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Insights of 6G and artificial intelligence-based internet-of-vehicle towards communication

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ABSTRACT

The significance of internet-of-vehicle (IoV) is spontaneously increasing with exponentially rising demands towards transportation system and road safety. At present, there are various number of scientific approaches which is meant for leveraging the communication performance in IoV, but yet the problem still exists over multiple attributes e.g. resource management, privacy, security, and service offloading. Such problems are anticipated to be solved by 6G services that offers better communication capabilities compared to its prior version of 5G. At the same time, the quality of communication system can be enhanced by artificial intelligence (AI), which is capable of solving complex real-world problems. Therefore, this manuscript offers an insight towards strength and weakness of existing 6G based study model as well as AI-based solution in order to contribute towards highlighting an essential research gap that could directly offer better insight towards future planning towards improving communication in IoV.

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1. INTRODUCTION

Internet-of-vehicles (IoV) is a futuristic technology that aims for establishing an interactive communication system between the vehicle and different entities in the form of other vehicle, sensors, pedestrian, and road side units [1]. Different from vehicular adhoc network (VANET), there are two dependable technologies of IoV i.e. intelligence [2] and networking of vehicles [3]. The networking system of a vehicle consist of mobile network, on-board information services, and VANET [4]. Hence, it will eventually mean VANET is a subject of an IoV that provides communication among the vehicles within a shorter transmission range. A vehicle exchange information among each other in order to share information about navigation, remote positioning, and other related data using onboard information service. In this scenario, a vehicle can be considered to play a role of a mobile terminal which will constitute a mobile networks. On the other hand, the vehicle intelligence will mean the usage of an advanced technologies e.g. artificial intelligence (AI), cognitive computing, big data analysis, and deep learning. This module is basically used for accomplishing sharing and exchange of information between the vehicles and environment or people or infrastructure. It thereby incorporates higher ranges of communication. Adoption of IoV is witnessed in various forms of application. The recent work of Ji *et al*. [5] have discussed about two types of application supported by IoV i.e. service application and safety application. The service application is further classified into diagnostic application, business service, and daily service. The safety application is further classified into management of intelligent traffic, warning of road information, and public safety [5]. With this reported vast range of possible application, there is a need of incorporation of various methods towards meeting the functionalities of IoV application. This demand integrated effort originating from multiple disciplines e.g. robotics, network and communication, transportation, and automobiles [6]. There are various review work, which states the significant and pivotal role of 6G towards accomplishing the research goal of IoV [7]–[10]. Therefore, there is a tough challenge of IoV while implementing 6G in order to meet the strict indicators of key performance which are catered up to little extent by 5G. At the same time, it would be an imperative to say that vehicular network in IoV is characterized by dynamic traffic with higher degree of heterogeneity as well as larger scale of environment with an objective to meet the strict demands of ultralow latency.

In line of this challenges, the next proximity solution is evolved by noticing the increasing adoption of artificial-based approaches on different streams of problems. There are good number of reviews that states the strength of existing techniques of AI over wireless network [11]–[15]. However, this is not so easy to solve with an increasing number of complexity associated with increasing number of vehicles on the road with introduction of new technologies. Although, AI can solve various sophisticated problems, but it is imperative to see that that are also associated with various challenges. This challenges are mainly with respect to larger size of data as well as lack of their standardization. Therefore, this paper contributes towards investigation the strength and weakness of AI as well as 6G towards communication improvement in IoV system. The organization of this paper is as follows: Section 2 discusses about the compact insight of IoV followed by AI approaches in IoV in section 3. Section 4 discusses about existing approaches towards 6G enabled IoV. Section 5 discusses about study contribution with respect to research trend observed, essential findings of some of notable existing study, and research gap. Finally, conclusion of this paper is briefed in section VI.

2. COMPACT INSIGHTS TO IOV

IoV is basically a form of a distributed networking system which offers various forms of communication advancement harnessing the data generated from all the vehicular nodes as well as network [16]. The prime agenda of an IoV is to facilitate an interactive communication services between vehicular node and various entities (e.g. fleet management, infrastructure on roadside, nearby vehicles, pedestrian, and human drivers). An essential networking system practiced in conventional IoV is shown in Figure 1.

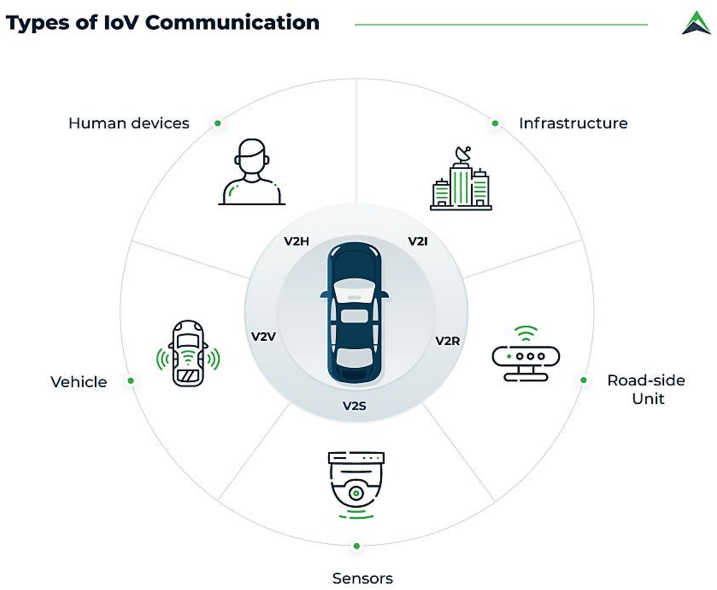

Figure 1. Essential networking system of IoV [16]

Figure 1 highlights five essential networking system of an IoV i.e. vehicle to human (V2H), vehicle-to-vehicle (V2V), vehicle-to-sensor (V2S), vehicle-to-road side unit (V2R), and vehicle-to-infrastructure (V2I) [17]. The complete working methodology of an IoV is powered by a standard architecture. Various studies has claimed of either three, or five, or seven layer models of an IoV [18]. However, five model is still considered to have higher acceptance in majority of studies which consist of following layers [19]:

- Perception layer: different forms of data acquisition component is present in this layer in the form of intelligent infrastructure, road side units, smartphones, wearables, actuators and sensors within a vehicular node. Each vehicular node is provided with a global identification terminal that basically acts as identifier in order to carry out communication using radio frequencies. This layer offers more importance to the sensing process which facilitates more information about determining an event, infrastructures of surrounding units, driving patterns, and position of car. Further, the process of digitization of information is also carried out by this layer.
- Network layer: this is one of the most important layer in IoV that is responsible for performing an autonomous exchange of data with the vehicle and other networking entities present in an environment. It is also responsible for offering proper coordination of different task towards maintaining heterogeneous networks. The communication system within the vehicular node is facilitated by satellite network, Bluetooth, Wi-Fi, 4/5G, and WAVE. The distribution of the data is carried out by perception layer as permitted by network layer and forwarded to artificial intelligence layer.
- Artificial intelligence layer: this layer is responsible for subjecting the aggregated data to the machine learning approach in order to undertake a decision of suitable analytical operation. This layer mainly executes computational model for specialized system, modules of cloud computing, and big data analytics. An internal architecture of a cloud is present within the AI layer that demands seamless interaction with different elements of system as well as processing services.
- Application layer: the outcome of operation carried out by Artificial Intelligence layer is considered by this layer in order to forward them to the end user in the form of smart services. Basically, the commercialization associated with the AI technology is provided by this layer. This layer is also responsible for aggregating the data and forward them to further business layer in order to carry out demanded operation.
- Business layer: this is the last layer present in an architecture of an IoV that is mainly responsible for transmitting the cumulative analyzed outcome to the end customer after it obtains from the analytical model. This layer performs its analytical operation using different forms of tools and services that can offer predictive operation thereby contributing towards usage and investment of resources.

Irrespective of wider scope of application of an IoV, it is also characterized by various challenges, which has attracted the scientific communities to evolve with some emerging solution. Following are some critical challenges associated with an IoV system [20]: i) security & privacy concerns: adoption of wireless communication in IoV results in reported vulnerabilities e.g. data disclosure, replay attack, and leakage of session key, ii) challenges of 5G: majority of existing IoV uses 5G services which suffers from coordination problem between the MEC server in order to opt for better server with low rate of latency. Another potential challenge is offloading task on edge devices using 5G, iii) routing Issues for charging electric vehicle: the frequent demands of power recharging in electric vehicle doesn't let it work optimally, and iv) transmission of massive data: due to unstable links, increased mobility, fluctuating vehicle density, and overhead of information, IoV often encounters challenges in dissemination data of larger sizes. The next section discusses about usage of AI in IoV in order to improve its communication performance.

3. AI APPROACHES IN IOV

The area of AI incorporates the intellectual characteristic within the machine in order to solve all the complex problems of practical environment similar to humans [21]. The domain of AI includes various disciplines viz. data mining, fuzzy logic, expert system, heuristic approach, natural language processing, knowledge discovery, data engineering, and machine learning [22]. Most recently, there are increasing level of interest towards applying AI for improving the communication performance of IoV. The incorporation of AI leads to reduction in task performing time, which is one of the essential demands of every transportation system in AI as reported in work of Ji *et al.* [23]. From the computational efficiency viewpoint, AI can assist in simplifying the process of multi-tasking with pre-defined resource to connecting one vehicle to all communication system available at cost effective manner. Further, it has no dependency of human interaction as it is characterized by zero downtime and uninterrupted operation. This section discusses about essential AI based approaches witnessed in existing approaches.

The recent work carried out by Anbalagan *et al.* [24] has emphasized towards the placement of road-side unit (RSU) for facilitating seamless communication in IoV. The study has used machine learning approach where the transmission delay is reduced while RSU placement is improved using received signal strength. The study also offers resistance from attackers. It was also noted that deep learning mechanism has contributed towards upgrading essential characteristic performance for IoV. Adoption of deep learning was seen in work of Chang *et al.* [25] which is capable of predicting the head-on collision of vehicles using cloud environment. The study model is meant to be executed within an infotainment system while all the sensory data of vehicles and traffic is collected, computed, and information of accident is predicted within cloud server. The incorporation of an intelligence within vehicles can further facilitate selection of an worker. Such direction of study is carried out by Dong *et al.* [26] who have used reinforcement learning for this purpose. Further, the study has used Markov decision model towards for framing up the selection of worker problem while it uses policy gradient algorithm as deep learning method. The adoption of reinforcement learning is also witnessed in work of He *et al.* [27] considering the problem towards offloading task in IoV. The technique has implemented averaging stochastic weight along with prioritized encountered average that contributes towards saving energy. Further the model also contributes towards reduction of level of noise during training process. The work carried out by Liang *et al.* [28] have emphasized towards optimizing resources for IoV using AI. The study implements Semi-Markov decision towards modelling resource allocation problems while hierarchical reinforcement learning is adopted towards solving this problem. The core idea of the presented technique is mainly towards planning resource allocation.

Apart from the above mentioned learning techniques under current Section 3, federated learning has been also evolving as another frequently used mechanism for strengthening communication system in unmanned aerial vehicles IoT. The work carried out by Lim *et al.* [29] has used federated learning mechanism for securely collecting the data to offer better privacy preservation towards intelligent transportation system. Further a contract matching scheme is constructed in this study using incentive policy. Another work carried out by Lin *et al.* [30] has used integration of deep reinforcement learning with the blockchain technology in order to assist in secure communication in IoV. The technique is based on spatial crowdsourcing deployed over software defined network targeting towards efficient privacy preservation in communication system. The model deals with task management in IoV using multi-blockchain where the throughput is maximized and overhead is controlled. Similar line of research work is also carried out by Liu *et al.* [31] emphasizing over the connectivity among the vehicles in critical area. The study implements a spectral partitioning method to find out the optimal topological cost for addressing possible vulnerabilities in communication system of an IoV.

Adoption of deep learning was also reported by Ning *et al.* [32] for facilitating autonomous communication of vehicles in IoV. The model extracts the social features of the vehicles for establishing relationship with adjacent vehicles. The study make use of convolution neural network (CNN) for facilitating content sharing among the vehicles. The study outcome shows increased connectivity, reduced latency, and higher message propagation. The work carried out by Phung *et al.* [33] have implemented a fog computing based environment that facilitates towards computing task as well as information propagation in IoV using federated learning scheme. Apart from this, federated learning was also used for enhancing the communication performance of vehicles using TCP. Such work is presented by Pokhrel and Choi [34] where local learning parameters, output, and inputs are exchanged. The study has implemented an analytical modelling in order to ensure data stability. Sharma and Liu [35] have implemented supervised machine learning in order to perform detection of misbehavior. Considering the use-case of real-time application of IoV, the presented model applies a statistical method as well as multiple set of supervised learning scheme viz. voting and boosting based ensembled method, random forest, naïve bayes, and K-nearest neighboring. In the line of artificial intelligence, the prominence is offered mainly towards predictive operation. A unique predictive operation can offer better scheduling approaches in IoV as noted in study of Wang *et al.* [36]. The study presents a maximization of the delivery profit by selecting the optimal position of the vehicle.

Xu *et al.* [37] have used deep Q-network for addressing offloading problems in edge computing. The work address the overloading problem of computing devices running on edges. The study uses deep learning for service offloading of multi-users which uses both reinforcement as well as approximation of value function. Apart from this, study towards adoption of AI for enhancing communication performance has also been discussed by Xu *et al*. [38], Yang *et al*. [39], Yuan *et al*. [40], and Zhou *et al*. [41]. Table 1 highlights the compact information of problems being addressed, methodologies being used, strength and weakness associated with all the existing AI-based methodologies towards strengthening communication in IoV.

4. STUDIES TOWARDS 6G ENABLED IOV

The evolution of 6G services has offered various extensive communication performance compared to its prior version of 5G by integrating different forms of sub-network together [42]. It offers a heterogeneous structure targeting towards setting up highly intelligent as well as dynamic networking system all together. This enhance communication capabilities of 6G can be effectively utilized towards setting up communication scheme in IoV which offers intelligent connectivity among cloud, road, and vehicle in more collaborative way. The incorporation of 6G offers better decision making capabilities among the vehicular nodes as well as network system facilitating better quality of experience as well as road safety. However, irrespective of various beneficial features that IoV can obtained by following 6G services, they are also characterized by various privacy and security challenges (Osorio *et al.* [43]). Autonomous driving application can be eventually benefitted by faster and effective transmission performance of 6G; however, its accuracy with respect to delivered quality of service in presence of various uncertain environment is another biggest concern in IoV. To some extent, adoption of mobile edge computing offers better supportability towards large scale deployment of vehicular nodes in IoV. This section offers briefing about contributory studies on IoV that has adopted 6G deployment scenario.

Table 1. Summary of existing AI-based IoV approaches

Authors	Problems	Methodology	Advantage	Limitation
Anbalagan *et al.* [24]	Placement of RSU	Memetic algorithm	Offers security, reduced transmission delay	Doesn't address dynamic traffic
Chang *et al.* [25]	Accident detection	Densely connected convolution network, Squeeze and excitation network	Higher accuracy of accident detection	Accuracy depends on extensive training; response time is extended in large traffic
Dong *et al.* [26]	Worker selection	Reinforcement learning	Better transmission quality	Inconsistent transmission for dynamic networks
Lim *et al.* [29]	Privacy preservation	Federated learning, contract matching	Minimal cost implementation	Not energy efficient
Lin *et al.* [30]	Communication Privacy in IoV	Deep reinforcement learning, multi-blockchain	Reduced overhead, increased throughput	Offers protection for specific attacks only
Liu *et al.* [31]	Connectivity in critical area of IoV	Spectral partitioning,	Ensure system robustness	Processing time could increase in presence of dense network
Ning *et al.* [32]	Connectivity improvement among vehicles	CNN	Reduced latency, higher data transmission	Problems of class imbalance is not addressed
Phung *et al.* [33]	Computational efficiency in transportation system	Federated learning	Effective privacy preservation	Couldn't resist critical intrusion
Pokhrel and Choi [34]	Enhancing communication of TCP	Q-learning, federated learning	Enhanced throughput, reduced packet loss	Study not benchmarked
Sharma and Liu [35]	Misbehavior detection	Multiple machine learning	Supports comprehensive plausibility checks	Couldn't different normal and malicious data
Wang *et al.* [36]	Predicting destination of location	Long short-term memory, Bayes	Higher prediction accuracy	Longer training time
Xu *et al.* [37]	Service offloading	Deep Q-learning	Ensure higher quality of service	Model not benchmarked
Xu *et al.* [38]	Internet access in vehicles	Reinforcement learning	Supports link adaptation protocols	Demands higher iteration
Yang *et al.* [39]	Resource management in IoV	Reinforcement learning	Lower latency, higher reliability	Increasing processing time
Yuan *et al.* [40]	Controller assignment	Reinforcement learning	Reduced delay	Longer training time
Zhou *et al.* [41]	Enhancing edge-based communication	Reinforcement learning	Reduces convergence time	Model not benchmarked

It has been also noticed that learning-based scheme has its significant contribution towards facilitating better communication services in IoV by adopting 6G. According to study carried out by Tang *et al.* [44], machine learning-based approaches play a core role of an enabler for an AI for all futuristic application of IoV. The variants of Application of machine learning in IoV is shown in Figure 2. The study towards autonomous driving using 6G is developed by Chen *et al.* [45]. The model make use of deep learning scheme as well as channel access technologies in order to quantify the upper bounds of delay in vehicular nodes. The states of the system are predicted using Markov Chain method for safer distance mapping. Recently, the deployment of cognitive radio access for intelligent vehicle has been investigated to find out a problem associated with data sharing and spectrum sensing issue in IoV. This problem was addressed by Deepanramkumar and Jaisankar [46] by introducing a secure beamforming mechanism using Recurrent neural network that is supportive of 6G. The study has used elliptical curve encryption as well as advance encryption standard in order to formulate data security. The throughput performance is further upgraded using dynamic clustering mechanism where dual agent system is used for spectrum sensing. The work carried out by Hui *et al.* [47] has addressed problems of heterogeneous computing resources while adopting 6G in vehicular networks. A secure edge-based method using smart contract is adopted. The core idea of this work is mainly towards achieving better quality of experience for moving vehicles. The model further uses game theory in order to find the better service availability. The work of Jia *et al.* [48] has discussed about the satellite-based transmission system with the vehicle on the ground. The study objective is towards reducing the cost of total energy of transmission and trajectory of the unmanned aerial vehicle. The study also formulates a heuristic algorithm in order to solve the large network complexity problem. Similar line of study considering satellite based communication system was also carried out by Liu *et al.* [49]. The author has implemented an opportunistic sharing of spectrum followed by an optimization technique for its process in order to allocate transmit power and sub-channels. The study present an iterative approach towards allocating resources for enhancing network efficiency.

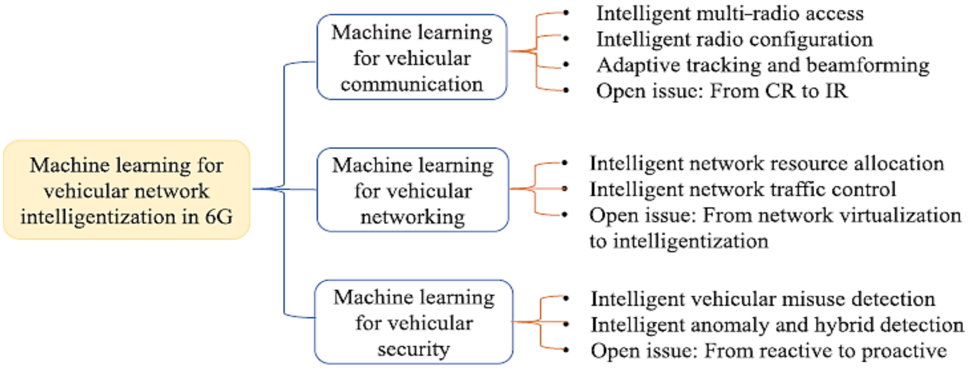

Figure 2. Variants of application of machine learning in IoV [44]

The work carried out by Lv *et al.* [50] have presented another study model for 6G communication system for IoV emphasizing over the channel characteristic. The author has presented a simplified empirical study to investigating about wave properties as well as power factors associated with data propagation in IoV. The work carried out by Na *et al.* [51] have considered the case study of unmanned aerial vehicles and it mechanism of relaying services to IoT terminals. The presented model contributes towards a unique allocation of subplot system as well as planning of trajectories. The core idea of implementation of this study is mainly towards improving the rate of mean uplink transmission in IoT considering all possible mobility constraints. Clustering is carried out for all IoT terminals while Lagrange multiplier is used subplot allocation. The work carried out by Wang *et al.* [52] have presented a collaborative framework towards scheduling resources and trajectories for all IoT objects that runs on 6G technologies. The model facilitates transmission of an energy. Study towards secure validation is carried out by Wang *et al.* [53] where the model reportedly uses blockchain for secure relaying of services in IoV running on 6G. The blockchain network obtains microservices while it keeps a track of all end-point interaction. Further, an edge caching method is implemented for performing compilation of services at edge nodes. Adoption of federated learning was noticed in work of Zhou *et al.* [54] for improving the aggregation process in IoV while working on heterogeneous data. Xu *et al.* [55] have carried out a service migration methodology for offering flexible and dynamic allocation of resources with reduced cost. The study uses evolutionary algorithm for this purpose. Table 2 highlights the summarized briefing of strength, and weakness associated with adopted methodologies on 6G towards improving communication in IoV.

5. STUDY CONTRIBUTION

From the discussion with respect to prior Section-4, it was noticed that AI as well as 6G has notable scope and opportunities in order to improve the performance of an emerging concept of IoV. Irrespective of various advancement in existing literatures, as noted from prior sections, there are two conclusive findings i.e. i) applying information technology is never a big deal as there are archives of technologies that can be used for addressing symptomatic issues in IoV, and ii) security concern has been still an unsolved problem as noted from different variants of existing schemes. Apart from this, the closer investigation about the applications and use-cases considered in existing literatures also shows that it can be used for improving associated area of collective lifestyle, terminal manufacturing, telecom operation, construction of public facilities, urban traffic, transport & logistic, management of urban congestion. Although, the analytical operation can be significantly boosted by harnessing potentials of AI, but still the concept of existing cellular services of 4G and 5G in IoV are yet questionable. They just facilitate offering the existing technologies in their wave-based propagation, which are not yet standardized in uniform fashion in many countries. Therefore, 6G stands a best scope for IoV. This section further discusses about the contribution of proposed review in the form of research trend, essential research findings, and highlights of research gap.

Table 2. Summary of existing 6G enabled IoV

Authors	Problems	Methodology	Advantage	Limitation
Chen *et al*. [45]	Data sharing, spectrum sensing	Bi-Gated Recurrent Neural Network, Unscented Kalman filter	Lower delay, higher detection accuracy	Model not meant for terahertz communication
Deepanramkumar and Jaisankar [46]	Securing millimeter wave in IoV	Advanced Encryption Standard, Elliptical Curve Cryptography, Unscented Kalman Filter, Bi-Gated Recurrent Neural Network	Better transmission performance, higher detection accuracy	Not applicable for unknown attacker
Hui *et al*. [47]	Secure communication in heterogeneous vehicle	Game theory, resource allocation, smart contrast	Enhanced quality of experience	Modelling demands apriori information of attacker
Jia *et al*. [48]	Reliable data collection in Aerial networks	Dantzig Wolfe decomposition, heuristic algorithm	Better transmission of data	Study doesn't address noise or artifact present in signal.
Liu *et al*. [49]	Cell free networks	Opportunistic spectrum sharing, resource allocation (multi-domain)	Enhanced network efficiency	Higher iteration leads to computational complexity
Lv *et al*. [50]	Improving channel characteristic of 6G	Analytical model for assessing wave characteristic	Simplified mechanism of assessment	Lack of benchmarking
Na *et al*. [51]	Subplot allocation, trajectory planning of unmanned aerial vehicle	Clustering, Lagrange multiplier	Optimizes trajectory planning	Highly iterative mechanism
Wang *et al*. [52]	Enhancing transmission performance of 6G	Resource scheduling, trajectory optimization	Accomplish higher objective value	Memory and computational constraints not considered
Wang *et al*. [53]	Stream security	Blockchain, mobile edge computing, blind signature-based on identity	Improved hit rate of cache, reduced switching delay	Occupies more memory block for signatures per blocks
Zhou *et al*. [54]	Aggregation of heterogeneous data in IoV	Federated Learning	Better scalability performance	Lack of benchmarking
Xu *et al*. [55]	Service migration	Pareto Evolutionary Algorithm	Cost effective model	Not applicable on practical scenario

5.1. Research trend

In order to find out the research trend, the proposed system aggregates the manuscript published in last 5 years (2017 to 2022). While review of trend is carried out with respect to multiple attributes. Following are the outcomes of proposed research trend respresnted in Figure 3. Figure 3(a) exhibits that there are more archives for 5G based implementation in IoV, which is currently investigated standard, while there is not much attention towards 4G. Interesting fact to observe is that study towards 6G-based methods, although less, are increasing in faster pace. It is because the scientific community is aware of potential benefits of 6G towards communication improvement in contrast to its prior version.

Figure 3(b) highlights the trend for AI-based methodologies towards communication performance improvement in IoV. For crisp analysis, the AI methods were generically classified to two most frequently adopted techniques i.e. machine learning and deep learning. The trend graph showcase that deep learning methods has been increasingly adopted in comparison to machine learning attributes. However, this doesn't conclude that machine learning is not an appropriate for IoV compared to deep learning. The fact is both deep learning and machine learning has their own advantages and disadvantages, while they are carefully adopted in order to deal with different set of predictive problems appearing in communication of IoV.

Figure 4 highlights the research treen associated with various consideration of research problem in IoV viz. software defined network (SDN), Cognitive radio network (CRN), trajectory planning, task/service offloading, resource management, and various security concerns. A significant observation that can be witnessed is that although majority of existing research work mainly talks about security/privacy problems, but the reality is that scientific community has offered their more attention towards solving resource management-based problems in IoV. Security has received the second most attention while other problems are very less seemed to be attended.

5.2. Essential research findings

From the discussion of prior sections, it was notable that 6G is one of the empowering tool towards facilitating better communication performance in IoV. In order to accomplish a promising results in communication system, it is essential to cater up highly planned and customized demands of quality of service.

There is a need of processing the massive amount of the data in IoV along with managing its diversified resources. Such steps will offer better control over storage resources, computing resources as well as communication. In order to cater up such form of demands, AI integrated with edge computing can be adopted in order to mitigate complex problem; however, such works are very few to be found in existing studies. From the viewpoint of machine learning, there is an essential need of implementing a decentralized learning as well as training-based technologies. Such strategy can build more robust model of communication by exploring all the impediments towards it. Although, there are various research papers being studied in the proposed review work, but it identifies some of the essential study model in order to conclude its findings. The discussion of essential findings are as follows:

(a)
(b)

Figure 3. Trend towards (a) generation of network usage and (b) AI usage

It is to be noted that core aim as well as vision of 6G network is to facilitate ultra-dense network with reduced latency and faster rate of data transmission especially required in IoV. While facilitation of artificial intelligence further accelerate the process of finding optimal connection ensuring seamless connection. However, this is quite a challenging task. There are various forms of existing studies carried out most recently towards this target. The work carried out by Abdel-Basset *et al*. [56] have used various computational intelligence in order to optimize the connection between the vehicle and sink. The model is also appended with cross-over operator in order to carry out better convergence over 6G network. However, the limitation of this model is it has an extensive set of learning operation involved which could lead to intermittent link even in 6G network. The study carried out by Chen *et al*. [45] have used deep learning in order to facilitate autonomous driving in IoV using 6G. The model has used Markov chain to carry out prediction of system states in order to retain safer distance between two vehicles. The limitation of this model is it used stochastic network calculus for distance control without considering connectivity with other vehicles much. Similar direction of work is also witnessed in literature of Ergen *et al*. [57] who has introduced a decentralized edge architecture for consistent distribution of computational capacity using computational resources of the vehicles. The limitation of this model is it is a theoretical framework that has not been benchmarked.

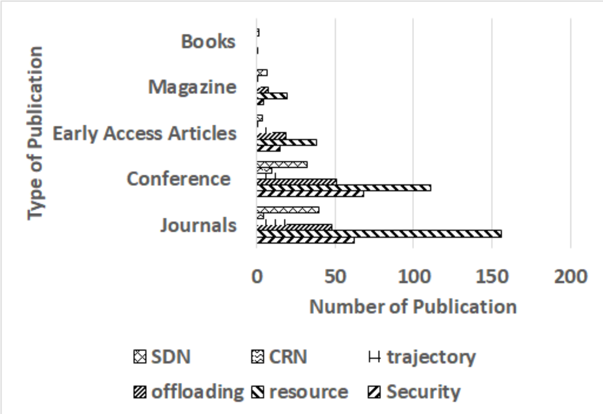

Figure 4. Trend towards problem adoption

Work carried out by Jiao *et al*. [58] have developed an intelligence access technology over 6G where power factor is used along with expectation maximization algorithm for communication purpose. The limitation is that the model targets resource allocation without considering complete topological information of vehicular network. Lv *et al*. [50] have developed a framework that ensure vehicular connectivity in 6G network with complete channel characteristics in IoV. The study limitation is massively generated data of vehicles is not utilized in this regards and it depends on training data entirely. The work of Nawaz *et al*. [59] have developed a model for connecting large set of vehicles in IoV using 6G networks especially focusing on non-coherent communication. The model limitation is that it specific rate of data transmission in dense network is not explored, which could render 6G unutilized. The work carried out by Shrestha *et al*. [60] have carried out discussion of using 6G services over unmanned vehicular network using multi-layer parameters. The limitation of this study is that it doesn't highlight any tentative solution towards dealing with massive data rates from such forms of vehicles. The work carried out by Tang *et al*. [44] have discussed about contribution of machine learning approaches over 6G network, which is impressively elaborated about its perspective from various IoV application. Existing study has also work towards streaming services using blockchain in IoV in 6G as presented by Wang *et al*. [53]. The limitation of the model is that adoption of blockchain has been carried out without dealing with impending issues of blockchain. The work carried out by Xu *et al*. [55] have discussed about service migration in 6G over IoV emphasizing over energy factor. The limitation is this model it offers trade-off between speed and reliability of data transmission even using 6G as the migration technique is highly iterative.

Further studies using artificial intelligence has been carried out by Yang *et al*. [61] where different approaches has been reviewed in the context of application in 6G communication system. According to this study, there are massive advancement in such smart implementation required and it is still under development. The limitation of this study is that it doesn't offer direct indication or guideline for future adoption of artificial intelligence in 6G. It is also seen that machine learning approach is one of the integral and novel approach to be initiated for 6G communication as seen in work of Qi *et al*. [62]. The author has used a case study of internet-of-things and has used deep learning approach for facilitating better form of communication with a target to improvise a energy. Although, the outcome exhibits better performance but still it suffers limitation of inducing higher computational complexities without any form of benchmarking. The work carried out by Mishra and Tripathi [63] have presented a unique business model of artificial intelligence and machine learning considering a use case of various heavy application which will be more-or-less dependent on speedy networks. The model has exhibited better innovation in business model of intelligence; however, its limitation is that it is not assessed from the data transmission perspective and it is more inclined towards analytics. Consideration of communication factors are very essential as without this, it is challenging to initiate any form of modelling practices. Study in this direction has been carried out by Mahmood *et al*. [64] where various key indicators has been investigated e.g. low-powered devices, global connectivity, essential dependencies, security, and privacy. The limitation of this work is that it doesn't brief out any specific mechanism for optimization of resources using these communication drivers. This lets to an open research question that what could be further mechanism towards harnessing the power of artificial intelligence on using over application to be using 6G network. It should be noted that studies towards using artificial intelligence is just a beginning and it has a long way to go.

5.3. Research gap

After reviewing the existing research contribution associated with adopting 6G services and AI towards communication improvement in IoV, it is noticed that there is a wide research gap between exact demand and available approaches. At present, there is no report of any unified research model using all the scope and concept of IoV considering the viewpoint of any nationwide factor. Further, different protocols of IoV are still yet to be concretely established for facilitating the demanded outcome of communication system. There are also few studies that has emphasized towards developing an integrated standards and strategies towards complete realization of IoV with more security and regulation. Hence, the present state of art approaches doesn't actually balance between the standardization as well as national security while applying 6G. There are also few number of reported study model towards communication uniquity associated with existing elements of network and so they witness more failures while attempting to analyze larger scale of data with reliability. Hence, there is a practical need to give more emphasis towards analysis, mining, recovery of data, visualization of network, and considering operation over cloud environment. Therefore, the core demand for reliable work will be to develop a baseline architecture which can facilitate this by considering three essential problems i.e. improving machine learning, management of analyzing larger dataset, and optimization of resource management process. The identified research gaps are illustrated in Figure 5. Hence, the preliminary research gap explored are as:

- Not much extensive usage of novel and cost-effective artificial intelligence (even in form of machine learning) approaches are witnessed in 6G based IoV environment.
- There are various existing works e.g. [18]–[27] towards IoV but such studies are found to not consider managing of massively generated data in IoV.
- Identification of optimal resources in existing IoV based on 6G network is still in infancy stage which are majorly theoretical and un-benchmarked with narrowed test environment.

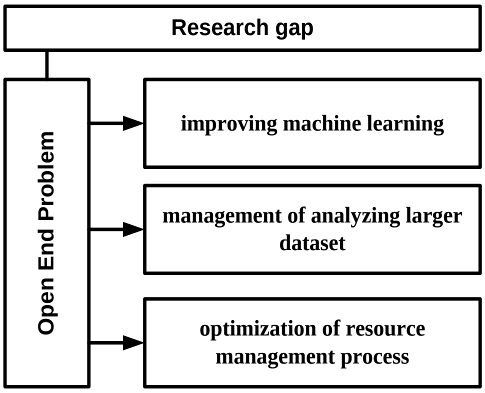

Figure 5. Identified research gap

6. CONCLUSION

6G is still in its nascent state of development which suffers limitation of 100% coverage, terahertz communication, optimizing spectrum, and challenges in incorporating Artificial intelligence for making smart network. Therefore, after reviewing the existing study , it is felt that there is a need to develop a communication model which is compliant of 6G wireless network with a peak data rate more than 1 Tb/s and claimed reduced latency of 10-100μs with higher mobility. At the same time, Artificial intelligence is seen to increasingly used in various field of network; however owing to the dependency of massive data and computing resources towards maximizing the usage of AI, it still finds highly challenging to be implemented in 6G which is 100 times faster than 5G. Developing a Artificial Intelligence in 6G network is still feasible if a proper case study with formulation of all the constraint is carried out in mathematical modelling; However, this is very less to be seen in existing approaches. 6G claims of offering an ubiquitous connecting environment e.g. Internet-of-Things. Therefore, the future study considers a use case of Internet-of-Vehicles, where the assessment environment of proposed Artificial intelligence in 6G networks becomes feasible.

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