaps or error in transmission of message faced network with serious problems
	Learning	✓	✓		-Improve the decision-making capability and managing delay and travel time automatically	-Challenge in predicting and detecting trajectory or congestion in network
	Multi	✓	✓	✓	-Agents can	-Need

	Agent System				easily and intelligently predict and learn changes or movements of network -Increase safety and traffic management quality in uncertain and complex network -Using simply from some capabilities such as parallelism or communication rules	specific requirements for good adapting

5. CONCLUSION

In this paper we aimed to explain vehicular Ad-Hoc networks, applications of these systems and the most important challenges of them. We attempted to classify the researches of these systems to organize them for higher intelligence.

The focus of this paper was on the safety and traffic management applications. As well as multi-agent systems used in the VANET in the recent years. The power of multi-agent systems and the common point of them for adapting to the intelligent transportation system motivated many researches in traffic and vehicle network fields such as management of traffic light, planning and organizing the light system of the streets.

With the development of multi-agent systems, expect that they will be used more than past especially in the safety, traffic and clustering of vehicles in ITS. In the future, researchers will use multi-agent system tools in the different parts of VANET. Also we can review some studies about routing, security and etc. in the vehicular Ad-Hoc network.

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