SOCIETAL INTELLIGENCE FOR SAFER AND SMARTER TRANSPORTATION

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ABSTRACT:

Our Transportation System (TS) has seen fascinating changes in recent years, with infrastructure & vehicles becoming more sophisticated. With an extensive range of players with varying degrees of intellect & connectedness, the TS is probable to be extremely diversified. The most intelligent & connected of these are autonomous cars, which have the possible to meaningfully improve the efficiency & dependability of the TS. The autonomous car at the separate level is the primary focus of the present design of independent driving approaches & autonomous driving is not actively supported by the TS. The safety & effectiveness of individual cars as well as the organization as a complete might be importantly improved by utilizing the rising intelligence & connection in transportation. Vehicles must communicate & infrastructure of transportation to make this conceivable. We present the Social Intelligence (SI) framework in this post. SI is appropriate for transportation because, in contrast to the current Multiunit Intelligence (MI) frameworks, it permits a wide range of interactions between the many objects at several levels. We also show how the SI framework may adjust to these coatings by rendering the heavy process into 4functional layers.

I. INTRODUCTION

Our transportation networks have seen some fascinating advances in recent years. The era of Intelligent Transportation Systems (ITS) is being ushered in by the introduction of intelligent capabilities into a variety of scheme mechanisms at different stages, such as the organization & the vehicles involved in conveyance. However, with Vehicle-to-Vehicle (V2V), Vehicle-to-Infrastructure (V2I), Vehicle-to-Everything (V2X) & Internet of Vehicles (IoV) networking, connectivity is providing to enable information sharing & partnerships among the system's participants. Autonomous driving is unity of the greatest innovative features & methods in intelligent transportation systems (ITS). With their full intelligence, autonomous cars should be able to drive safely & efficiently without the need for human assistance. There are numerous advantages to integrating Autonomous Vehicles (AV) into our existing TS, counting increased safety, reduced traffic, more effective use of transportation resources, improved commutes & more. While AV research began in the 1920s, the 1st AV example was shaped in the 1980s. Since of the limited h/w technology, they didn't start to draw attention until a little over ten years ago. So forth, have advanced dramatically during the last ten years. These bode well for autonomous driving in the future. On the agenda is the growth of AVs & their extensive integration into people's daily lives. These days, many research organizations &businesses worldwide have already tested driverless AVs on public highways.

II. RELATED WORKS

In the literature, several methods for tracking numerous objects have been put forth. Previous approaches, which included strategies like Bayesian tracking and Kalman filters, were mainly concerned with tracking individual objects. However, these methods have trouble managing several things at once, particularly when those objects are partially or completely obscured. The tracking problem is now modeled as a set of hypotheses in graph-based tracking strategies, which are the more current approaches. For every object trajectory, these methods keep track of several hypotheses that can be expanded or reduced in response to fresh frame data, enabling increasingly precise monitoring over time. To improve object tracking outcomes, methods like Maximum Likelihood Estimation (MLE) and the Hungarian algorithm for data association have been incorporated. Combining these techniques improves object detection and tracking accuracy across frame sequences by enabling the tracking system to make decisions globally across time. Temporal detection is a crucial notion in this context because it offers a feedback loop that improves detection outcomes and preserves object trajectory coherence.

III. METHODOLOGY

As was covered in the section before this one, the TS & all its users must meet their individual efficiency & safety goals. It seems sense to examine the potential for using MI in TS given the pervasive placement of intelligence & connectivity amongst the participants. There are other technologies along this line in the works that is now available. Next, we'll present things & talk about how feasible they are for transportation.

Collective Intelligence (CVI):

CVI, sometimes mentioned to as "swarm intelligence," is the term used to characterize the cooperative pains of intelligent evolution for a collection. Rendering to this paradigm, every entity in a cluster cooperates on a task in command to attain one or more global goals. People are AVs & have no preferences, particular interests, or goals. Everyone in the group strives to agree on something. Stated differently, the procedure of CVI is uniform. The specified worldwide teamwork with predetermined rules providing by the organization control center is the primary means of contact between the intelligent entities inside this frame. UAVs working together to comprehensive a job are an example of CVI. The cluster task is used to measure CVI performance. The conclusion of group tasks serves as a device for CVI performance. To whole the mission collectively, individual UAVs adhere to the established collaboration procedure. It doesn't substance which objects contribute additional than others, which ones are more intelligently evolved during the evolutionary process, or which ones play extra crucial roles in completing the organization task as extended as it is helpful to achieve the system goal. Even an individual's existence in dire circumstances may be expendable if the collective needs it. An instance of the mechanisms & relationships of a scheme of CVI.

Collaborative Intelligence (CI):

CI is occasionally used synonymously with "CVI." However, there are some slight but important alterations between the two. Entities that participate in the CI framework are not required to be anonymous. In other words, each individual can have unique characteristics & intelligence levels & there is usually some degree of heterogeneity among the participants: some may be stronger while others are weaker; some may contribute more than others. However, similar to CVI, the ultimate goal is to complete some group duties. Individuals do not have purely selfish interests or goals. Individual intelligent entities' interactions could be described as coordinated global teamwork under the System Control Center (SCC). Crowdsourcing is an example in which the system solicits material from a cluster of users on a certain occurrence & all users submit their obtained information based on their individual competences. Under this architecture, participants may have varying capabilities to contribute to the overall system in different scenarios & the SCC monitors the status of each individual unit & organizes their collaboration to optimize overall system efficiency. All entities have the same motive to contribute to the overall system & must always obey the directives of the SCC without reservation. An illustration of the components & interactions of a CI system.

Feasibility for Transportation:

Present MI frameworks clearly focus solely on group objectives & duties. skills, functions & locale of participants can be handled to varying degrees in these frameworks, but the participating entities' particular preferences, interests & aims are completely ignored. In TSs, the situation is very different. The ultimate purpose of transportation is to best meet the safety & competence needs of individual transportation participants. Although participants can work together to achieve system-level transportation safety & efficiency goals, these activities are intended to improve system support for participants. In other words, individual aims are important in transportation, whereas system objectives are secondary & supportive. As a result, none of the current MI frameworks meet the requirements of our developing TS.

TECHNIQUE OR ALGORITHM USED

It has been applied to intelligent transportation systems (ITS) in terms of the 4 different useful modules of intelligent transportation systems (ITS), composed with the opportunities & problems that arise. Similar organizations including diverse actors with together local & global benefits can also usage the optional SI framework. We initially split the driving procedure into four-layered modules, each with unique functionalities founded on the objectives to complete the driving duties & information processed & created, in instruction to direct the application of the SI request & operation in intelligent transportation systems (ITS). Layers include online operation & control, situational interpretation, scheduling & planning & scene construction.

LSTM:

Thankfully, the issue is resolved by a particular kind of RNN known as an LSTM (long-short term memory). LSTMs are a kind of recurrent neural network; however they do a number of mathematical operations to improve their memory rather than just feeding their results into the network's subsequent section.

Step 1: The three inputs enter either the learn or forget gates of the LSTM.

Step 2: data that passes the learn gate (it is learned) & forget gate (it is not forgotten, forgotten information remains at the gate) will be sent to the remember gate, which creates the new long-term memory & the use gate, which refreshes short-term memory.

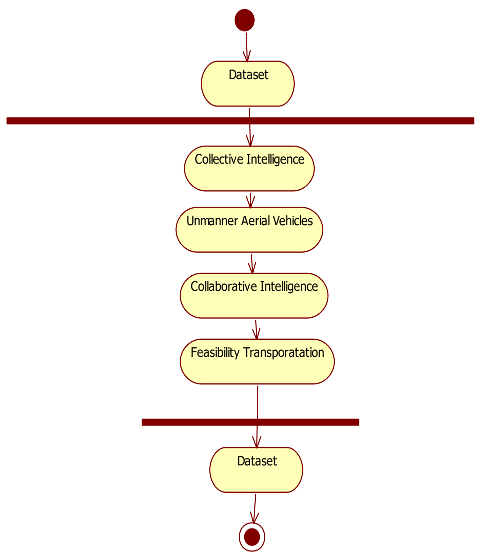

Fig3.1 Activity Diagram

Dataset: The process starts with a dataset. This could be any collection of data relevant to the analysis being performed.

Collective Intelligence: The dataset is then processed using collective intelligence techniques. This involves gathering insights and knowledge from multiple sources, such as human experts, crowdsourcing, or machine learning algorithms.

Unmanned Aerial Vehicles: The collective intelligence is then applied to the domain of unmanned aerial vehicles (UAVs). This could involve tasks like analyzing UAV data, developing UAV control algorithms, or predicting UAV behavior.

Collaborative Intelligence: The analysis of UAVs likely involves collaborative intelligence, where multiple agents or systems work together to achieve a common goal. This could include coordination among multiple UAVs, communication with ground control, or interaction with other systems.

Feasibility Transportation: The final step involves evaluating the feasibility of using UAVs for transportation purposes. This could involve assessing factors like safety, efficiency, cost, and regulatory compliance.

Overall, the flowchart illustrates a process that starts with data, leverages collective and collaborative intelligence to analyze UAVs, and ultimately aims to determine the feasibility of using UAVs for transportation.

KEY FACTORS OF TRAINING

Transportation systems (TS)s in contemporary civilizations encounter many obstacles in the areas of sustainability, efficiency & safety. Increased traffic density brought on by urbanization, population growth & the growing need for mobility has increased the frequency of accidents, caused traffic jams & deteriorated the environment. Despite improvements in infrastructure & vehicle technology, human decision-making, regulatory compliance & situational awareness continue to be major weaknesses.

Furthermore, current TSs frequently lack the means to incorporate real-time social data, such as hyper-local safety concerns, public opinion, or patterns of collective activity. Attempts to develop safer, more intelligent & adaptable mobility solutions are hampered by this misalignment between societal intelligence & TSs.

EXTRACTING KEY POINTS

Even though there are several multi-entity intelligence frameworks that describe how intelligence is implemented when numerous participants operate together, nobody of them can capture the special characteristics of AV collaboration. Entities function in the current frameworks without respect for their individual interests, with the presentation of the scheme being the main consideration.

Disadvantage of Existing System

- Reduced precision.
- Poor parking conditions, low security.
- Inefficient use of transportation resources.

IV. PROPOSED ALGORITHM

The existing autonomous driving strategies in the proposed system are mostly focused on individual AV & the overall TS does not offer proactive assistance for autonomous driving. Autonomous driving is one of the novel features & methods in intelligent transportation systems (ITS).

With their full intelligence, the AVs should be able to drive safely & successfully without assistance from humans. There are numerous advantages to integrating AVs into our current transportation system, including increased safety, less traffic, better parking, more effective use of available resources, improved commutes & more

Advantages of Proposed System

- Easy to predict. Enhanced safety
- Improved parking conditions
- More efficient utilization of transportation resource.

DISCUSSION OF RESULTS:

The analysis of accident data reveals several key risk factors. High-risk periods include morning and afternoon rush hours when traffic congestion and driver stress are elevated. The data also suggests that the overall number of accidents is increasing over time, indicating a growing safety concern. While the majority of accidents are categorized as slight, the proportion of serious accidents, though relatively low, is a significant concern. Understanding these patterns allows for the development of targeted safety interventions, such as public awareness campaigns, traffic engineering improvements, and driver education programs, to reduce the likelihood and severity of accidents.

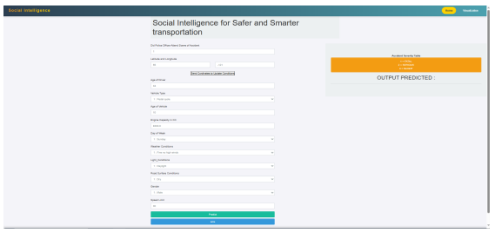

Fig 4.1: The image depicts a web form for a social intelligence platform, likely used for transportation safety and efficiency analysis.

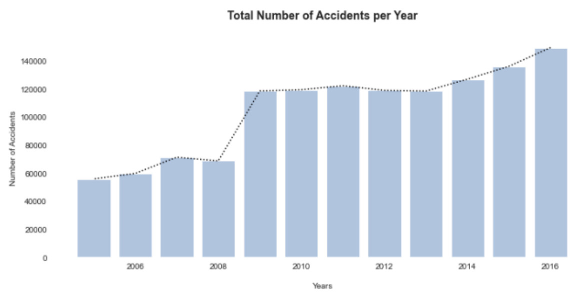

Fig 4.2: The bar graph shows a significant increase in the total number of accidents from 2006 to 2016, with a peak in 2016.

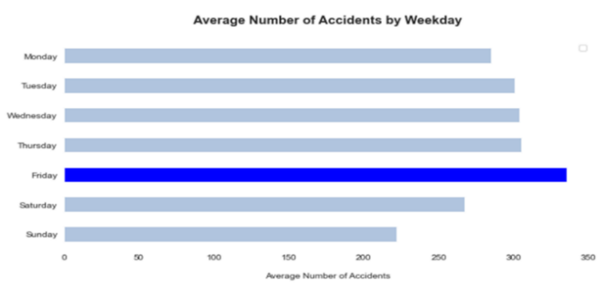

Fig 4.3: The bar graph shows the average number of accidents by weekday, with Friday having the highest average number of accidents.

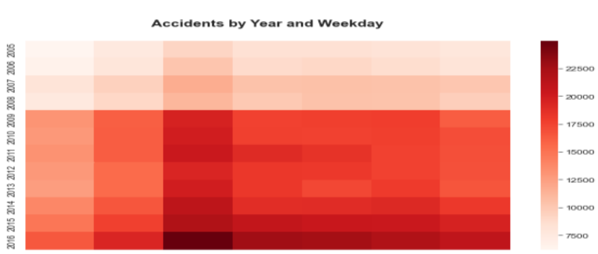

Fig 4.4: The heatmap shows the number of accidents by year and weekday

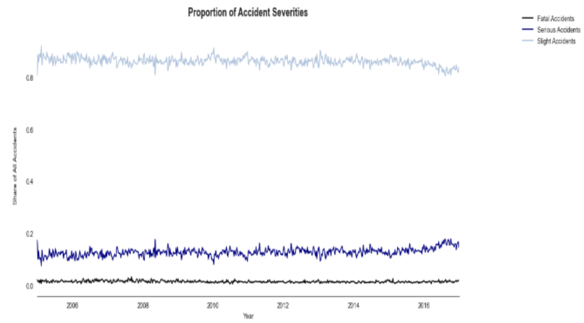

Fig 4.5: The line graph shows the proportion of fatal, serious, and slight accidents over time.

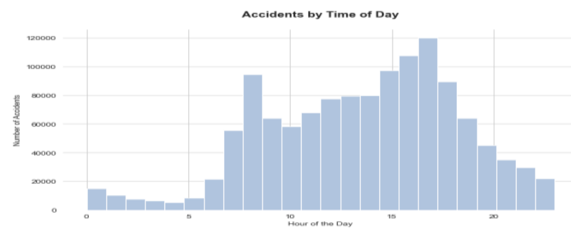

Fig 4.6: The bar graph shows the number of accidents by hour of the day.

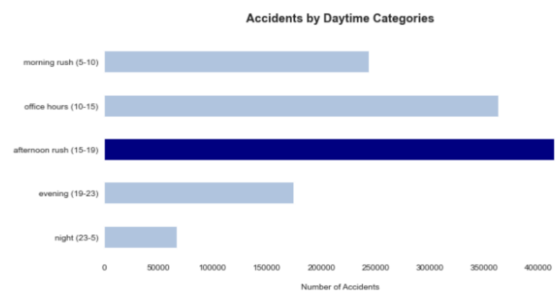

Fig 4.7: The bar graph shows the number of accidents by daytime categories

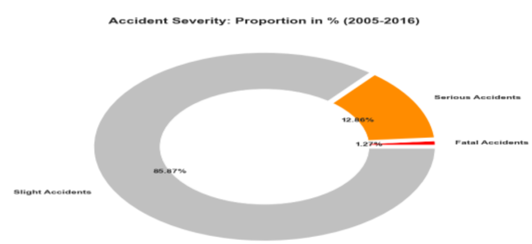

Fig 4.8: The pie chart shows the proportion of accident severities from 2005 to 2016.

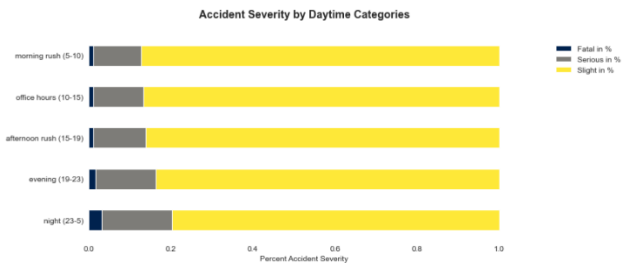

Fig4.9: The stacked bar chart shows the proportion of accident severities by daytime categories.

V. CONCLUSION AND FUTUREENHANCEMENT

In this study, we have presented a new Multi entity Intelligence framework called the Societal Intelligence for vehicle players in intelligent transportation systems (ITS) with mixed intelligence and connectivity. There has been wide conversation of the Societal Intelligence characteristics and the special relationships between its constituents. It has been applied to intelligent transportation systems (ITS) in terms of the four different functional modules of intelligent transportation systems (ITS) together with the opportunities and the problems that arise. Similar systems including diverse actors with both local and global interests can also use the suggested societal Intelligence framework. The suggested societal Intelligence framework, for instance, can also be used to describe how various parties interact in power systems, where they all share grid infrastructure but act differently depending on their own motivations.

The competition in our future work will be about restricted resources, including highway lanes, right-to-road & more affordable, quicker, or easily accessible gas stations, among other things. It should be renowned that the current multiunit frameworks under review have never included such competing interactions. Cooperation is another facet of these exchanges, albeit one that is more appropriate & implicit in conventional transportation. Travel safety can only be guaranteed through individual transportation participants working together. These collaborations take place at the system level, like enforcing laws & regulations, traffic lights & stop/yield signs, as well as at the individual participant level, like checking & occasionally slowing down to yield on multilane roadways. It is anticipated that these interactions & interventions will reach a new level in terms of both quality & quantity as intelligence & connection at all levels increase.

REFERENCES

[1]G. Dimitrakopoulos and P. Demestichas, “Intelligent transportation systems,” IEEE Veh. Technol. Mag., vol. 5, no. 1, pp. 77–84, Mar. 2010.

[2] L. Figueiredo, I. Jesus, J. A. T. Machado, J. R. Ferreira, and J. L. Martinsde Carvalho, “Towards the development of intelligent transportation systems,” in Proc. IEEE Intell. Transp. Syst. (ITSC), Oakland, CA, USA, Aug. 2001, pp. 1206–1211.

[3]S. Sou and O. K. Tonguz, “Enhancing VANET connectivity through roadside units on highways,” IEEE Trans. Veh. Technol., vol. 60, no. 8, pp. 3586–3602, Oct. 2011.

[4] J. Barrachina et al., “Road side unit deployment: A density-based approach,” IEEE Intell. Transp. Syst. Magn., vol. 5, no. 3, pp. 30–39, Jul. 2013.

[5] A. B. Reis, S. Sargento, F. Neves, and O. K. Tonguz, “Deploying roadside units insparse vehicular networks: What really works and whatdoes not,” IEEE Trans. Veh. Technol., vol. 63, no. 6, pp. 2794–2806, Jul. 2014.

[6]N. Lu, N. Cheng, N. Zhang, X. Shen, and J. W. Mark, “Connected vehicles: Solutions and challenges,” IEEE Internet Things J., vol. 1, no. 4, pp. 289–299, Aug. 2014

[7] X. Cheng, R. Zhang, and L. Yang, “Wireless toward the era of intelligent vehicles,” IEEE Internet Things J., vol. 6, no. 1, pp. 188–202, Feb. 2019

[8] X. Cheng, C. Chen, W. Zhang, and Y. Yang, “5G-enabled cooperative intelligent vehicular (5GenIV) framework: When Benz meets Marconi,” IEEE Intell. Syst., vol. 32, no. 3, pp. 53–59, May/Jun. 2017.

[9] X. Cheng, R. Zhang, and L. Yang, 5G-Enabled Vehicular Communications and Networking. Cham, Switzerland: Springer,2018.

[10] X. Cheng, L. Yang, and X. Shen, “D2D for intelligent transportation systems: A feasibility study,” IEEE Trans. Intell. Transp. Syst., vol. 16, no. 4, pp. 1784–1793, Aug. 2015.

[11] V. Milanes, J. Villagra, J. Godoy, J. Simo, J. Perez, and E. Onieva, “An intelligent V2I-based traffic management system,” IEEE Trans. Intell. Transp. Syst., vol. 13, no. 1, pp. 49–58, Mar. 2012.

[12] J. Wang, C. Jiang, Z. Han, Y. Ren, and L. Hanzo, “Internet of Vehicles: Sensing-aided transportation information collection and diffusion,” IEEETrans. Veh. Technol., vol. 67, no. 5, pp. 3813–3825, May 2018.

[13] J. Levinson et al., “Towards fully autonomous driving: Systems and algorithms,” in Proc. IEEE Intell. Veh. Symp. (IV), Baden-Baden, Germany, Jun. 2011, pp. 163–168.

[14] E. Yurtsever, J. Lambert, A. Carballo, and K. Takeda, “A survey of autonomous driving: Common practices and emerging technologies,” IEEE Access, vol. 8, pp. 58443–58469, 2020.

[15] M. Maurer et al., Autonomous Driving. Heidelberg, Germany: Springer,2016.
[16] J. Yang and J. Coughlin, "In-vehicle technology for self-driving cars: Advantages and challenges for aging drivers," Int. J. Autom. Technol., vol. 15, no. 2, pp. 333–340, 2014.
[17] K. Bimbraw, "Autonomous cars: Past, present and future a review of the developments in the last century, the present scenario and the expected future of autonomous vehicle technology," in Proc. IEEE 12th Int. Conf. Informat. Control Autom. Robot. (ICINCO), vol. 1, 2015, pp. 191–198.
[18] Waymo. (2021). Waymo Driver. Accessed: Jan. 12, 2021. [Online].Available: https://waymo.com/tech/
[19] Uber. (2021). Uber ATG Technology. Accessed: Jan. 12, 2021. [Online].Available: https://www.uber.com/us/en/atg/technology
[20] K. Wiggers. (2020). Yandex Begins Testing Self-Driving Carsin Michigan. Accessed: Jan. 12, 2021. [Online]. Available:https://venturebeat.com/2020/08/06/yandex-begins-testing-self-drivingcars-in-michigan/
[21] BBC News. (2020). Uber's Self-Driving Operator ChargedOver Fatal Crash. Accessed: Jan. 12, 2021. [Online]. Available:https://www.bbc.com/news/technology-54175359
[22] K. Wiggers. (2020). Waymo's Driverless Cars Were Involved in18 Accidents Over 20 Months. Accessed: Jan. 12, 2021. [Online].Available: https://venturebeat.com/2020/10/30/waymos-driverless-carswere-involved-in-18-accidents-over-20-month/
[23] R. Heilweil. (2020). Tesla Needs to Fix Its Deadly Autopilot Problem. Accessed: Jan. 12, 2021. [Online].Available: https://www.vox.com/recode/2020/2/26/21154502/tesla-autopilotfatal-crashes
[24] T. Litman, Autonomous Vehicle Implementation Predictions, Victoria Trans. Policy Inst., Victoria, BC, Canada, 2017.
[25] C. Blum and D. Merkle, "Swarm intelligence," Swarm Intelligence in Optimization, C. Blum and D. Merkle, Eds. Heidelberg, Germany: Springer, 2008, pp. 43–85.
[26] B. K. Panigrahi, Y. Shi, and M.-H. Lim, Handbook of Swarm Intelligence: Concepts, Principles and Applications, vol. 8. New York, NY, USA: Springer, 2011.
[27] M. Y. Arafat and S. Moh, "Localization and clustering based on swarm intelligence in UAV networks for emergency communications," IEEE Internet Things J., vol. 6, no. 5, pp. 8958–8976, Oct. 2019.
[28] F. Dai, M. Chen, X. Wei, and H. Wang, "Swarm intelligence-inspired autonomous flocking control in UAV networks," IEEE Access, vol. 7, pp. 61786–61796, 2019.
[29] S. L. Epstein, "Wanted: Collaborative intelligence," Artif. Intell., vol. 221, pp. 36–45, Apr. 2015.
[30] Y. Chen, G. Lee, L. Shu, and N. Crespi, "Industrial Internet of Things based collaborative sensing intelligence: Framework and research challenges," Sensors, vol. 16, no. 2, p. 215, 2016.
[31] X. Wang, X. Zheng, Q. Zhang, T. Wang, and D. Shen, "Crowdsourcing in its: The state of the work and the networking," IEEE Trans. Intell. Transp. Syst., vol. 17, no. 6, pp. 1596–1605, Jun. 2016.
[32] X. Wan, H. Ghazzai, and Y. Massoud, "Mobile crowdsourcing for intelligent transportation systems: Real-time navigation in urban areas," IEEE Access, vol. 7, pp. 136995–137009, 2019.
[33] H. Ezzedine, T. Bonte, C. Kolski, and C. Tahon, "Intermodal transportation system management: Towards integration of traffic management system and users information system," in Proc. Multiconf. Compute. Eng.Syst. Appl., Beijing, China, Oct. 2006, pp. 972–979.
[34] M. A. Javed and E. B. Hamida, "On the interrelation of security, QoS, and safety in cooperative its," IEEE Trans. Intell. Transp. Syst., vol. 18, no. 7, pp. 1943–1957, Jul. 2017.
[35] M. Salazar, F. Rossi, M. Schiffer, C. H. Onder, and M. Pavone, "On the interaction between autonomous mobility-on-demand and public transportation systems," in Proc. 21st Int. Conf. Intell. Transp. Syst. (ITSC),Nov. 2018, pp. 2262–2269.
[36] M. Tsukada, M. Kitazawa, T. Oi, H. Ochiai, and H. Esaki, "Cooperative awareness using roadside unit networks in mixed traffic," in Proc. IEEE Veh. Netw. Conf. (VNC), Los Angeles, CA, USA, Dec. 2019, pp. 1–8.